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Explosives and Other Dangerous Articles

Revision of Regulations

(Continued)

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- Sec. aluminum, primarily for the transportation of corrosive liquids.
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AUTHORITY: The provisions of this Part 78 issued under 62 Stat. 738, 74 Stat. 808; 18 U.S.C. 834.

Subpart A—Specifications for Carboys, Jugs in Tubs, and Rubber Drums

§ 78.1 Specification 1A; boxed carboys.

Glass, earthenware, clay, or stoneware.

§ 78.1-1 Compliance.

(a) Required in all details.

§ 78.1-2 Reuse of packages.

(a) Parts of outside container and cushioning must be replaced when broken, decayed, or inefficient in any way.

(b) Carboys with lip cracked or badly chipped not authorized; gasket seat must be even. Packages must be capable of passing tests prescribed in § 78.1-9.

§ 78.1-3 Closing devices required.

(a) As follows except when otherwise authorized in the packing regulations:

(1) Acidproof stoppers or other devices, with gaskets, securely fastened; venting closures are required when necessary to prevent internal pressure in excess of 8 pounds per square inch gauge at 130° F.

(2) Glass stoppers ground to fit and securely fastened are authorized when internal pressures do not exceed 8 pounds per square inch gauge at 130° F.

§ 78.1-4 Capacity and marking of carboy.

(a) Containers 5 to 13 gallons are classed as carboys. Must be embossed to indicate maker and year of manufacture; mark of maker to be registered with the Bureau of Explosives.

§ 78.1-5 Glass carboys.

(a) Thoroughly annealed; top of lip smooth and even; must contain at least 20 pounds of glass for 12-gallon carboys and 21 pounds for 13-gallon carboys. Glass in side walls should be well distributed and at least 1/16" thick. Defective carboys not authorized.

§ 78.1-6 Earthenware, clay, or stoneware carboys.

(a) Of acidproof material.

§ 78.1-7 Outside containers.

(a) Wooden boxes completely enclosing body of carboy or wooden boxes completely enclosing body and neck of carboy, with 4 vertical corner posts, two cleats for shoes and two carrying cleats. (See paragraph (e) of this section).

(b) Lumber to be well seasoned, commercially dry, and free from decay, loose knots, knots that would interfere with nailing, and other defects that would materially lessen the strength.

(c) Assemble sides and ends with grain of wood horizontal and nail as specified. Nail bottom to sides and ends; fasten top by any efficient means. Cleats for shoes to be along edges of bottom parallel to carrying cleats. (See paragraph (e) of this section).

(d) Parts and dimension as follows:

Nominal carboy capacity not over	Minimum dimensions			Nails—sides and bottom	
	Thickness sides, top, bottom and ends	¹ Vertical corner posts	¹ Carrying cleats and shoes	² Size not less than	³ Spacing average not over
5 to 7.....	Inch 5/8	Inches 5/8 x 2 1/4	Inches 5/8 x 1 1/4	Penny 7	Inches 2 1/4
from 7 to 13.....	2 5/16	2 5/16 x 3 1/4	2 5/16 x 2 1/16	8	2 3/4

¹ Other dimensions with equal cross section acceptable.

² Screws of equal efficiency authorized.

³ Spacing 6 inches acceptable along edge grain of bottoms.

(e) In place of bottom cleats, the following is authorized: 2 angle irons at least 1 1/4" x 1 1/4" x 1/16", applied across grain of bottom boards from corner to corner, supported by acid resistant metal corner supports securely fastened to sides and ends at each bottom corner so as to raise bottom boards of box at least 3/4" above bottom of corner supports; nailing along end grain of bottom boards not required.

(f) Special box. Must comply with this specification except as follows: Bottom of box must be nailed to 4 nailing cleats which form part of the sides and ends of box. Top of box must be reinforced by 2 cleats of 1/2-inch lumber 4 inches wide, extending the entire width of the top at right angles to the sides of the boards forming the top; a vacant space of 1 inch between outside edge of top and cleat should be allowed for nailing top to box; parts and dimensions must be as follows:

Carboy capacity, not over (gallons)	Minimum dimensions					Nails, sides, and bottom	
	Thickness of sides, top, and ends	Thickness of bottom	Thickness and width of bottom nailing cleats	Carrying cleats and shoes	Triangular vertical corner posts	Size not less than ¹	Spacing average not over ²
5 to 13.....	Inch 3/4	Inches 2 5/16	Inches 2 5/16 by 2 1/2	Inches 2 5/16 by 2 1/2	Inches 2 1/2 by 2 1/2 (short sides).	Penny 8	Inches 2 1/4
						10	2 3/4

¹ Screws of equal efficiency authorized.

² Spacing 6 inches acceptable along edge grain of bottoms.

(g) **Cushioning materials.** Cushioning devices or materials must be of such type, or be so secured within the outer container, that the carboy cannot shift in a way that cushioning efficiency is reduced.

§ 78.1-8 Marking of outside container.

(a) On each container with letters and figures at least 3/4 inch high applied by hot branding iron or printing ink of a color sharply contrasting to background of package with high pressure dies as follows:

(1) ICC-1A. This mark shall be understood to certify that the complete package complies with all specification requirements.

(2) Name or symbol (letters) of company setting up the package, or other party assuming responsibility for its compliance with specification requirements; this must be registered with the Bureau of Explosives and located just above or below the mark specified in subparagraph (1) of this paragraph.

§ 78.1-9 Tests.

(a) **Apparatus.** Standard required. Detail prints can be obtained from Bureau of Explosives, 63 Vesey Street, New York 7, New York.

(b) **Method.** Fill with water to lower edge of neck; swing 55" measured from wall to nearest bottom edge of basket:

(1) Side shock; test at least 10 carboys.

(2) Bottom shock; test at least 5 carboys.

NOTE 1: In instances where 99 or less carboys are in service during either 6-month period of the year it shall be acceptable to test 10 percent of the total but not less than 3 carboys on both the side and bottom swing. If this provision is used, the report of test results must so state.

(c) **Acceptable results.** 90 percent of carboys must not break under side shock and same for bottom shock, except both results must be 100 percent if modified test authorized by Note 1 of paragraph (b) of this section is used.

(d) **When required.** By each manufacturer, and each shipper who fills and ships new or used carboys; during each 6 months of each year, one series each year to be witnessed by representative of Bureau of Explosives; separate tests required for:

(1) New packages (those with new outside container).

(2) Used packages.

(3) Packages with carboys differing over 2 gallons.

(4) Packages differing in kind of cushioning.

(e) **Exception.** Tests not required by shipper who fills and ships or reships for one shipment only packages obtained from a manufacturer or shipper who has had tests made.

(f) **Reports.** Required to be made to Bureau of Explosives on form as follows:

REPORT OF TESTS OF CARBOYS

(As required by I. C. C. Regulations and Specifications)

(Place) _____

(Date) _____

Test made for _____

(Give name and address of plant for which tests were made)

Description of package	Results					
	Number of test	55-inch swing		Number of test	55-inch swing	
		Side	Bottom		Side	Bottom
Capacity.....	1	-----	-----	13	-----	-----
Condition ¹	2	-----	-----	14	-----	-----
Type of inside container ²	3	-----	-----	15	-----	-----
Cushioning ³	4	-----	-----	16	-----	-----
Diameter of bottle.....	5	-----	-----	17	-----	-----
Size of outside container (inside).....	6	-----	-----	18	-----	-----
	7	-----	-----	19	-----	-----
	8	-----	-----	20	-----	-----
	9	-----	-----	21	-----	-----
	10	-----	-----	22	-----	-----
	11	-----	-----	23	-----	-----
	12	-----	-----	24	-----	-----

¹ State whether outside container is new or used.
² State whether glass, earthenware, etc.
³ State whether hay, mineral wool, ground cork, excelsior, wood strips type, cork pads type, etc.
 Specification mark is.....
 Identification symbol is.....
 Remarks.....

(Signature).....
 (Per).....

§ 78.1-10 Approval of veneer, plywood, and laminated wood boxes.

(a) Boxes of veneer, plywood, laminated wood, or any combination thereof, which comply with §§ 78.1-1 to 78.1-10 (except § 78.1-7 (a), (c), and (d), are approved provided:

(1) Outside containers shall completely enclose body of carboy or body and neck of carboy.

(2) That complete inner packing and box specifications have been filed with and approved by the Bureau of Explosives.

(3) That these boxed carboys pass the regular tests prescribed in § 78.1-9.

(4) That boxed carboys after a minimum service period of 6 months pass the tests prescribed in § 78.1-9.

(5) That a detailed report of tests prescribed under paragraph (a) (4) of this section has been filed with and accepted as satisfactory by the Bureau of Explosives.

§ 78.2 Specification 1B; boxed lead carboys.

§ 78.2-1 Compliance.

(a) Required in all details.

§ 78.2-2 Reuse of packages.

(a) Parts of outside container and cushioning must be replaced when broken, decayed, or inefficient in any way.

(b) Test, see § 78.2-7, required before each shipment.

§ 78.2-3 Closing.

(a) By stoppers securely fastened.

§ 78.2-4 Capacity, marking, and manufacture of carboy.

(a) **Capacity and marking of carboy.** Containers 5 to 13 gallons are classed as carboys. Must be permanently marked to indicate maker and year of manufacture; mark of maker to be registered with the Bureau of Explosives.

(b) **Manufacture of carboy.** Of pure-chemical or pure-electrolytic virgin lead; side and bottom sheets 8 pounds and top sheets 10 pounds per square foot minimum; all seams burned.

§ 78.2-5 Outside containers.

(a) Wooden box, completely enclosing body of carboy, with 4 vertical corner posts, 2 cleats for shoes, and 2 carrying cleats. Corner posts not required when ends are twice the specified thickness.

(b) Lumber to be well seasoned, commercially dry, and free from decay, loose knots, knots that would interfere with nailing, and other defects that would materially lessen the strength.

(c) Assemble sides and ends with grain of wood horizontal and nail as specified. Nail bottom to sides and ends; fasten top by any efficient means. Cleats for shoes to be along edges of bottom parallel to carrying cleats. (See paragraph (e) of this section.)

(d) Parts and dimensions as follows:

Carboy capacity, not over	Minimum dimensions			Nails—Sides and bottom	
	Thickness—Sides, top, bottom, and ends	Vertical corner posts	Carrying cleats and shoes	Size, not less than	Spacing, average not over
Gallons 5 to 6...	Inches 5/8	Inches 3/4 x 2 1/2	Inches 5/8 x 1 1/4	Penny 7	Inches 2 1/4
				6	2
7 to 13...	3/4	3/4 x 3 1/2	3/4 x 2 1/4	9	2 3/4
				8	2 1/2

¹ Other dimensions with equal cross section acceptable.
² Screws of equal efficiency authorized.
³ Spacing 6 inches acceptable along edge grain of bottoms.

(e) In place of bottom cleats, the following is authorized: 2 angle irons at least 1 1/4" x 1 1/4" x 1/8", applied across grain of bottom boards from corner to corner, supported by acid resistant metal corner supports securely fastened to sides and ends at each bottom corner so as to raise bottom boards of box at least 3/4" above bottom of corner supports; nailing along end grain of bottom boards not required.

§ 78.2-6 Marking of outside container.

(a) On each container with letters and figures at least 3/4 inch high applied by hot branding iron or printing ink of a color sharply contrasting to background of package with high pressure dies as follows:

(1) ICC-1B. This mark shall be understood to certify that the complete package complies with all specification requirements.

(2) Name or symbol (letters) of company setting up the package, or other party assuming responsibility for its compliance with specification requirements; this must be registered with the Bureau of Explosives and located just above or below the mark specified in subparagraph (1) of this paragraph.

§ 78.2-7 Tests.

(a) To 5 pounds per square inch internal pressure without leakage; required before each shipment.

§ 78.2-8 Approval of veneer, plywood and laminated wood boxes.

(a) Boxes of veneer, plywood, laminated wood, or any combination thereof, which comply with §§ 78.2-1 to 78.2-8 except § 78.2-5 (a), (c), and (d) are approved provided:

(1) Outside containers shall completely enclose body of carboy or body and neck of carboy.

(2) That complete inner packing and box specifications have been filed with and approved by the Bureau of Explosives.

(3) That these boxed carboys pass the regular tests prescribed in § 78.2-7.

(4) That boxed carboys after a minimum service period of 6 months pass the tests prescribed in § 78.2-7.

(5) That a detailed report of tests prescribed under subparagraph (4) of this paragraph has been filed with and accepted as satisfactory by the Bureau of Explosives.

§ 78.3 Specification 1C; carboys in kegs.

Glass, earthenware, clay or stoneware.

§ 78.3-1 Compliance.

(a) Required in all details.

§ 78.3-2 Reuse of packages.

(a) Parts of outside container and cushioning must be replaced when broken, decayed, or inefficient in any way.

(b) Carboys with lip cracked or badly chipped not authorized; gasket seat must be even. Packages must be capable of passing tests prescribed in § 78.3-9.

§ 78.3-3 Closing devices required.

(a) As follows except when otherwise authorized in the packing requirements:

(1) Acidproof stoppers or other devices, with gaskets, securely fastened; venting closures are required when necessary to prevent internal pressure in excess of 8 pounds per square inch gauge at 130° F.

(2) Glass stoppers ground to fit and securely fastened are authorized when internal pressures do not exceed 8 pounds per square inch gauge at 130° F.

§ 78.3-4 Capacity and marking of carboy.

(a) Containers 5 to 13 gallons are classed as carboys. Must be embossed to indicate maker and year of manufacture; mark of maker to be registered with the Bureau of Explosives.

§ 78.3-5 Glass carboys.

(a) Thoroughly annealed; top of lip smooth and even; must contain at least 20 pounds of glass for 12-gallon carboys and 21 pounds for 13-gallon carboys. Glass in side walls should be well distributed and at least 1/8" thick. Defective carboys not authorized.

§ 78.3-6 Earthenware, clay, or stoneware carboys.

(a) Earthenware, clay, or stoneware carboys of acidproof material.

§ 78.3-7 Manufacture of kegs.

(a) Manufacture of kegs as follows:

(1) *Staves and headings.* To be of white oak, chestnut oak, red oak, black cherry, or Douglas fir; quarter sawed with the grain, from straight-grained timber, so no annual ring shall slope over half the thickness of stave or head; thoroughly kiln dried, moisture content 7 percent to 11 percent; free from rotten sap, checks, pitch pockets, cat faces, and other defects that show through on both sides.

(2) *Hoops.* To be of cooperage-grade hoop steel.

(b) *Staves:* To be sawed evenly and circular; croze center to be within 1/8" of end of stave; stave end to have 1/8" free from bevel.

(1) *Heading.* Of uniform thickness and properly circled; planed on outside and properly jointed and glued, or doweled and flagged; dowel diameter not over 5/12 thickness of head.

(c) The keg: Stave joints reasonably flush on outside.

(d) Parts required and dimensions, as follows:

(1) Staves, when finished on outside:

Capacity of container, not over	Maximum			Minimum	
	Length	Width	Bilge circle	Staves	Thickness
Gallons	Inches	Inches	Inches	Number	Inch
30.....	30	5	74	16	5/8
15.....	24	4 1/2	54	14	3/4
10.....	22	4 1/4	50	12	1/2
5.....	18	4	40	10	1/2

Foregoing thicknesses are of staves finished on one side. One-sixteenth inch must be added for unfinished staves. Foregoing maximum lengths are authorized to be increased 6 percent or less, provided the thickness of stave is increased at least one-sixteenth inch for each increase of 1 inch in length or fraction thereof.

(2) *Heading, after planing:*

Capacity of container, not over	Maximum		Minimum	
	Pieces	Diameter	Thickness	Width
Gallons	Number	Inches	Inch	Inches
30.....	6	18	3/4	2 1/4
15.....	6	14	3/4	2
10.....	6	13	1/2	2
5.....	4	11	1/2	2

(3) *Hoops, number and size:*

Capacity of container, not over (gallons)	Minimum number of hoops	Minimum size of hoops (inches in width and Birmingham gauge)							
		Head		First quarter		Second quarter		Bilge	
		Inch	Gauge	Inch	Gauge	Inch	Gauge	Inch	Gauge
30	6	1 1/2	18	1 1/4	19	-----	-----	1 1/2	18
15	6	1 1/4	19	1 1/4	19	-----	-----	1 1/4	19
10	6	1 3/8	19	1	19	-----	-----	1 3/8	19
5	6	1	19	1	19	-----	-----	1	19

(c) *Cushioning materials.* Cushioning devices or materials must be of such type, or be so secured within the outer container, that the carboy cannot shift

in a way that cushioning efficiency is reduced.

§ 78.3-8 Marking of outside container.

(a) On each container with letters and figures at least 3/4 inch high applied near the bilge by hot branding iron or printing ink of a color sharply contrasting to background of package with high pressure dies as follows:

(1) ICC-1C. This mark shall be understood to certify that the complete package complies with all specification requirements.

(2) Name or symbol (letters) of company setting up the package, or other party assuming responsibility for its compliance with specification requirements; this must be registered with the Bureau of Explosives and located just above or below the mark specified in subparagraph (1) of this paragraph.

§ 78.3-9 Tests.

(a) *Apparatus.* Standard required. Detail prints can be obtained from Bureau of Explosives, 63 Vesey Street, New York 7, New York.

(b) *Method.* Fill with water to lower edge of neck; swing 55" measured from wall to nearest bottom edge of basket:

(1) Side shock; test at least 10 carboys.

(2) Bottom shock; test at least 5 carboys.

NOTE 1: In instances where 99 or less carboys are in service during either 6-month period of the year it shall be acceptable to test 10 percent of the total but not less than 3 carboys on both the side and bottom swing. If this provision is used, the report of test results must so state.

(c) *Acceptable results.* 90 percent of carboys must not break under side shock and same for bottom shock, except both results must be 100 percent if modified test authorized by Note 1 of paragraph (b) of this section is used.

(d) *When required.* By each manufacturer, and each shipper who fills and ships new or used carboys; during each 6 months of each year, one series each year to be witnessed by representative of Bureau of Explosives; separate tests required for:

(1) New packages (those with new outside container).

(2) Used packages.

(3) Packages with carboys differing over 2 gallons.

(4) Packages differing in kind of cushioning.

(e) *Exception.* Tests not required by shipper who fills and ships or reships for one shipment only packages obtained from a manufacturer or shipper who has had tests made.

(f) *Reports.* Required to be made to Bureau of Explosives on form as follows:

REPORTS OF TESTS OF CARBOYS

(As required by I. C. C. Regulations and Specifications)

(Place) -----

(Date) -----

Test made for -----

(Give name and address of plant for which tests were made)

Description of package	Results					
	No. of test	55-inch swing		No. of test	55-inch swing	
		Side	Bottom		Side	Bottom
Capacity.....	1			13		
Condition ¹	2			14		
Type of inside container ²	3			15		
	4			16		
	5			17		
Cushioning ³	6			18		
	7			19		
	8			20		
Diameter of bottle.....	9			21		
	10			22		
	11			23		
Size of outside container (inside).	12			24		

Specification mark is.....
 Identification symbol is.....
 Remarks.....
 (Signature).....
 (Per).....

¹ State whether outside container is new or used.
² State whether glass, earthenware; etc.
³ State whether hay, mineral wool, ground cork, excelsior, wood strips ----- type, cork pads ----- type, etc.

§ 78.4 Specification 1D; boxed glass carboys.

§ 78.4-1 Compliance.

(a) Required in all details.

§ 78.4-2 Reuse of packages.

(a) Parts of outside container and cushioning must be replaced when broken, decayed, or inefficient in any way.
 (b) Carboys with lip cracked or badly chipped not authorized; gasket seat must be even. Packages must be capable of passing tests prescribed in § 78.4-8.

§ 78.4-3 Closure.

(a) Threaded screw cap which shall be constructed of a suitable plastic or other material resistant to lading.
 (b) Gasket or lining for cap must be used and shall be resistant to lading and:
 (1) Must be liquid tight or;
 (2) Must be liquid tight up to venting pressure when such venting is prescribed for the material which is to be shipped.
 (c) At least one complete continuous thread must be engaged with gasket in place.

§ 78.4-4 Capacity and marking of carboy.

(a) *Capacity.* 6.5 United States gallons nominal capacity, 7.0 United States gallons overflow, tolerance plus or minus 10 fluid ounces.

(b) *Marking.* Each carboy bottle must be embossed in bottom as follows:

Maker's mark (to be registered with Bureau of Explosives)
 Year of Manufacture
 ICC-1D

§ 78.4-5 Glass carboy bottle.

(a) Must be machine-blown, thoroughly and properly annealed, with screw thread finish having at least one continuous thread to accommodate closure; top of lip smooth and even; must contain 14 pounds of glass, tolerance minus 8 ounces plus 16 ounces. Minimum thickness to be .075 inch. Defective carboys not authorized.

§ 78.4-6 Outside containers.

(a) Wooden boxes completely enclosing body and neck of carboy, with 4 vertical corner posts, two cleats for shoes and two carrying cleats. An opening not exceeding 3 inches in width may be provided directly above the neck of bottle, if the top of the box is made up of not more than two pieces of lumber of $\frac{3}{32}$ inch thickness. Bottom board of the two ends of the box must be constructed of lumber at least one inch thick, must be flush with the carrying cleats and be at least $2\frac{3}{4}$ inches in width. Cleats or other fasteners used to secure cover must not extend beyond carrying cleats.

(b) Lumber to be well seasoned commercially dry, and free from decay, loose knots, knots that would interfere with nailing, and other defects that would materially lessen the strength.

(c) Assemble sides and ends with grain of wood horizontal and nail as specified. Nail bottom to sides and ends; fasten top by any efficient means (friction closure not authorized). Cleats for shoes to be along edges of bottom parallel to carrying cleats and at right angle to the direction of bottom board or boards.
 (d) Parts and dimensions as follows:

Carboy capacity, nominal (not over gallons)	Minimum dimensions			Nails—Sides and bottom	
	¹ Thickness—Sides, top, bottom, and ends	² Vertical corner posts	³ Carrying cleats and shoes	Size	⁴ Spacing, average
6.5.....	Inch $\frac{1}{2}$	Square inches 2.0	Inches $\frac{1}{2} \times 2\frac{3}{4}$	Penny 6	Inches 2

¹ Except as prescribed or permitted under § 78.4-6 (a).
² Cross sectional area.
³ Other dimensions with equal cross section acceptable. In lieu of separate carrying cleats, side board, at point where cleat should be located, may be constructed of lumber not less than one inch thick so that overhang will be at least $\frac{1}{2}$ inch.
⁴ Screws of equal efficiency authorized.
⁵ Spacing 6 inches acceptable along edge grain of bottoms.

(e) *Cushioning materials.* Cushioning devices or materials must be of such type, or be so secured within the outer container, that the carboy cannot shift in a way that cushioning efficiency is reduced.

§ 78.4-7 Marking of outside container.

(a) On each container with letters and figures at least $\frac{3}{4}$ inch high applied by hot branding iron or printing ink of a color sharply contrasting to background of package with high pressure dies as follows:

(1) ICC-1D. This mark shall be understood to certify that the complete package complies with all specification requirements.

(2) Name or symbol (letters) of company setting up the package, or other party assuming responsibility for its compliance with specification requirements; this must be registered with the Bureau of Explosives and located just above or below the mark specified in subparagraph (1) of this paragraph.

§ 78.4-8 Tests.

(a) *Apparatus.* Standard required. Detail prints can be obtained from Bureau of Explosives, 63 Vesey Street, New York 7, New York.

(b) *Method.* Fill with water to lower edge of neck; swing 55" measured from wall to nearest bottom edge of basket:

- (1) Side shock; test at least 10 carboys
- (2) Bottom shock, test at least 5 carboys.

NOTE 1: In instances where 99 or less carboys are in service during either 6-month period of the year it shall be acceptable to test 10 percent of the total but not less than 3 carboys on both the side and bottom swing. If this provision is used, the report of test results must so state.

(c) *Acceptable results.* 90 percent of carboys must not break under side shock and same for bottom shock, except both results must be 100 percent if modified test authorized by Note 1 of paragraph (b) of this section is used.

(d) *When required.* By each manufacturer, and each shipper who fills and ships new or used carboys; during each 6 months of each year, one series each year to be witnessed by representative of Bureau of Explosives; separate tests required for:

- (1) New packages (those with new outside container).
- (2) Used packages.
- (3) Packages differing in kind of cushioning.

(e) *Exception.* Tests not required by shipper who fills and ships or reships for one shipment only packages obtained from a manufacturer or shipper who has had tests made.

(f) *Reports.* Required to be made to Bureau of Explosives on form as follows:

REPORT OF TESTS OF CARBOYS

(As required by I. C. C. Regulations and Specifications)

(Place).....
 (Date).....
 Test made for.....
 (Give name and address of plant for which tests were made)

Description of package	Results					
	No. of test	55-inch swing		No. of test	55-inch swing	
		Side	Bottom		Side	Bottom
Capacity.....	1			13		
Condition ¹	2			14		
Type of inside container ²	3			15		
	4			16		
	5			17		
Cushioning ³	6			18		
	7			19		
	8			20		
Diameter of bottle.....	9			21		
	10			22		
	11			23		
Size of outside container (inside).	12			24		

¹ State whether outside container is new or used.
² State whether glass earthenware; etc.
³ State whether hay, mineral wool, ground cork, excelsior, wood strips ----- type, cork pads ----- type, etc.
 Specification mark is.....
 Identification symbol is.....
 Remarks.....
 (Signature).....
 (Per).....

(g) *Internal pressure test.* Bottles shall be capable of withstanding a sustained internal pressure of 20 p. s. i. gauge for a 15-day period. Bottle manufacturer shall demonstrate to Bu-

reau of Explosives that bottles of a proposed design will meet this test prior to start of production.

(h) **Hydrostatic pressure test.** One bottle selected at random from each 200 produced on each mold shall be subjected to an instantaneous hydrostatic pressure test to bursting. Pressure at which bottle bursts must not be less than 40 p. s. i. gauge. If bottle so tested fails at a pressure less than 40 p. s. i., 12 additional samples must be selected from the same lot of 200 bottles and tested in the same manner. All 12 samples must pass required test otherwise entire lot shall be rejected.

§ 78.5 Specification 1X; boxed carboys, 5 to 6½ gallons, for export only.

Glass, earthenware, clay, or stoneware. Single-trip container.

§ 78.5-1 Compliance.

(a) Required in all details.

§ 78.5-2 Closing devices required.

(a) As follows except when otherwise authorized in the packing regulations:

(1) Acidproof stoppers or other devices, with gaskets, securely fastened; venting closures are required when necessary to prevent internal pressure in excess of 8 pounds per square inch gauge at 130° F.

(2) Glass stoppers ground to fit and securely fastened are authorized when internal pressures do not exceed 8 pounds per square inch gauge at 130° F.

(3) For box: Two flat metal nailless straps, at least ⅝ inch by 0.020 inch, encircling top, sides, and bottom and securely sealed, are required.

§ 78.5-3 Capacity and marking of carboy.

(a) Containers must be 5 to 6½ gallon size and embossed to indicate maker and year of manufacture.

§ 78.5-4 Glass carboys.

(a) Thoroughly annealed; top of lip smooth and even. Glass in side walls should be well distributed and at least ⅛ inch thick. Defective carboys not authorized.

§ 78.5-5 Earthenware, clay, or stoneware carboys.

(a) Earthenware, clay, or stoneware carboys of acidproof material.

§ 78.5-6 Outside containers.

(a) Wooden boxes completely enclosing body and neck of carboy, with 4 vertical corner posts. Top may consist of cap fitting snugly inside body of box and resting on corner posts.

(b) Lumber to be well seasoned, commercially dry, and free from decay, loose knots, knots that would interfere with nailing, and other defects that would materially lessen the strength.

(c) Assemble sides and ends with grain of wood horizontal and nail as specified; nail bottom to ends; fasten top by any efficient means.

(d) Parts and dimensions. Sides, top, and bottom at least ½ inch thick; vertical corner posts at least 2.25 square

inches cross section; nails at least 6-penny at 2-inch intervals or 5-penny at 1¾-inch intervals.

(e) **Cushioning materials.** Cushioning devices or materials must be of such type, or be so secured within the outer container, that the carboy cannot shift in a way that cushioning efficiency is reduced.

§ 78.5-7 Marking of outside container.

(a) On each container with letters and figures at least ¼ inch high applied by hot branding iron or printing ink of a color sharply contrasting to background of package with high pressure dies as follows:

(1) ICC-1X. This mark shall be understood to certify that the complete package complies with all specification requirements.

(2) Name or symbol (letters) of company setting up the package, or other party assuming responsibility for its compliance with specification requirements; this must be registered with the Bureau of Explosives and located just above or below the mark specified in subparagraph (1) of this paragraph.

§ 78.5-8 Marking.

(a) Each outside container must also be plainly marked "FOR EXPORT ONLY, NOT RETURNABLE" and the top must be marked "THIS SIDE UP".

§ 78.5-9 Tests.

(a) **Apparatus.** Standard required. Detail prints can be obtained from Bureau of Explosives, 63 Vesey Street, New York 7, New York.

(b) **Method.** Fill with water to lower edge of neck; swing 55" measured from wall to nearest bottom edge of basket:

(1) Side shock; test at least 10 carboys.

(2) Bottom shock; test at least 5 carboys.

(c) **Acceptable results.** 90 percent of carboys must not break under side shock; same for bottom shock.

(d) **When required.** By each manufacturer, and each shipper who fills and ships new carboys; during each 6 months of each year, one series each year to be witnessed by representative of Bureau of Explosives; separate tests required for:

(1) New packages (those with new outside container).

(2) Packages differing in kind of cushioning.

(e) **Exception.** Tests not required by shipper who fills and ships or reships for one shipment only packages obtained from a manufacturer or shipper who has had tests made.

(f) **Reports.** Required to be made to Bureau of Explosives on form as follows:

REPORT OF TESTS OF CARBOYS

(As required by I. O. C. Regulations and Specifications)

(Place) -----
(Date) -----

Test made for -----

(Give name and address of plant for which tests were made)

Description of package	Nc. of test	Results			
		55-inch swing		55-inch swing	
		Side	Bottom	Side	Bottom
Capacity	1	---	---	13	---
Condition ¹	2	---	---	14	---
Type of inside container ² ..	3	---	---	15	---
Cushioning ³	4	---	---	16	---
Diameter of bottle	5	---	---	17	---
Size of outside container (inside) ..	6	---	---	18	---
	7	---	---	19	---
	8	---	---	20	---
	9	---	---	21	---
	10	---	---	22	---
	11	---	---	23	---
	12	---	---	24	---

Specification mark is -----
Identification symbol is -----
Remarks -----

(Signature) -----
(Per) -----

¹ State whether outside container is new or used.
² State whether glass, earthenware, etc.
³ State whether hay mineral wool, ground cork, excelsior, wood strips ---- type, cork pads ---- type, etc.

§ 78.6 Specification 1EX; glass carboys in plywood drums.

Single trip container.

§ 78.6-1 Compliance.

(a) Required in all details.

§ 78.6-2 Lumber.

(a) To be well seasoned, commercially dry, and free from decay, loose knots, knots that would interfere with nailing, and other defects that would materially lessen the strength.

§ 78.6-3 Closing devices required.

(a) As follows except when otherwise authorized in the packing regulations:

(1) Acidproof stoppers or other devices, with gaskets, securely fastened; venting closures are required when necessary to prevent internal pressure in excess of 8 pounds per square inch gauge at 130° F.

(2) Glass stoppers ground to fit and securely fastened are authorized when internal pressures do not exceed 8 pounds per square inch gauge at 130° F.

§ 78.6-4 Capacity and marking of carboy.

(a) Containers must be 5 to 6½ gallons capacity and embossed to indicate maker and year of manufacture.

§ 78.6-5 Glass carboys.

(a) Thoroughly annealed; top of lip smooth and even. Glass in side walls should be well distributed and at least ⅛ inch thick. Defective carboys not authorized.

§ 78.6-6 Outside containers.

(a) Plywood drums completely enclosing body and neck of carboy and constructed as follows:

(1) **Body shell.** To be of two plies of hardwood veneer, each not less than ⅛ inch in thickness, firmly glued together, with the grain of the outside ply parallel and the inner ply vertical to the heads. The body shall be butt-jointed and shall be fastened on the outside with a 28-gauge steel strip, not less than 1½ inches in width. 17-gauge staples shall be driven on each side of the joint, spaced

not more than 1½ inches apart and clinched on inside of the body:

(2) **Heads.** Top and bottom heads shall be of three ply hardwood veneer, each ply not less than ½ inch in thickness, all firmly glued together, with the grain of each outer ply at right angles to the grain of the center ply. Each head shall be circled to fit snugly inside of the body. Interior heads shall be of the same construction.

(3) **Hoops.** To be of hardwood veneer, not less than 1¾ inches wide by ½ inch thick. Hoops shall be fastened to the body by 17-gauge staples on not less than 3 inch centers and shall be overlapped not less than 3 inches.

(4) **Head liners.** When plywood cushioning is used the inner lining strips which support the plywood cushion shall be of hardwood veneer not less than ½ inch in thickness and ⅝ inch in width and shall butt or slightly gap. All other head lining strips shall be made of hardwood veneer not less than ½ inch in thickness and ⅝ inch in width and shall overlap not less than 3 inches. The bottom head liner and the inside liner strips for the false head and support of the top head shall be fastened by 17-gauge staples on not less than 3 inch centers. The staples shall be driven through the outer hoop and body and clinched on the inside of the veneer strips; except that the strips holding the false head shall have staples only through the body shell and liner. The top liner which forms the final closure shall be fastened to the body by 14-gauge staples driven through the head liner and body into the outer hoop on not less than 4 inch centers.

(5) **Battens.** A ⅝ inch by 2 inch batten shall be applied to top and bottom and shall be secured at each end by two nails driven through the hoops and shell.

(b) **Cushioning materials.** Cushioning devices or materials must be of such type, or be so secured within the outer container, that the carboy cannot shift in a way that cushioning efficiency is reduced.

§ 78.6-7 Approval.

(a) The complete inner packing and drum specification must be filed with and approved by the Bureau of Explosives.

§ 78.6-8 Marking of outside container for compliance with specification.

(a) On each container with letters and figures at least ¾ inch high applied by hot branding iron or printing ink of a color sharply contrasting to background of package with high pressure dies as follows:

(1) **ICC-1EX.** This mark shall be understood to certify that the complete package complies with all specification requirements.

(2) Name or symbol (letters) of company setting up the package, or other party assuming responsibility for its compliance with specification requirements; this must be registered with the Bureau of Explosives and located just above or below the mark specified in subparagraph (1) of this paragraph.

§ 78.6-9 Marking of outside container for use.

(a) Each outside container must also be plainly marked "SINGLE-TRIP CON-

TAINER" just above or below the mark specified in § 78.6-8(a) (1) of this section.

§ 78.6-10 Tests.

(a) **Apparatus.** Standard required. Detail prints can be obtained from Bureau of Explosives, 63 Vesey Street, New York 7, New York.

(b) **Method.** Fill with water to lower edge of neck; swing 55" measured from wall to nearest bottom edge of basket:

- (1) Side shock; test at least 10 carboys.
- (2) Bottom shock; test at least 5 carboys.

NOTE 1: In instances where 99 or less carboys are in service during either 6-month period of the year it shall be acceptable to test 10 percent of the total but not less than 3 carboys on both the side and bottom swing. If this provision is used, the report of test results must so state.

(c) **Acceptable results.** 90 percent of carboys must not break under side shock and same for bottom shock, except both results must be 100 percent if modified test authorized by Note 1 of paragraph (b) of this section is used.

(d) **When required.** By each manufacturer, and each shipper who fills and ships new carboys; during each 6 months of each year, one series each year to be witnessed by representative of Bureau of Explosives; separate tests required for:

(1) New packages (those with new outside containers).

(2) Packages differing in kind of cushioning.

(e) **Exception.** Tests not required by shipper who fills and ships or reships for one shipment only packages obtained from a manufacturer or shipper who has had tests made.

(f) **Reports.** Required to be made to Bureau of Explosives on form as follows:

REPORT OF TESTS OF CARBOYS

(As required by I. C. C. Regulations and Specifications)

(Place) -----
(Date) -----

Test made for -----

(Give name and address of plant for which tests were made)

Description of package	Results					
	No. of test	55-inch swing		No. of test	55-inch swing	
		Side	Bottom		Side	Bottom
Capacity	1			13		
Condition ¹	2			14		
	3			15		
Type of inside container ²	4			16		
	5			17		
Cushioning ³	6			18		
	7			19		
Diameter of bottle	8			20		
	9			21		
Size of outside container (inside)	10			22		
	11			23		
	12			24		

Specification mark is -----
Identification symbol is -----
Remarks -----

(Signature) -----
(Per) -----

¹ State whether outside container is new or used.
² State whether glass, earthenware, etc.
³ State whether hay, mineral wool, ground cork, excelsior, wood strips type, cork pads type, etc.

§ 78.7 Specification 1E; glass carboys in plywood drums.

§ 78.7-1 Compliance.

(a) Required in all details.

§ 78.7-2 Reuse of packages.

(a) Outside container, including metal side seam, must be replaced when broken, decayed, or inefficient in any way.

(b) Carboys with lip cracked or badly chipped not authorized; gasket seat must be even. Packages must be capable of passing tests prescribed in § 78.7-8

§ 78.7-3 Capacity and marking of carboy.

(a) Glass containers 5 to 7 gallons in this specification are classed as carboys. Must be embossed to indicate maker and year of manufacture; mark of maker to be registered with the Bureau of Explosives.

§ 78.7-4 Glass carboys.

(a) Thoroughly annealed; top of lip smooth and even. Glass in side walls should be well distributed and at least ¼ inch thick. Defective carboys not authorized.

(b) **Closing devices required.** (For carboys without screw thread finish.) As follows except when otherwise authorized in the packing regulations:

(1) Acidproof stoppers or other devices, with gaskets, securely fastened; venting closures are required when necessary to prevent internal pressure in excess of 8 pounds per square inch gauge at 130° F.

(2) Glass stoppers ground to fit and securely fastened are authorized when internal pressures do not exceed 8 pounds per square inch gauge at 130° F.

§ 78.7-5 Glass carboy bottle.

(a) (Threaded screw-cap closure only.) Must be machine-blown, thoroughly and properly annealed, with screw thread finish having at least one continuous thread to accommodate closure; top of lip smooth and even; must contain 14 pounds of glass, tolerance minus 8 ounces plus 16 ounces. Minimum thickness to be 0.075 inch. Defective carboys not authorized.

(b) **Closure.** (1) Threaded screw cap which shall be constructed of a suitable plastic or other material resistant to lading.

(2) Gasket or lining for cap must be used and shall be resistant to lading and must be liquid tight; or must be liquid tight up to venting pressure when such venting is prescribed for the material which is to be shipped.

(3) At least one complete continuous thread must be engaged with gasket in place.

§ 78.7-6 Outside containers.

(a) Plywood drums completely enclosing body of carboy or completely enclosing body and neck of carboy and constructed as follows:

(1) **Lumber.** To be well seasoned, commercially dry, and free from decay, loose knots, knots that would interfere with nailing, and other defects that would materially lessen the strength.

(2) **Body shell.** To be of two plies of good commercial box or sheathing grade hardwood veneer, each not less than ¼ inch

inch in thickness, firmly glued together with waterproof glue (a section of plywood from body shell is immersed in water at room temperature for 48 hours. If no delamination or separation of plies is apparent, the glue is deemed to be waterproof) with the grain of the outside ply parallel and the inner ply vertical to the heads. The body shall be butt-jointed and shall be fastened on the outside with a 28-gauge steel strip, not less than 1½ inches in width. Staples of 17-gauge shall be driven on each side of the joint, spaced not more than 1½ inches apart and clinched on inside of the body.

(3) **Heads.** To be of three plies of good commercial box or sheathing grade hardwood veneer, each not less than ¼ inch in thickness, firmly glued together with waterproof glue (a section of plywood from head is immersed in water at room temperature for 48 hours; if no delamination or separation of plies is apparent, the glue is deemed to be waterproof), with the grain of each outer ply at right angles to the grain of the center ply. Each head shall be circled to fit snugly inside of the body. Interior heads shall be of the same construction.

(4) **Hoops.** To be of hardwood veneer, not less than 1¾ inches wide by ½ inch thick. Hoops shall be fastened to the body by 17-gauge staples on not less than 3-inch centers and shall be overlapped not less than 3 inches.

(5) **Head liners.** (Plywood drum completely enclosing body of carboy). When plywood cushioning is used the inner lining strips which support the plywood cushion shall be of hardwood veneer not less than ¼ inch in thickness and ⅝ inch in width and shall butt or slightly gap. All other head lining strips shall be made of hardwood veneer not less than ½ inch in thickness and ⅝ inch in width and shall overlap not less than 3 inches. The top head liners shall be fastened by 17-gauge staples on not less than 3-inch centers. The staples shall be driven through the outer hoop and body and clinched on the inside of the veneer strips. The bottom head liners shall be fastened the same as top head liners, or, by 14-gauge staples driven through the head liner and body into the outer hoop on not less than 4-inch centers.

(6) **Head liners.** (Plywood drum completely enclosing body and neck of carboy). When plywood cushioning is used the inner lining strips which support the plywood cushion shall be of hardwood veneer not less than ½ inch in thickness and ⅝ inch in width and shall overlap not less than 3 inches. The inside head liners and the inside liner strips for the false head and support of the top head shall be fastened by 17-gauge staples on not less than 3-inch centers. The staples shall be driven through the outer hoop and body and clinched on the inside of the veneer strips, except that the strips holding the false head shall have staples only through the body and shell liner. The top head liner which forms the final closure shall be fastened to the body by 14-gauge staples driven through the

head liner and body into the outer hoop on not less than 4-inch centers. The bottom head liners shall be fastened the same as top head liners, or, by 17-gauge staples driven through the outer hoop and body and clinched on the inside of the veneer strips on not less than 3-inch centers.

(7) **Battens.** At least ⅝ inch by 2 inches secured at each end by two nails driven through the hoops and body shell. One batten must be applied to the bottom of plywood drums, completely enclosing the body of carboys; and two battens must be applied to plywood drums completely enclosing the body and neck of carboys, one of which must be affixed to the top and the other to the bottom of the drum.

(b) **Cushioning materials.** Cushioning devices or materials must be of such type, or be so secured within the outer container, that the carboy cannot shift in a way that cushioning efficiency is reduced.

§ 78.7-7 Marking of outside container.

(a) On each container with letters and figures at least ¼ inch high applied by hot branding iron or printing ink of a color sharply contrasting to background of package with high pressure dies as follows:

(1) ICC-1E. This mark shall be understood to certify that the complete package complies with all specification requirements.

(2) Name or symbol (letters) of company setting up the package, or other party assuming responsibility for its compliance with specification requirements; this must be registered with the Bureau of Explosives and located just above or below the mark specified in paragraph (a) (1) of this section.

(f) **Reports.** Required to be made to Bureau of Explosives on form as follows:

REPORT OF TESTS OF CARBOYS

(As required by I. O. C. Regulations and Specifications)

(Place)
(Date)
Tests made for
(Give name and address of plant for which tests were made)

Description of package	Results					
	Number of test	55-inch swing		Number of test	55-inch swing	
		Side	Bottom		Side	Bottom
Capacity.....	1			13		
Condition ¹	2			14		
Type of inside container ²	3			15		
Cushioning ³	4			16		
	5			17		
Diameter of bottle.....	6			18		
	7			19		
Size of outside container (inside).....	8			20		
	9			21		
	10			22		
	11			23		
	12			24		

Specification mark is
Identification symbol is
Remarks

(Signature)
(Per)

¹ State whether outside container is new or used.
² State whether glass, earthenware, etc.
³ State whether hay, mineral wool, ground cork, excelsior, wood strips type, cork pads type, etc.

§ 78.8 Specification 28; metal-jacketed lead carboys.

§ 78.8-1 Compliance.

(a) Required in all details.

§ 78.8-2 Size.

(a) Not over 15 gallons (nominal).

§ 78.7-8 Tests.

(a) **Apparatus.** Standard required. Detail prints can be obtained from Bureau of Explosives, 63 Vesey Street, New York 7, New York.

(b) **Method.** Fill with water to lower edge of neck; swing 55 inches measured from wall to nearest bottom edge of basket:

(1) Side shock; test at least 10 carboys.

(2) Bottom shock; test at least 5 carboys.

NOTE 1: In instances where 99 or less carboys are in service during either 6-month period of the year it shall be acceptable to test 10 percent of the total but not less than 3 carboys on both the side and bottom swing. If this provision is used, the report of test results must so state.

(c) **Acceptable results.** 90 percent of carboys must not break under side shock and same for bottom shock, except both results must be 100 percent if modified test authorized by Note 1 of paragraph (b) of this section is used.

(d) **When required.** By each manufacturer, and each shipper who fills and ships new or used carboys; during each 6 months of each year, one series each year to be witnessed by representative of Bureau of Explosives; separate tests required for:

(1) New packages (those with new outside container).

(2) Used packages.

(3) Packages with carboys differing over 2 gallons.

(4) Packages differing in kind of cushioning.

(e) **Exception.** Tests not required by shipper who fills and ships or reships for one shipment only packages obtained from a manufacturer or shipper who has had tests made.

§ 78.8-3 Test.

(a) By 5 pounds internal-pressure, without leakage, before each shipment.

§ 78.8-4 Parts required and dimensions.

(a) As in §§ 78.8-5 to 78.8-8.

§ 78.8-5 Carboy closing device.

(a) To consist of follower-ring with stud bolts, plate-gasket, and cap as shown in § 78.8-8.

(b) Follower-ring to be 1½" wide with machined top face, inner edges rounded off to about ¼" radius, and fitted with 4 stud bolts, fastened to prevent turning, for 2" neck and 6 bolts for larger necks.

(c) Neck of carboy to be flanged over to edge of follower-ring and may be swedged out under it; inside diameter of neck not over 4".

§ 78.8-6 Outside container.

(a) Welding authorized in place of rivets shown; body rivets, if used, to be countersunk on inside.

(b) Bayonet fastenings, or other efficient method, authorized to secure top to body in place of bolts shown.

(c) Two adequate lifting handles required on body.

(d) Projections above level of top edge of body not authorized.

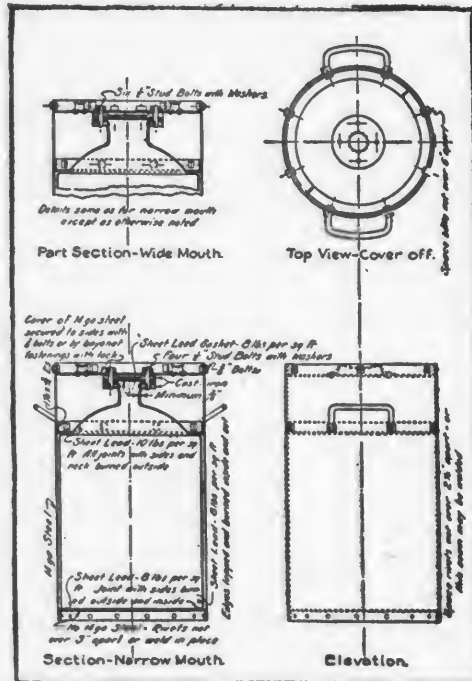
§ 78.8-7 Marking on each outside container.

(a) By embossing on top with raised marks ¾" high as follows (stamping authorized if clearly legible):

(1) ICC-28. This mark shall be understood to certify that the container complies with all specification requirements.

(2) Name or symbol (letters) of maker; this must be registered with the Bureau of Explosives and located just above, below, or following the mark specified in subparagraph (1) of this paragraph.

§ 78.8-8 Shipping container specification No. 28.



§ 78.9 Specification 28A; metal-jacketed lead carboys.

§ 78.9-1 Compliance.

(a) Required in all details.

§ 78.9-2 Size.

(a) Not over 15 gallons (nominal).

§ 78.9-3 Test.

(a) By 5 pounds internal pressure, without leakage, before each shipment.

§ 78.9-4 Parts required and dimensions.

(a) As in §§ 78.9-5 to 78.9-8.

§ 78.9-5 Carboy closing device.

(a) To consist of follower-ring with stud bolts, plate-gasket, and cap as shown.

(b) Follower-ring to be 1½" wide with machined top face, inner edges rounded off to about ¼" radius, and fitted with 4 stud bolts, fastened to prevent turning, for 2" neck and 6 bolts for larger necks.

(c) Neck of carboy to be flanged over to edge of follower-ring and may be swedged out under it; inside diameter of neck not over 8".

§ 78.9-6 Outside container.

(a) Welding authorized in place of rivets shown; body rivets, if used, to be countersunk on inside.

(b) Bayonet fastenings, or other efficient method authorized to secure top to body in place of bolts shown.

(c) Two adequate lifting handles required on body.

(d) Projections above level of top edge of body not authorized.

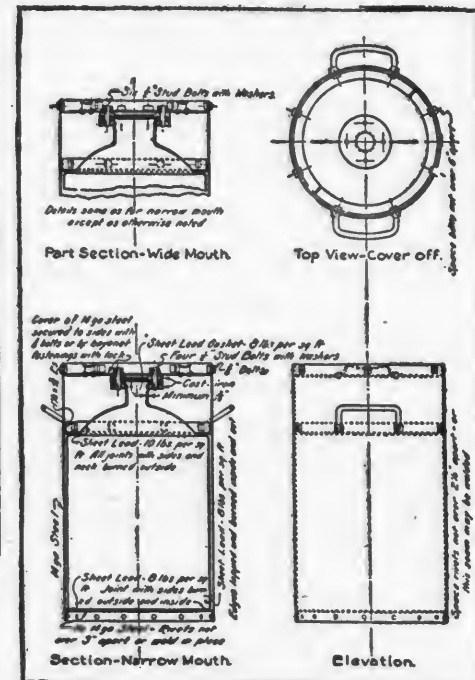
§ 78.9-7 Marking on each outside container.

(a) By embossing on top with raised marks ¾" high as follows (stamping authorized if clearly legible):

(1) ICC-28A. This mark shall be understood to certify that the container complies with all specification requirements.

(2) Name or symbol (letters) of maker; this must be registered with the Bureau of Explosives and located just above, below, or following the mark specified in subparagraph (1) of this paragraph.

§ 78.9-8 Shipping container specification No. 28A.



§ 78.12 Specification 34B; aluminum carboys.

§ 78.12-1 Compliance.

(a) Required in all details.

§ 78.12-2 Rated capacity.

(a) As marked, see § 78.12-9; 5 to 15 gallons; actual capacity shall be rated capacity plus at least 2 percent.

§ 78.12-3 Composition.

(a) Body and heads of aluminum at least 99 percent pure, or an aluminum base alloy of equivalent corrosion resistance and physical properties.

§ 78.12-4 Outage.

(a) Two percent of rated capacity, plus a maximum tolerance of 1 quart.

§ 78.12-5 Seams.

(a) Welded, including attachment of handles and other devices. Circumferential seams at least 3" from bottom.

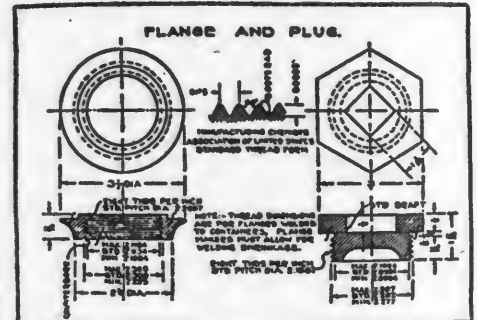
§ 78.12-6 Parts and dimensions.

(a) Thickness of material at least 0.110"; handles required.

§ 78.12-7 Closures.

(a) Adequate to prevent leakage; openings over 2.3" not authorized; suitable gaskets required.

(b) When threaded plugs, or caps, are used, they must be close fitting with gasket surfaces which bear squarely on each other when without gasket; they must have not over 8 threads per inch, with 5 complete threads engaged when gasket is in place, or not over 4 threads per inch, with 2 complete threads similarly engaged. Thread form must conform with the following drawing:



§ 78.12-8 Projections.

(a) Closing devices and other parts must be able to withstand tests prescribed in § 78.12-11.

§ 78.12-9 Marking on each container.

(a) On top by stamping with pressure dies, by embossing with raised marks, or plate attached by welding, as follows:

(1) ICC-34B. This mark shall be understood to certify that the container complies with all specification requirements.

(2) Name or symbol (letters) of maker; this must be registered with the Bureau of Explosives and located just above, below, or following the mark specified in subparagraph (1) of this paragraph.

(3) Nominal thickness of metal in decimals of an inch of the thinnest part; rated capacity in gallons; year of manufacture (for example, 0.110-15-50).

§ 78.12-10 Size of marking.

(a) Size of marking (minimum): 1/2" high.

§ 78.12-11 Type tests.

(a) Samples, taken at random and closed as for use, shall withstand prescribed tests without leakage except that leakage through closure shall not constitute failure. Tests to be made by each company starting production and to be repeated every four months. Samples last tested to be retained until further tests are made. The type tests are as follows:

(1) Test by dropping, filled with water to 98 percent capacity, from height of 4 feet onto solid concrete so as to strike on bottom edge or circumferential seam.

(2) Hydrostatic pressure test of 40 pounds per square inch sustained for 5 minutes.

§ 78.12-12 Leakage test.

(a) Each container shall be tested, with seams under water or covered with soapsuds or heavy oil, by interior pressure of at least 10 pounds per square inch. Leakers shall be rejected or repaired and retested.

§ 78.13 Specification 1H; polyethylene carboys in low carbon steel or other equally efficient metal crates.

§ 78.13-1 Compliance.

(a) Required in all details.

§ 78.13-2 Capacity and marking of carboy.

(a) Containers 5 to 13 gallons capacity are classed as carboys. Actual capacity must be marked capacity plus 5 percent minimum. Must be permanently marked to indicate marked capacity, maker (symbols, if used, must be registered with the Bureau of Explosives), month and year of manufacture, and ICC-2T in figures and letters at least 1/4 inch high.

§ 78.13-3 Polyethylene carboys.

(a) Carboys shall be made of polyethylene with no plasticisers or additives and have a maximum melt index value of 2.5 grams per 10 minutes as determined in accordance with method acceptable to the Bureau of Explosives. Carboys must have a minimum weight and wall thickness in accordance with the following table:

Marked capacity	Minimum wall thickness	Minimum weight of bottles
Gallons	Inch	Pounds
5	1/8	3
6 1/2	1/8	4
13	1/8	8

(b) Closing device shall be of material resistant to the lading and adequate to prevent leakage. Opening for closure shall not be over 3 1/2 inches in diameter.

(c) Polyethylene carboys, as manufactured and filled to marked capacity with a material which remains in a liquid form, shall be capable of withstanding a 4-foot drop without leakage, after prior conditioning so that contents will be 0° Fahr. or colder, onto solid concrete on any portion of the carboy.

§ 78.13-4 Outside containers.

(a) Metal crates:

(1) Specifications for each size outside container must be filed by each plant prior to start of production and be approved by the Bureau of Explosives.

§ 78.13-5 Marking of outside container.

(a) Each outside container must be plainly marked by attachment of a metal plate, or permanent marking in contrasting color directly on the polyethylene carboy in a visible area. Marking must be in letters and figures at least 3/4 inch high and must be by embossing or stamping when applied on metal plates. Marking must be as follows:

(1) ICC-1H. This mark shall be understood to certify that the complete package complies with all specification requirements.

(2) Name or symbol (letters) of company setting up the package, or other party assuming responsibility for its compliance with the specification requirements; this must be registered with the Bureau of Explosives and located just above or below the mark specified in paragraph (a) (1) of this section.

§ 78.13-6 Tests.

(a) One sample, taken at random and with inner container filled to marked capacity with water and closed as for use, shall be capable of withstanding prescribed tests without leakage or serious rupture of outer container. Tests shall be made of each size by each company starting production. The type tests are as follows:

(1) Complete package must be capable of withstanding 2 drops from a height of 4 feet onto solid concrete, the first drop to be made diagonally so top corner will strike the concrete; the second drop onto a 2-inch by 6-inch timber resting on the concrete with the 6-inch leg vertical, the drop being made with the package in a horizontal position and at right angles to the timber so that impact is near the center of the crate side-wall members.

§ 78.14 Specification 1K; glass carboys cushioned with expandable polystyrene in wooden wirebound box outside containers.

§ 78.14-1 Reuse of packages.

(a) Top, base or side sections of outside container and cushioning must be replaced when broken, decayed, or inefficient in any way.

(b) Carboys with lip cracked or badly chipped not authorized; gasket seat must be even. Packages must be capable of passing tests prescribed in § 78.14-8.

§ 78.14-2 Closing devices required.

(a) As follows except when otherwise authorized in the packing regulations:

(1) Acidproof stoppers or other devices, with gaskets, securely fastened; venting closures are required when necessary to prevent internal pressure in excess of 8 pounds per square inch gauge at 130° F.

(2) Glass stoppers ground to fit and securely fastened are authorized when internal pressures do not exceed 8 pounds per square inch gauge at 130° F.

§ 78.14-3 Capacity and marking of carboy.

(a) Thirteen gallon bottles. Must be embossed to indicate maker and year of manufacture; mark of maker to be registered with the Bureau of Explosives.

§ 78.14-4 Bottles.

(a) Thoroughly annealed; top of lip smooth and even; must contain at least 21 pounds of glass. Glass in side walls should be well distributed and at least 1/16 inch thick.

§ 78.14-5 Cushions.

(a) Expandable polystyrene, molded to produce a completely fused closed cell structure and designed as to provide a snug fit in all areas of contact with the inside container, in the following forms:

(1) Formed in place around the inside container; density 1.25 plus or minus 0.25 pounds per cubic foot, minimum thickness of sidewalls 1 inch and of bottoms 1.5 inches.

(2) Preformed cushions, one top and one bottom; density 2.75 plus or minus 0.5 pounds per cubic foot, minimum thickness of side walls 1 inch and of bottoms 1.37 inches.

(b) Assembled containers must be capable of passing tests prescribed in § 78.14-8.

§ 78.14-6 Outside containers.

(a) Wooden wirebound boxes completely enclosing body of carboy or completely enclosing body and neck of carboy.

(b) Lumber shall be as follows:

(1) Lumber shall be well seasoned and commercially dry; free from decay, objectionable knots, slanting shakes, sharp cross grain, and other defects that materially lessen the strength. Grain of wood in cleats and battens must not cross piece within its length.

(2) Authorized tolerances; cleats, battens and handles, minus 1/32 inch; single thickness veneer minus 5 percent; resawn boards, 1/32 inch below specified thickness for boards 1/4 inch or more thick.

(3) Woods authorized are in the following groups:

GROUP 2	
Southern yellow pine.	North Carolina pine.
Hemlock.	Douglas fir.
	Larch (Tamarack).
GROUP 3	
White elm.	Black ash.
Red gum.	Black gum.
Sycamore.	Tupelo.
Pumpkin ash.	Maple-soft or silver.
GROUP 4	
Hard maple.	Birch.
Beech.	Rock elm.
Oak.	White ash.
Hackberry.	Hickory.

(c) Binding wires and staples shall be as follows:

(1) Galvanized coated annealed steel or other material of equal strength, Washburn and Moen sizes,

(d) Minimum construction requirements shall be as follows:

(3) Packages differing in kind or shape of cushioning.
 (e) Exception. Tests not required by shipper who fills and ships or reships for one shipment only packages obtained from a manufacturer or shipper who has had tests made.
 (f) Reports. Required to be made to the Bureau of Explosives on form as follows:

REPORT OF TESTS OF CARBOYS
 (As required by I.C.C. Regulations and Specifications)

Test made for _____ (Place)
 (Give name and address of plant for which tests were made) _____ (Date)

Description of package	No. of test		55-inch swing		No. of test	55-inch swing	
	Side	Bottom	Side	Bottom		Side	Bottom
Capacity.....	1				13		
Condition 1.....	2				14		
Type of inside container 1.....	3				15		
Cushioning 1.....	4				16		
Diameter of bottle.....	5				17		
Size of outside container (inside).....	6				18		
	7				19		
	8				20		
	9				21		
	10				22		
	11				23		
	12				24		

Specification mark is _____
 Identification symbol is _____
 Remarks _____

1 State whether outside container is new or used.
 2 State whether glass, earthenware, etc.
 3 State whether hay, mineral wool, ground cork, excelsior, wood strips ---- type cork pads ---- type, etc.

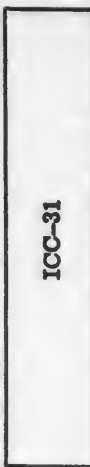
§ 78.15 Specification 31; jugs in tubs.
 § 78.15-1 Compliance.
 (a) Required in all details.
 § 78.15-2 Jugs.
 (a) Of acid-resisting material; capacity not over 2 gallons; only 1 jug in each tub.

§ 78.15-3 Size of tub.
 (a) Sufficient to allow 1 1/2" space around jug except at top where 1/2" space is acceptable.
 § 78.15-4 Material for tub.
 (a) Of sound wood; 7/16" staves; 7/16" top and bottom; at least 5 wooden hoops 7/8" x 1/8" (approx.) or 3 metal hoops with rolled edge at least 3/4" x 29 gauge United States standard.

§ 78.15-5 Construction.
 (a) Staves to be set up evenly; bottom hoop to be fastened with at least seven pers, or other closure equally acid-

§ 78.15-6 Cushioning.
 (a) To be tightly packed with adequate cushioning material.
 § 78.15-7 Marking.
 (a) On each container with letters and figures at least 1/2" high in rectangle as follows:

§ 78.15-8 Closing for shipment.
 (a) Jug to be closed by rubber stop-



(b) This mark shall be understood to certify that the package complies with all specification requirements.

Wirebound boxes	Square box for preformed cushions	Octagonal box for preformed cushions	Cylindrical box for preformed cushions	Octagonal box for formed-in-place cushions
Faceboard thickness (sides only—without handle cleats)	3/8" — 1/2"	3/8" — 1/2"	3/8" — 1/2"	3/8" — 1/2"
Group 2 woods	3/8" — 1/2"	3/8" — 1/2"	3/8" — 1/2"	3/8" — 1/2"
Group 3 and 4 woods	3/8" — 1/2"	3/8" — 1/2"	3/8" — 1/2"	3/8" — 1/2"
Faceboard thickness (sides only— with handle cleats)	3/8" — 1/2"	3/8" — 1/2"	3/8" — 1/2"	3/8" — 1/2"
Group 2 woods	3/8" — 1/2"	3/8" — 1/2"	3/8" — 1/2"	3/8" — 1/2"
Group 3 woods	3/8" — 1/2"	3/8" — 1/2"	3/8" — 1/2"	3/8" — 1/2"
Cleats	3/8" — 1/2"	3/8" — 1/2"	3/8" — 1/2"	3/8" — 1/2"
Handle cleat	3/8" — 1/2"	3/8" — 1/2"	3/8" — 1/2"	3/8" — 1/2"
Binding wires	2-12 gauge	2-12 gauge	2-12 gauge	2-12 gauge
Number and gauge over outside cleats	2-12 gauge	2-12 gauge	2-12 gauge	2-12 gauge
Number and gauge intermediate wires	2-12 gauge	2-12 gauge	2-12 gauge	2-12 gauge
Staples	1 1/4" — 16 gauge	1 1/4" — 16 gauge	1 1/4" — 16 gauge	1 1/4" — 16 gauge
Top 1	3/8" — 1/2"	3/8" — 1/2"	3/8" — 1/2"	3/8" — 1/2"
Face material thickness	3/8" — 1/2"	3/8" — 1/2"	3/8" — 1/2"	3/8" — 1/2"
Battens	3/8" — 1/2"	3/8" — 1/2"	3/8" — 1/2"	3/8" — 1/2"
Base	3/8" — 1/2"	3/8" — 1/2"	3/8" — 1/2"	3/8" — 1/2"
Face material thickness	3/8" — 1/2"	3/8" — 1/2"	3/8" — 1/2"	3/8" — 1/2"
Battens	3/8" — 1/2"	3/8" — 1/2"	3/8" — 1/2"	3/8" — 1/2"
Runners	3/8" — 1/2"	3/8" — 1/2"	3/8" — 1/2"	3/8" — 1/2"

1 A hole of suitable type may be made in top of box to provide for the protruding neck of inner container. There shall be 1 inch minimum clearance between bottle and inside of hole.

(e) Assembly:
 (1) The box shall be constructed to provide a snug fit with the cushioning for the inside container. Wooden shims of correct thickness may be used to keep carboy tight in overpack.
 (2) The boxes shall be closed with threaded loop fasteners using a regular clinch.

§ 78.14-7 Marking of outside container.
 (a) On each container with letters and figures at least 3/4 inch high applied by hot branding iron or colored ink with high pressure dies as follows:
 (1) ICC-1K. This mark shall be understood to certify that the complete package complies with all specification requirements.
 (2) Name or symbol (letters) of company setting up the package, or other party assuming responsibility for its compliance with specification requirements. This must be registered with the Bureau of Explosives and located just above or below the mark specified in subparagraph (1) of this paragraph.

§ 78.14-8 Tests.
 (a) Apparatus. Standard required. Detail prints can be obtained from the

Bureau of Explosives, 63 Vesey Street, New York 7, New York.
 (b) Method. Fill with water to lower edge of neck; swing 55 inches measured from wall to nearest bottom edge of basket:
 (1) Test 10 carboys each against bottom and one side.
 NOTE 1: Instances where 99 or less carboys are in service during either 6-month period of the year it shall be acceptable to test 10 percent of the total but not less than 3 carboys on both the side and bottom swing. If this provision is used, the report of test results must so state.
 (c) Acceptable results. One hundred percent of carboys must not break under side or bottom shocks. If failures occur, the test is to be repeated with an additional 10 carboys for which the passing requirement shall be 100 percent.
 (d) When required. By each manufacturer, and each shipper who fills and ships new or used carboys; during each 6 months of each year, one series each year to be witnessed by representative of the Bureau of Explosives; separate tests required for:
 (1) New packages.
 (2) Used packages.

resistant; cork stoppers not authorized. Top of tub to be secured in place by at least four substantial metal strips, at least 1/16" x 3 1/2" nailed to side and top of tub.

§ 78.18 Specification 43A; rubber drums.

§ 78.18-1 Compliance.

(a) Required in all details.

§ 78.18-2 Rated capacity.

(a) As marked, see § 78.18-8. Actual capacity shall be rated capacity plus at least 2 percent.

§ 78.18-3 Body and heads.

(a) Of at least two laminations; inside lamination of synthetic rubber, or of pale crepe rubber compounded with paraffin or otherwise treated, such as to be capable of withstanding the action of hydrofluoric acid, up to 85 percent hydrofluoric acid maximum, for 30 days without any substantial deterioration; other laminations of cotton fiber and rubber.

§ 78.18-4 Rolling hoops.

(a) Tough rubber free from cotton or other fiber.

§ 78.18-5 The drum.

(a) Body, heads, lining, rolling hoops, and filling hole flange to be all vulcanized together at one operation. No cements, adhesives or secondary vulcanization authorized.

§ 78.18-6 Parts and dimensions.

(a) Parts and dimensions as follows:

1 Rated capacity (U.S. wine gallons)	Minimum weight (pounds)	Rolling hoops					
		Minimum thickness		Chime (quarter round)		Body (half round)	
		Body (inch)	Head (inch)	Width (inches)	Depth (inch)	Width (inches)	Depth (inch)
5	18	3/8	1/2	1 3/4	1 3/4	2	1
13	30	3/8	1/2	2	1 3/4	2	1
30	85	3/8	1/2	2 1/2	1	2 1/4	1

1 Other capacities not authorized.

§ 78.18-7 Closures.

(a) To be such as to prevent spillage or leakage in transit and must be approved by the Bureau of Explosives.

§ 78.18-8 Marking on each container.

(a) Marking on top head plainly and permanently as follows:

(1) ICC-43A; this mark shall be understood to certify that the container complies with all specification requirements.

(2) Name or symbol (letters) of maker; this must be registered with the Bureau of Explosives and located just above, below, or following the mark specified in subparagraph (1) of this paragraph.

(3) Rated gallonage and year of manufacture (for example, 5-50).

§ 78.18-9 Type tests.

(a) Samples, taken at random and closed for use, shall withstand prescribed tests without leakage. Tests to be made of each type and size by each company starting production and to be repeated every four months. Samples

last tested to be retained until further tests are made. The type tests are as follows:

(1) Test by dropping, filled with water to 98 percent capacity, from height of 6 feet onto solid concrete so as to strike diagonally on top chime. Also a 4-foot drop to strike directly on closing device. Parts projecting beyond chime or rolling hoops must also be capable of withstanding this test.

(2) Hydrostatic pressure test of 40 pounds per square inch sustained for 5 minutes, using drums which have passed the drop test; side walls must not expand beyond chime hoops.

§ 78.18-10 Material test.

(a) Samples from side wall and end must have breaking strength at least 1,200 pounds per square inch.

Subpart B—Specifications for Inside Containers, and Linings

§ 78.20 Specification 2A; inside containers, metal cans, pails and kits.

§ 78.20-1 Capacity, thickness of metal, test, and closure.

(a) Capacity. Not over 10 gallons.

(b) Thickness of metal. At least 28-gauge, United States standard (commercial 135-pound tin plate), for cans over 1-gallon capacity; smaller cans of metal of adequate thickness.

(c) Test. By interior pressure on each completed can, without leakage.

(d) Closure. Air-tight and leakproof.

§ 78.21 Specification 2T; polyethylene container.

§ 78.21-1 Compliance.

(a) Required in all details.

§ 78.21-2 Capacity and marking of container.

(a) Containers 5 to 13 gallons capacity are covered by this specification. Actual capacity must be the marked capacity plus 5 percent minimum. Must be permanently marked to indicate marked capacity, maker (symbols, if used, must be registered with the Bureau of Explosives), month and year of manufacture, and ICC-2T in figures and letters at least 1/4 inch high.

§ 78.21-3 Material.

(a) Containers shall be made of polyethylene and shall have the following properties (see Note 1):

Melt index.....	2.6 maximum.
Density.....	0.910-0.925.
Tensile strength.....	1500 pounds per square inch minimum.
Percent elongation...	400 percent minimum.

NOTE 1: Properties to be obtained by a test method approved by Bureau of Explosives. Other materials may be added which shall not affect the properties specified in paragraph (a) of this section.

(1) Container must have a minimum weight and wall thickness in accordance with the following table:

Marked capacity not over (gallons)	Minimum wall thickness (inch)	Minimum weight of containers (pounds)
5	0.0625	3
6 1/4	.0625	4
13	.0625	8

(b) Closing device shall be of material resistant to the lading and adequate to prevent leakage and not over 3 1/2 inches in diameter.

(c) Tests. Samples taken at random, empty or filled, and prepared as specified and closed as for use, shall be capable of withstanding the following tests without breakage or leakage:

(1) Empty container shall be dropped on any part from a height of 6 feet onto solid concrete, immediately after conditioning for at least 24 hours at 0° F.

(2) The polyethylene container in a prescribed outer specification container, as authorized by Part 73 of this chapter, filled to 98 percent of capacity with water shall be dropped from a height of 4 feet onto solid concrete so as to drop diagonally on top edge or any part considered weaker.

(3) The polyethylene container in a prescribed outer specification container, as authorized by Part 73 of this chapter, filled to 98 percent of capacity with a solution which is compatible with polyethylene and remains liquid at 0° F. shall be dropped from a height of 4 feet onto solid concrete on any part of the container when container and contents are at or slightly below 0° F.

(d) Polyethylene container must fit snugly in outside container.

§ 78.22 Specification 2C; inside containers, corrugated fiberboard cartons.

§ 78.22-1 Construction.

(a) To be of double-wall board, 275-pound strength, or 2 thicknesses of double-faced board, 175-pound strength, Mullen or Cady test; slides or linings to be 1-piece with joint cloth-taped.

§ 78.22-2 Outside container.

(a) Outside container must be lined throughout with, and cartons separated by, double-wall corrugated fiberboard of 275-pound strength, Mullen or Cady test.

§ 78.23 Specification 2D; inside containers, duplex paper bags.

§ 78.23-1 Construction.

(a) Bags to be at least 2 thicknesses of shipping sack Kraft paper, or equivalent, and as follows:

Maximum weight of contents (pounds)	Minimum 1 weight (per 500 sheets 24" x 36")	
	One sheet, weight 1 (pounds)	Other sheet, weight 1 (pounds)
2	30	30
6	50	40
12	60	50
25	70	60

1 Weight 15 percent less authorized for rope paper containing 35 percent or more of manila rope fiber.

§ 78.23-2 Test.

(a) Bags, filled and closed as for shipment, must be able to withstand drop of 4 feet onto concrete without rupture or sifting, except that 2-foot drop is acceptable for bags to contain 25 pounds.

§ 78.24 Specification 2U; molded or thermoformed polyethylene containers having rated capacity of over one gallon. Removable head containers or containers fabricated from film not authorized.

§ 78.24-1 Compliance.

(a) Required in all details.

§ 78.24-2 Material.

(a) Containers shall be made of polyethylene and shall have the following properties (see Note 1):

- Melt index..... 2.6 maximum.
- Density..... 0.910-0.925.
- Tensile strength..... 1,500 pounds per square inch minimum.
- Percent elongation... 400 percent minimum.

NOTE 1: Properties to be obtained by a test method approved by Bureau of Explosives. Other materials may be added which shall not affect the properties specified in paragraph (a) of this section.

§ 78.24-3 Construction capacity.

(a) Container must be constructed in accordance with the following table:

Rated capacity not over (gallons)	Minimum overall thickness (inch) ¹	Percent outage over marked capacity permitted
5.....	0.010	15
15.....	.015	15
55.....	.016	5

¹ For cubical containers, the area adjacent to and forming the opening for closure may have a minimum thickness of 0.008 inch for 5 gallons rated capacity and sizes larger than 5 gallons may have a minimum thickness of 0.010 inch.

§ 78.24-4 Closure.

(a) Shall be of material resistant to lading and adequate to prevent leakage. Vented closures where specified under Part 73 of this chapter authorized. No opening over 2.7 inches in diameter authorized.

§ 78.24-5 Marking.

(a) Each container must be permanently marked by embossment to show rated capacity, month and year of manufacture, maker (symbols, if used, must be registered with the Bureau of Explosives), and ICC-2U in figures and letters at least ¼ inch in size.

§ 78.24-6 Type test.

(a) Samples taken at random shall withstand prescribed test without breakage. Test shall be made on each type and size at each manufacturing location starting production and shall be repeated every four months. The type test is as follows:

(1) Empty inner container shall be dropped on any part from a height of 6 feet onto solid concrete immediately after conditioning for at least 24 hours at 0° F.

§ 78.24-7 Tests.

(a) Samples taken at random, filled and prepared as specified and closed as for use, shall be capable of withstanding the following tests without leakage:

(1) The polyethylene container in a prescribed outer specification container, as authorized by Part 73 of this chapter,

filled to 98 percent of capacity with water shall be dropped from a height of 4 feet onto solid concrete so as to drop diagonally on top edge or any part considered weaker.

(2) The polyethylene container in a prescribed outer specification container, as authorized by Part 73 of this chapter, filled to 98 percent of capacity with a solution which is compatible with polyethylene and remains liquid at 0° F. shall be dropped from a height of 4 feet onto solid concrete on any part of the container when container and contents are at or slightly below 0° F.

(3) The polyethylene container in a prescribed outer specification container, as authorized in Part 73 of this chapter, filled to 98 percent of capacity with water shall be capable of withstanding a vibration test by placing the container on the vibration table anchored in such manner that all horizontal motion shall be restricted and only vertical motion allowed. The test shall be performed for one hour using an amplitude of one inch at a frequency that causes the test container to be raised from the floor of the table to such a degree that a piece of paper or flat steel strap or tape can be passed between the table and the container.

§ 78.25 Specification 2F; inside metal containers and liners.

§ 78.25-1 Construction.

(a) Containers over 1-gallon capacity and all lining must be at least 30 gauge, United States standard (commercial 107-pound tin plate) and sealed leakproof.

§ 78.26 Specification 2G; inside containers, fiber cans and boxes.

§ 78.26-1 Capacity, and thickness of metal and fiber.

(a) Capacity not over 6 pounds, net. Metal tops, bottoms, and connections of suitable thickness are authorized. Minimum fiber thickness as follows:

- (1) Up to ¼-pound size: 0.021".
- (2) Up to 1-pound size: 0.026".
- (3) Up to 3-pound size: 0.036".
- (4) Up to 6-pound size: 0.050", provided that 0.036" fiber heads with 130-pound strength¹ are authorized; or 0.028" with 175-pound strength; or 0.036" with 90-pound strength,¹ provided each container is wrapped with shipping sack Kraft paper of 60-pound base weight pasted thereon.

§ 78.27 Specification 2TL; polyethylene container.

§ 78.27-1 Material requirements.

(a) Container shall be made of polyethylene and shall have the following properties (see Note 1):

- Melt index..... 2.6 maximum.
- Density..... 0.910-0.925.
- Tensile strength..... 1500 pounds per square inch minimum.
- Percent elongation..... 400 percent minimum.

NOTE 1: Properties to be obtained by a test method approved by the Bureau of Explosives. Other materials may be added which

¹ Mullen or Cady test.

shall not affect the properties specified in paragraph (a) of this section.

§ 78.27-2 Construction, capacity and marking.

(a) Container must be constructed in accordance with the following table:

Marked capacity ¹ not over (gallons)	Minimum wall thickness (inches)	Minimum weight of containers (pounds)
5.....	0.015	1
14.....	.050	5½

¹ Actual capacity must be the marked capacity plus 5 percent minimum.

(b) Closure: Closure shall be of material resistant to lading and adequate to prevent leakage. Vented closures where specified under Part 73 of this chapter authorized. No opening over 3½ inches in diameter authorized.

(c) Marking: Each container must be permanently marked to show the rated (marked) capacity, month and year of manufacture, maker (symbols, if used, must be registered with the Bureau of Explosives) and ICC-2TL in figures and letters at least ¼ inch in size.

(d) Polyethylene container must fit snugly in outside container.

§ 78.27-3 Type test.

(a) Samples taken at random shall withstand prescribed test without breakage. Test shall be made on each type and size at each manufacturing location starting production and shall be repeated every four months. The type test is as follows:

(1) Empty container shall be dropped on any part from a height of 6 feet onto solid concrete, immediately after conditioning for at least 24 hours at 0° F.

§ 78.27-4 Tests.

(a) Samples taken at random, filled and prepared as specified and closed as for use, shall be capable of withstanding the following tests without leakage:

(1) The polyethylene container in a prescribed outer specification container as authorized by Part 73 of this chapter, filled to 98 percent capacity with water shall be dropped from a height of 4 feet onto solid concrete so as to drop diagonally on top edge or on any part considered weaker.

(2) The polyethylene container in a prescribed outer specification container, as authorized by Part 73 of this chapter, filled to 98 percent capacity with a solution which is compatible with polyethylene and remains liquid at 0° F. shall be dropped from a height of 4 feet onto solid concrete on any part of the container when container and contents are at or slightly below 0° F.

§ 78.28 Specification 2J; inside containers, waterproof paper bags for linings.

§ 78.28-1 Material.

(a) Two sheets of paper cemented together and creped to afford 25 percent stretch; paper to be shipping sack Kraft, 30 pounds per ream (500 sheets, 24" x 36") before creping; total weight 90 pounds per ream.

§ 78.28-2 Test.

(a) Material folded into cones and filled with water to depth of 2" at 70° F. must not show water on outside within 24 hours.

§ 78.28-3 Construction.

(a) Form to fit the outside container without stretching; seams and closures to afford a siftproof bag.

§ 78.29 Specification 2K; inside containers, paper bags for linings.

§ 78.29-1 Paper and construction.

(a) Shipping sack Kraft paper, creped; at least 45 pounds per ream (500 sheets, 24" x 36") before creping.

(b) Construction. Form to fit the outside container without stretching; seams and closure to afford a siftproof bag.

§ 78.30 Specification 2L; lining for boxes.

§ 78.30-1 Box lining.

(a) Box lining must be of strong paraffined paper, or other suitable material, without joints or other openings at the bottom or at sides of box, and shall fully protect contents in contact with top of box.

(b) Tensile strength of material must be at least 35 pounds with the grain and 17 pounds across grain, tested by direct pull on strips measuring 3" by 1". Average results of three or more tests with the grain and three or more across grain shall be used.

(c) Material shall be impervious to water and nitroglycerin at 77° F. Test for imperviousness shall consist of folding material into cones, loosely to avoid breakage at creases. Cones tested for nitroglycerin shall be filled to 1" depth; those for water to 2". No leakage of liquid shall occur during 24 hours' exposure.

(d) Material must transmit no oily or greasy stain to unglazed paper. Test shall consist of placing one thickness of material, with two thicknesses of unglazed paper on each side, in an oven at 104° F. for 24 hours, under pressure of a lead disk 1½" thick and of 10 pounds weight resting edgewise on the paper.

(e) Saturating paraffin, when used, shall have melting point of 125° F. or above. Test shall consist of extracting paraffin from 1 ounce or more of material with ether. After evaporation of all ether, paraffin shall be melted and poured upon the surface of water contained in a hemispherical dish approximately 3¼" in diameter. Dish shall be three-fourths full of water above melting point of paraffin. Thermometer shall be placed with bulb three-fourths immersed in center of dish. Water and paraffin shall be allowed to cool until paraffin upon the surface of water commences to solidify. Temperature shall then be read and recorded as melting point of paraffin.

§ 78.30-2 Bag.

(a) Bag complying with requirements of paragraphs (b), (c), and (d) of this section also authorized.

(b) Material must be: 2 sheets of shipping sack Kraft paper joined by asphaltum, or equivalent; outer sheet at least 60 pounds and inner sheet at least

30 pounds per ream (500 sheets, 24" x 36"); inner sheet coated with wax, or equivalent, with melting point at least 125° F.; compliance with § 78.30-1 (b) and (c) required.

(c) Seams must be pasted with adhesive not affected by nitroglycerin.

(d) Completed bag must be formed to fit outside container without undue strain and must be impervious to seepage of nitroglycerin.

§ 78.31 Specification 2M; waterproofed paper lining.

§ 78.31-1 Waterproofed paper.

(a) Waterproofed paper for box lining must be strong, folded or constructed without joints or openings at sides, bottoms, or ends, and shall fully protect contents at top of box.

§ 78.32 Specification 2N; inside containers, metal cans.

§ 78.32-1 Size.

(a) Not over 14-pounds water capacity (388 cubic inches).

§ 78.32-2 Material.

(a) Tin plate, good quality, as follows:

Maximum diameter of can	Minimum thickness of metal (inch)	
	In body	In heads
4½ inches....	0.01134 (1C-107 pound tin plate).	0.01305 (1XL-128 pound tin plate).
6¼ inches....	0.01134 (1C-107 pound tin plate).	0.01485 (2XL-148 pound tin plate).

NOTE 1: Because of the present emergency and until further order of the Commission, the minimum thickness of metal in heads may be 1XL-107-pound tin plate for cans of not over 4½ inch diameter and 1XL-135-pound tin plate for cans of not over 6¼ inches diameter, provided side seams are soldered and heads are attached to body by full double seams internally soldered.

§ 78.32-3 Manufacture.

(a) Seams soldered or full double seam. Outside surface rustproofed by lacquer or equivalent.

§ 78.32-4 Test.

(a) When closed as for shipment, must be capable of standing 40-pound interior pressure without leakage.

§ 78.33 Specification 2P; inside metal containers.

§ 78.33-1 Compliance.

(a) Required in all details.

§ 78.33-2 Type and size.

(a) Single-trip inside containers. Must be seamless, or with seams, welded, soldered, brazed, double seamed, or swedged.

(b) The maximum capacity of containers in this class shall not exceed 31.83 cubic inches (17.6 fluid ounces). The maximum inside diameter shall not exceed 3 inches.

§ 78.33-3 Inspection.

(a) By competent inspector.

§ 78.33-4 Duties of inspector.

(a) To inspect material and completed containers and witness tests, and to reject defective materials or containers.

§ 78.33-5 Material.

(a) Uniform quality steel plate such as black plate, electro-tin plate, hot dipped tin plate, tern plate or other commercially accepted can making plate; or non-ferrous metal of uniform drawing quality.

(b) Material with seams, cracks, laminations or other injurious defects not authorized.

§ 78.33-6 Manufacture.

(a) By appliances and methods that will assure uniformity of completed containers; dirt and scale to be removed as necessary; no defect acceptable that is likely to weaken the finished container appreciably; reasonably smooth and uniform surface finish required.

(b) Seams when used must be as follows:

(1) Circumferential seams: By welding, swedging, brazing, soldering, or double seaming.

(2) Side seams: By welding, brazing or soldering. Side seams not authorized on aluminum containers.

(c) Ends: The ends shall be of pressure design (not flat).

§ 78.33-7 Wall thickness.

(a) The minimum wall for any container shall be 0.009 inch.

§ 78.33-8 Tests.

(a) One out of each lot of 5,000 containers or less, successively produced per day, shall be pressure tested to not less than 180 pounds per square inch gauge with no bulging of either end. The container tested shall be complete with ends assembled.

(b) One out of each lot of 5,000 containers or less, successively produced per day, shall be pressure tested to destruction and must not burst below 210 pounds per square inch of pressure. The container tested shall be complete with ends assembled.

(c) Each such 5,000 containers or less, successively produced per day, shall constitute a lot and if the test container shall fail, the lot shall be rejected or ten additional may be selected at random and subjected to the test under which failure occurred. These containers shall be complete with ends assembled. Should any of the ten containers thus tested fail, the entire lot must be rejected. All containers constituting a lot shall be of like material, size, design, construction, finish and quality.

§ 78.33-9 Marking.

(a) On each container by printing, lithographing, embossing, or stamping manufacturer's name or symbol. If symbol is used it must be registered with the Bureau of Explosives.

§ 78.34 Specification 2R; inside containers, metal tubes.

§ 78.34-1 Materials.

(a) Metal tubes shall be stainless steel, malleable iron, or brass, or other materials having equivalent physical strength and fire resistance.

§ 78.34-2 Manufacture.

(a) The ends of the tubes must be fitted with screw-type closures or flanges (see § 78.34-4), except that one or both

ends of the tube may be permanently closed by a welded or brazed plate. Welded or brazed side seams are authorized.

(b) Welding or brazing must be done in a workmanlike manner and must be free from defects.

§ 78.34-3 Size.

(a) Inside diameter of the tube shall not exceed 12 inches, exclusive of flanges for handling or fastening devices and shall have wall thickness and length in accordance with the following:

Inside diameter not over (inches)	Wall thickness minimum (inch)	Length maximum (inches)
2.....	3/32	16
6.....	1/4	72
12.....	1/4	72

§ 78.34-4 Closing devices.

(a) Closing devices shall be as follows:

(1) Screw-type, caps or plugs; number of threads per inch must not be less than United States standard pipe threads and must have sufficient length of thread to engage at least 5 threads when securely tightened.

(2) Openings exceeding 3 inches inside diameter may be closed by securely bolted flanges and leak-tight gasket.

§ 78.34-5 Marking.

(a) Each container shall be marked with the words "RADIOACTIVE MATERIAL" either by embossing or die-stamping directly onto the container or by securely affixing by welding or brazing a metal plate bearing this notation to the container.

§ 78.35 Specification 2S; polyethylene container.

Removable head container not authorized.

§ 78.35-1 Compliance.

(a) Required in all details.

§ 78.35-2 Material requirements.

(a) Container shall be made of polyethylene and shall have the following properties (see Note 1):

Melt index.....	2.6 maximum.
Density.....	0.910-0.925.
Tensile strength.....	1,500 pounds per square inch minimum.
Percent elongation.....	400 percent minimum.

NOTE 1: Properties to be obtained by a test method approved by the Bureau of Explosives. Other materials may be added which shall not affect the properties.

§ 78.35-3 Construction, capacity and marking.

(a) Container must be constructed in accordance with the following table:

Marked capacity not over (gallons) ¹	Maximum capacity (gallons)	Minimum thickness—side wall and heads (inches) ²	Minimum weight (pounds)
5.....	6	.0625	1.4
13.5.....	14.5	.0625	3.25
15.....	16	.0625	3.5
29.....	30	.0625	5.5
53.....	54	.0625	9

¹ Marked capacity shall be minimum capacity.
² Side openings are not authorized.

(b) Marking. Each container must be permanently marked to show minimum capacity, month and year of manufacture, maker (symbols, if used, must be registered with the Bureau of Explosives) and ICC-2S in figures and letters at least 1/4 inch in size.

(c) Polyethylene container must fit snugly in outside container.

§ 78.35-4 Closures.

(a) Closing devices must be of screw thread type or fastened by positive means and be of material resistant to the lading and adequate to prevent leakage.

(b) Openings over 2.3 inches in diameter not permitted.

§ 78.35-5 Tests.

(a) Samples taken at random, empty or filled, and prepared as specified and closed as for use, shall be capable of withstanding the following tests without breakage or leakage:

(1) Empty container shall be dropped on any part from a height of 6 feet onto solid concrete, immediately after conditioning for at least 24 hours at 0° F.

(2) The polyethylene container in a prescribed outer specification container, as authorized by Part 73 of this chapter, filled to 98 percent of capacity with water shall be dropped from a height of 4 feet onto solid concrete so as to drop diagonally on top edge or any part considered weaker.

(3) The polyethylene container in a prescribed outer specification container, as authorized by Part 73 of this chapter, filled to 98 percent of capacity with a solution which is compatible with polyethylene and remains liquid at 0° F. shall be dropped from a height of 4 feet onto solid concrete on any part of the container when container and contents are at or slightly below 0° F.

§ 78.35a Specification 2SL; molded or thermoformed polyethylene container.

Removable head container or container fabricated from film not authorized.

§ 78.35a-1 Material requirements.

(a) Container shall be made of polyethylene and have the following properties (see Note 1):

Melt index.....	2.6 maximum.
Density.....	0.910-0.925.
Tensile strength.....	1,500 pounds per square inch minimum.
Percent elongation.....	400 percent minimum.

NOTE 1: Properties to be obtained by a test method approved by the Bureau of Explosives. Other materials may be added which shall not affect the properties of this section.

§ 78.35a-2 Construction, capacity and marking.

(a) Container must be constructed in accordance with the following table:

Marked capacity not over (gallons) ¹	Maximum capacity (gallons)	Minimum thickness—side wall and heads (inches) ²	Minimum weight (pounds)
13.5.....	14.5	0.030	2
15.....	16	.030	2.25
29.....	30.5	.030	3.25
53.....	54.5	.040	5

¹ Marked (actual) capacity shall be minimum capacity.
² Side openings are not authorized.

(b) Closure: Closure shall be of material resistant to lading and adequate to prevent leakage. Vented closures where specified under Part 73 of this chapter are authorized. No opening over 2.3 inches in diameter authorized.

(c) Markings: Each container must be permanently marked to show minimum capacity, month and year of manufacture, maker (symbols, if used, must be registered with the Bureau of Explosives) and ICC-2SL in figures and letters at least 1/4 inch in size.

(d) Polyethylene container must fit snugly in outside container.

§ 78.35a-3 Type test.

(a) Samples taken at random shall withstand prescribed test without breakage. Test shall be made on each type and size at each manufacturing location starting production and shall be repeated every four months. The type test is as follows:

(1) Empty container shall be dropped on any part from a height of 6 feet onto solid concrete immediately after conditioning for at least 24 hours at 0° F.

§ 78.35a-4 Tests.

(a) Samples taken at random, filled and prepared as specified and closed as for use, shall be capable of withstanding the following tests without leakage:

(1) The polyethylene container in a prescribed outer specification container, as authorized by Part 73 of this chapter, filled to 98 percent of capacity with water shall be dropped from a height of 4 feet onto solid concrete so as to drop diagonally on top edge or any part considered weaker.

(2) The polyethylene container in a prescribed outer specification container, as authorized by Part 73 of this chapter, filled to 98 percent of capacity with a solution which is compatible with polyethylene and remains liquid at 0° F. shall be dropped from a height of 4 feet onto solid concrete on any part of the container when container and contents are at or slightly below 0° F.

(3) The polyethylene container in a prescribed outer specification container, as authorized in Part 73 of this chapter, filled to 98 percent of capacity with water shall be capable of withstanding a vibration test by placing the container on the vibration table anchored in such manner that all horizontal motion shall be restricted and only vertical motion allowed. The test shall be performed for one hour using an amplitude of one inch at a frequency that causes the test container to be raised from the floor of the table to such a degree that a piece of paper or flat steel strap or tape can be passed between the table and the container.

Subpart C—Specifications for Cylinders

§ 78.36 Specification 3A; seamless steel cylinders.

§ 78.36-1 Compliance.

(a) Required in all details.

§ 78.36-2 Type, size and service pressure.

(a) Type and size. Seamless; not over 1,000 pounds water capacity (nominal).

(b) *Service pressure.*¹ At least 150 pounds per square inch.

§ 78.36-3 *Inspection by whom and where.*

(a) By competent and disinterested inspector acceptable to the Bureau of Explosives; chemical analyses and tests, as specified, to be made within limits of the United States.

§ 78.36-4 *Duties of inspector.*

(a) Inspect all material and reject any not complying with requirements; for cylinders made by billet-piercing process, billets to be inspected after parting and shown to be free from pipe, cracks, excessive segregation and other injurious defects.

(b) Verify chemical analysis of each heat of material by analysis or by obtaining certified analysis: *Provided*, That a certificate from the manufacturer thereof, giving sufficient data to indicate compliance with requirements, is acceptable when verified by check analyses of samples taken from one cylinder out of each lot of 200 or less.

(c) Verify compliance of cylinders with all requirements including markings; inspect inside before closing in both ends; verify heat treatment as proper; obtain samples for all tests and check chemical analyses; witness all tests; verify threads by gauge; report volumetric capacity and tare weight (see report form) and minimum thickness of wall noted.

(d) Render complete report (§ 78.36-22) to purchaser, cylinder maker, and the Bureau of Explosives.

§ 78.36-5 *Steel.*

(a) Open-hearth or electric steel of uniform quality. Content percent for the following not over: Carbon, 0.55; phosphorous, 0.045; sulphur, 0.050.

§ 78.36-6 *Identification of material.*

(a) Required; any suitable method except that plates and billets for hot-drawn cylinders shall be marked with heat number.

§ 78.36-7 *Defects.*

(a) Material with seams, cracks, laminations, or other injurious defects, not authorized.

§ 78.36-8 *Manufacture.*

(a) By best appliance and methods; dirt and scale to be removed as necessary to afford proper inspection; no fissure or other defect acceptable that is likely to weaken the finished cylinder appreciably; reasonably smooth and uniform surface finish required. If not originally free from such defects, the surface may be machined or otherwise treated to eliminate these defects. The thickness of the bottoms of cylinders welded or formed by spinning is, under no condition, to be less than two times the minimum wall thickness of the cylindrical shell; such bottom thicknesses to be measured within an area bounded by a line representing the points of contact between

the cylinder and floor when the cylinder is in a vertical position.

§ 78.36-9 *Welding or brazing.*

(a) Welding or brazing for any purpose whatsoever is prohibited except as follows:

(1) Welding or brazing is authorized for the attachment of neckrings and footrings which are non-pressure parts, and only to the tops and bottoms of cylinders having a service pressure of 500 pounds per square inch or less. Cylinders, neckrings, and footrings must be made of weldable steel, carbon content of which must not exceed 0.25 percent except in the case of 4130X steel which may be used with proper welding procedure.

(2) As permitted in § 78.36-8 (a).

NOTE 1: Cylinders used solely in anhydrous ammonia service may have a ½ inch diameter bar welded within their concave bottoms in accordance with the foregoing requirements.

§ 78.36-10 *Wall thickness.*

(a) For cylinders with service pressure less than 900 pounds the wall stress shall not exceed 24,000 pounds per square inch. Minimum wall 0.100" for any cylinder over 5" outside diameter.

(b) Calculation must be made by the formula:

$$S = \frac{P(1.3D^2 + 0.4d^2)}{D^2 - d^2}$$

where

S = wall stress in pounds per square inch;
P = minimum test pressure prescribed for water jacket test or 450 pounds per square inch whichever is the greater;
D = outside diameter in inches;
d = inside diameter in inches.

§ 78.36-11 *Heat treatment.*

(a) The completed cylinders must be uniformly and properly heat-treated prior to tests.

§ 78.36-12 *Openings in cylinders and connections (valves, fuse plugs, etc.) for those openings.*

(a) Threads required, to be clean cut, even, without checks, and to gauge.

(b) Taper threads, when used, to be of length not less than as specified for American Standard taper pipe threads.

(c) Straight threads having at least 6 engaged threads are authorized; to have tight fit and calculated shear strength at least 10 times the test pressure of the cylinder; gaskets required, adequate to prevent leakage.

§ 78.36-13 *Safety devices and protection for valves, safety devices, and other connections, if applied.*

(a) Must be as required by the Interstate Commerce Commission's regulations that apply (see §§ 73.34 (f) and 73.301 (i) of this chapter).

§ 78.36-14 *Hydrostatic test.*

(a) By water-jacket, or other suitable methods, operated so as to obtain accurate data. Pressure gauge must permit reading to accuracy of 1 percent. Expansion gauge must permit reading of total expansion to accuracy either of 1 percent or 0.1 cubic centimeter.

(b) Pressure must be maintained for 30 seconds and sufficiently longer to insure complete expansion. Any internal

pressure applied after heat-treatment and previous to the official test must not exceed 90 percent of the test pressure. If, due to failure of the test apparatus, the test pressure cannot be maintained, the test may be repeated at a pressure increased by 10 percent or 100 pounds per square inch, whichever is the lower.

(c) Permanent volumetric expansion must not exceed 10 percent of total volumetric expansion at test pressure.

(d) Each cylinder must be tested to at least 5/3 times service pressure.

§ 78.36-15 *Flattening test.*

(a) Between knife edges, wedge shaped, 60° angle, rounded to ½" radius; test 1 cylinder,¹ taken at random out of each lot of 200 or less, after hydrostatic test.

§ 78.36-16 *Physical test.*

(a) To determine yield strength, tensile strength, elongation, and reduction of area of material. Required on 2 specimens cut from 1 cylinder taken at random out of each lot of 200 or less.

(b) Specimens must be: Gauge length 8 inches with width not over 1½ inches; or, gauge length 2 inches with width not over 1½ inches; provided, that gauge length at least 24 times thickness with width not over 6 times thickness is authorized when cylinder wall is not over ⅜-inch thick. The specimen, exclusive of grip ends, must not be flattened. Grip ends may be flattened to within 1 inch of each end of the reduced section. When size of cylinder does not permit securing straight specimens, the specimens may be taken in any location or direction and may be straightened or flattened cold, by pressure only, not by blows; when specimens are so taken and prepared, the inspector's report must show in connection with record of physical tests detailed information in regard to such specimens. Heating of specimen for any purpose is not authorized.

(c) The yield strength in tension shall be the stress corresponding to a permanent strain of 0.2 percent of the gauge length.

(1) The yield strength shall be determined by either the "offset" method or the "extension under load" method as prescribed in ASTM Standard E8-57T.

(2) In using the "extension under load" method, the total strain (or "extension under load") corresponding to the stress at which the 0.2 percent permanent strain occurs may be determined with sufficient accuracy by calculating the elastic extension of the gauge length under appropriate load and adding thereto 0.2 percent of the gauge length. Elastic extension calculations shall be based on an elastic modulus of 30,000,000. In the event of controversy, the entire stress-strain diagram shall be plotted and the yield strength determined from the 0.2 percent offset.

(3) For the purpose of strain measurement, the initial strain shall be set while the specimen is under a stress of 12,000

¹The "service pressure" limits the use of the cylinder. It is shown by marks on cylinder; for example, ICC-3A2000 indicates the service pressure as 2,000 pounds per square inch.

¹For lots of 30 or less, physical and flattening tests are authorized to be made on a ring at least 8 inches long cut from each cylinder and subjected to same heat treatment as the finished cylinder.

the spun cylinder category by drilling to remove defective material, tapping and plugging.

§ 78.36-20 Marking.

(a) Marking on each cylinder by stamping plainly and permanently on shoulder, top head, or neck as follows:

- (1) ICC-3A followed by the service pressure (for example, ICC-3A1800, etc.).
(2) A serial number and an identifying symbol (letters); location of number to be just below the ICC mark; location of symbol to be just below the number. The symbol and numbers must be those of purchaser, user, or maker. The symbol must be registered with the Bureau of Explosives; duplications unauthorized.

(3) Inspector's official mark near serial number; date of test (such as 5-50 for May 1950), so placed that dates of subsequent tests can be easily added; and word "SPUN" or "PLUG" near ICC mark when an end closure in the finished cylinder has been welded by the spinning process, or effected by plugging.

§ 78.36-21 Size of marks. (a) At least 1/4 inch high if space permits.

§ 78.36-22 Inspector's report. (a) Required to be clear, legible, and in following form:

(Place) (Date) Gas Cylinders Manufactured for Location at Location at Consigned to Location at Quantity Size inches outside diameter by inches long.

Lot numbers, not over 500 cylinders in each lot, authorized for cylinders not over 2 inches outside diameter and for cylinders over 2 inches outside diameter when the volumetric capacity does not exceed 60 cubic inches. Symbol in front of or following the number with ample space between is also authorized. Other variation in location authorized only when necessitated by lack of space. Example: ICC-3A1800 1234 XX

NOTE 1: Spun cylinders rejected under the provisions of § 78.36-18 may be removed from

was found free from seams, cracks, laminations, and other defects which might prove injurious to the strength of the cylinder. The processes of manufacture and heat treatment of cylinders were supervised and found to be efficient and satisfactory.

The cylinder walls were measured and the minimum thickness noted was inch. The outside diameter was determined by a close approximation to be inches. The wall stress was calculated to be pounds per square inch under an internal pressure of pounds per square inch.

Hydrostatic tests, flattening tests, tensile tests of material, and other tests, as prescribed in specification No. ICC-3A were made in the presence of the inspector and all material and cylinders accepted were found to be in compliance with the requirements of that specification. Records thereof are attached hereto.

I hereby certify that all of these cylinders proved satisfactory in every way and comply with the requirements of Interstate Commerce Commission specification No. 3A except as follows:

Exceptions: (Signed) Inspector. (Place) (Date)

Marks stamped into the shoulder of the cylinder are: Specification ICC- to Inclusive. Serial numbers to Inclusive. Inspector's mark (registered) Identifying symbol (registered) Tare weights (yes or no) Other marks (if any)

These cylinders were made by process of (necks—footings) permitted in § 78.36-9 were attached by process of (welding—brazing) The material used was identified by the following (heat-purchase order) numbers

The material used was verified as to chemical analysis and record thereof is attached hereto. The heat numbers (were—were not) Marked on the material. All material, such as plates, billets and seamless tubing, was inspected and each cylinder was inspected both before and after closing in the ends; all that was accepted

Numbered to Inclusive. Size Made by inches outside diameter by For Company

NOTE: Any omission of analyses by heat, if authorized, must be accounted for by notation hereon reading "The prescribed certificate of the manufacturer of material has been secured, found satisfactory, and placed on file," or by attaching a copy of the certificate.

Table with columns: Test No., Heat No., Check analysis No., Cylinders represented (serial Nos.), Chemical analysis (C, P, S, B, Si, Mn, Ni, Or)

The analyses were made by (Signed)

(d) Render complete report (§ 78.37-22) to purchaser, cylinder maker, and the Bureau of Explosives.
 § 78.37-5 Authorized steel.
 (a) Open hearth or electric steel of uniform quality. The following chemical analyses are authorized (see note 1):

Designation	4130X (percent) (see note 2)	NE-8630 (percent) (see note 2)	9115 (percent) (see note 2)	9125 (percent) (see note 2)
Carbon.....	0.25/0.35	0.25/0.33	0.10/0.20	0.20/0.30
Manganese.....	0.40/0.90	0.70/0.90	0.50/0.75	0.50/0.75
Phosphorus.....	0.04 max.	0.04 max.	0.04 max.	0.04 max.
Sulphur.....	0.05 max.	0.04 max.	0.04 max.	0.04 max.
Silicon.....	0.20/0.35	0.20/0.35	0.60/0.90	0.60/0.90
Chromium.....	0.80/1.10	0.40/0.60	0.50/0.65	0.80/0.65
Molybdenum.....	0.15/0.25	0.15/0.25	0.05/0.15	0.05/0.15
Zirconium.....		0.40/0.70		
Nickel.....				

ends: verify heat treatment as proper; obtain samples for all tests and check chemical analyses; witness all tests; verify threads by gauge; report volumetric capacity and tare weight (see report form) and minimum thickness of wall noted.

Designation	9115X (percent) (see note 2)	9125X (percent) (see note 2)	Intermediate manganese (percent)
Carbon.....	0.10/0.20	0.20/0.30	0.40 max.
Manganese.....	0.50/0.75	0.50/0.75	1.35/1.55
Phosphorus.....	0.04 max.	0.04 max.	0.04 max.
Sulphur.....	0.04 max.	0.04 max.	0.05 max.
Silicon.....	0.60/0.90	0.60/0.90	0.10/0.30
Chromium.....	0.50/0.65	0.50/0.65	
Molybdenum.....	0.10/0.20	0.10/0.20	
Zirconium.....	0.05/0.15	0.05/0.15	
Nickel.....			

NOTE 1: A heat of steel made under any of the above specifications, check chemical analysis of which is slightly out of the specified range, is acceptable, if satisfactory in all other respects, provided the tolerances published by the American Iron and Steel Institute in Table 6-4 of "Supplementary Information July 1958, Alloy Steel: Semi-finished; Hot Rolled and Cold Finished Bars, July 1955," are not exceeded, or provided the variation in chemical analysis is approved by the Bureau of Explosives.
 NOTE 2: This designation shall not be restrictive and the commercial steel is limited in analysis as shown in the table.

NOTE 2: This designation shall not be restrictive and the commercial steel is limited in analysis as shown in the table.

§ 78.37-6 Identification of material.
 (a) Required; any suitable method except that plates and billets for hot-drawn cylinders shall be marked with heat number.

§ 78.37-7 Defects.
 (a) Material with seams, cracks, laminations, or other injurious defects, not authorized.

§ 78.37-8 Manufacture.
 (a) By best appliances and methods; dirt and scale to be removed as necessary to afford proper inspection; no fissure or

RECORD OF PHYSICAL TESTS OF MATERIAL FOR CYLINDERS
 (Place) (Date)
 Numbered _____ to _____ inclusive.
 Size _____ inches outside diameter by _____ Company
 For _____

Test No.	Cylinders represented by test (Serial Nos.)	Yield strength (pounds per square inch)	Tensile strength (pounds per square inch)	Elongation (percent in 8 inches)	Reduction of area (percent)	Flattening test

RECORD OF HYDROSTATIC TESTS ON CYLINDERS
 Numbered _____ to _____ inclusive.
 Size _____ inches outside diameter by _____ Company
 For _____

Serial numbers of cylinders tested arranged numerically	Actual test pressure (pounds per square inch)	Total expansion (cubic centimeters) †	Permanent expansion (cubic centimeters) †	Percent ratio of permanent total expansion to total expansion †	Tare weight (pounds) ‡	Volumetric capacity

† If the tests are made by a method involving the measurement of the amount of liquid forced into the cylinder by the test pressure, then the basic data, on which the calculations are made, such as the pump factors, temperature of liquid, coefficient of compressibility of liquid, etc. must also be given.
 ‡ Do not include removable cap but state whether with or without valve. These weights must be accurate to a tolerance of 1 per cent.

§ 78.37 Specification 3AA; seamless steel cylinders, made of definitely prescribed steels.

§ 78.37-1 Compliance.
 (a) Required in all details.

§ 78.37-2 Type, size and service pressure.
 (a) Type and size. Seamless; not over 1,000 pounds water capacity (nominal).
 (b) Service pressure. At least 150 pounds per square inch.

§ 78.37-3 Inspection by whom and where.
 (a) By competent and disinterested inspector acceptable to the Bureau of Explosives; chemical analyses and tests, as

the "service pressure" limits the use of the cylinder. It is shown by marks on cylinder; for example, ICC-3AA2000 indicates the service pressure as 2,000 pounds per square inch.

other defects acceptable that is likely to weaken the finished cylinder appreciably; reasonably smooth and uniform surface finish required. If not originally free from such defects, the surface may be machined or otherwise treated to eliminate these defects. The thickness of the bottoms of cylinders welded or formed by spinning is, under no condition, to be less than two times the minimum wall thickness of the cylindrical shell; such bottom thicknesses to be measured within an area bounded by a line representing the points of contact between the cylinder and floor when the cylinder is in a vertical position.
 § 78.37-9 Welding or brazing.
 (a) Welding or brazing for any purpose whatsoever is prohibited except as follows:
 (1) Welding or brazing is authorized for the attachment of neckrings and footings which are non-pressure parts, and only to the tops and bottoms of cylinders having a service pressure of 500 pounds per square inch or less. Cylinders, neckrings, and footings must be made of weldable steel, carbon content of

which must not exceed 0.25 percent except in the case of 4130X steel which may be used with proper welding procedure.

(2) As permitted in § 78.37-8.

§ 78.37-10 Wall thickness.

(a) For cylinders with service pressure less than 900 pounds the wall stress shall not exceed 24,000 pounds per square inch. Minimum wall 0.100" for any cylinder over 5" outside diameter.

(b) For cylinders with service pressure of 900 p. s. i. or more the minimum wall shall be such that the wall stress at the minimum specified test pressure shall not exceed 67 percent of the minimum tensile strength of the steel as determined from the physical tests required in §§ 78.37-16 and 78.37-17 and shall be not over 70,000 p. s. i.

(c) Calculation must be made by the formula:

$$S = \frac{P(1.3D^2 + 0.4d^2)}{D^2 - d^2}$$

where

S=wall stress in pounds per square inch;
P=minimum test pressure prescribed for water jacket test of 450 pounds per square inch whichever is the greater;
D=outside diameter in inches;
d=inside diameter in inches.

§ 78.37-11 Heat treatment.

(a) The completed cylinders must be uniformly and properly heat treated prior to tests. Heat treatment of cylinders of the authorized analyses shall be as follows:

(1) All cylinders must be oil quenched except as noted in subparagraphs (5) and (7) of this paragraph.

(2) The steel temperature on quenching shall be that recommended for the steel analysis, but in no case shall exceed 1750° F.

(3) All steels shall be tempered at a temperature most suitable for that steel.

(4) The minimum tempering temperature shall be not less than 1000° F. except as noted in subparagraph (6) of this paragraph.

(5) Steel 4130X may be normalized at a temperature of 1650° F. instead of being quenched, and cylinders so normalized need not be tempered.

(6) Intermediate manganese steels may be tempered at temperatures not less than 1150° F., and after heat treating, each cylinder must be submitted to a magnetic test to detect the presence of quenching cracks. Cracked cylinders shall be rejected and destroyed.

(7) Steels coming under this specification may be quenched in molten salt bath maintained at a temperature not less than 375° F.

§ 78.37-12 Openings in cylinders and connections (valves, fuse plugs, etc.) for those openings.

(a) Threads required, to be clean cut, even, without checks, and to gauge.

(b) Taper threads, when used, to be of length not less than as specified for American Standard taper pipe threads.

(c) Straight threads having at least 6 engaged threads are authorized; to have tight fit and calculated shear strength at least 10 times the test pressure of the

cylinder; gaskets required, adequate to prevent leakage.

§ 78.37-13 Safety devices and protection for valves, safety devices, and other connections, if applied.

(a) Must be as required by the Interstate Commerce Commission's regulations that apply (see §§ 73.34(f) and 73.301(i) of this chapter).

§ 78.37-14 Hydrostatic test.

(a) By water-jacket, or other suitable method, operated so as to obtain accurate data. Pressure gauge must permit reading to accuracy of 1 percent. Expansion gauge must permit reading of total expansion to accuracy either of 1 percent or 0.1 cubic centimeter.

(b) Pressure must be maintained for 30 seconds and sufficiently longer to insure complete expansion. Any internal pressure applied after heat-treatment and previous to the official test must not exceed 90 percent of the test pressure. If, due to failure of the test apparatus, the test pressure cannot be maintained, the test may be repeated at a pressure increased by 10 percent or 100 pounds per square inch, whichever is the lower.

(c) Permanent volumetric expansion must not exceed 10 percent of total volumetric expansion at test pressure.

(d) Each cylinder must be tested to at least 5/3 times service pressure.

§ 78.37-15 Flattening test.

(a) Between knife edges, wedge shaped, 60° angle, rounded to 1/2" radius; test 1 cylinder¹ taken at random out of each lot of 200 or less, after hydrostatic test.

§ 78.37-16 Physical test.

(a) To determine yield strength, tensile strength, elongation, and reduction of area of material. Required on 2 specimens cut from 1¹ cylinder taken at random out of each lot of 200 or less.

(b) Specimens must be: Gauge length 8 inches with width not over 1 1/2 inches; or, gauge length 2 inches with width not over 1 1/2 inches: *Provided*, That gauge length at least 24 times thickness with width not over 6 times thickness is authorized when cylinder wall is not over 3/16 inch thick. The specimen, exclusive of grip ends, must not be flattened. Grip ends may be flattened to within one inch of each end of the reduced section. When size of cylinder does not permit securing straight specimens, the specimens may be taken in any location or direction and may be straightened or flattened cold, by pressure only, not by blows; when specimens are so taken and prepared, the inspector's report must show in connection with record of physical tests detailed information in regard to such specimens. Heating of specimen for any purpose is not authorized.

(c) The yield strength in tension shall be the stress corresponding to a perma-

¹ For lots of 30 or less, physical and flattening tests are authorized to be made on a ring at least 8 inches long cut from each cylinder and subjected to same heat treatment as the finished cylinder.

nent strain of 0.2 percent of the gauge length.

(1) The yield strength shall be determined by either the "offset" method or the "extension under load" method as prescribed in ASTM Standard E8-57T.

(2) In using the "extension under load" method, the total strain (or "extension under load") corresponding to the stress at which the 0.2 percent permanent strain occurs may be determined with sufficient accuracy by calculating the elastic extension of the gauge length under appropriate load and adding thereto 0.2 percent of the gauge length. Elastic extension calculations shall be based on an elastic modulus of 30,000,000. In the event of controversy, the entire stress-strain diagram shall be plotted and the yield strength determined from the 0.2 percent offset.

(3) For the purpose of strain measurement, the initial strain shall be set while the specimen is under a stress of 12,000 pounds per square inch, the strain indicator reading being set at the calculated corresponding strain.

(4) Cross-head speed of the testing machine shall not exceed 1/4 inch per minute during yield strength determination.

§ 78.37-17 Physical and flattening tests.

(a) Acceptable results for physical and flattening tests; elongation at least 20 percent for 2" gauge length or at least 10 percent in other cases; flattening required without cracking to 6 times wall thickness.

§ 78.37-18 Leakage test.

(a) All spun cylinders and plugged cylinders (See Notes 1 and 2) must be tested for leakage by gas or air pressure after the bottom has been cleaned and is free from all moisture. Pressure, approximately the same as but no less than service pressure, must be applied to one side of the finished bottom over an area of at least 1/16 of the total area of the bottom but not less than 3/4 inch in diameter, including the closure, for at least one minute, during which time the other side of the bottom exposed to pressure must be covered with water and closely examined for indications of leakage. Leakers must be rejected. (See Note 1 to § 78.37-19.)

NOTE 1: A spun cylinder is one in which an end closure in the finished cylinder has been welded by the spinning process.

NOTE 2: A plugged cylinder is one in which a permanent closure in the bottom of a finished cylinder has been effected by a plug.

NOTE 3: As a safety precaution, if the manufacturer elects to make this test before the hydrostatic test, he should design his apparatus so that the pressure is applied to the smallest area practicable, around the point of closure, and so as to use the smallest possible volume of air or gas.

§ 78.37-19 Rejected cylinders.

(a) Reheat treatment authorized; subsequent thereto, acceptable cylinders must pass all prescribed tests. Repair by welding or spinning is not authorized.

NOTE 1: Spun cylinders rejected under the provisions of § 78.37-18 may be removed from the spun cylinder category by drilling to re-

Numbered _____ to _____ inclusive, inches long
 Size _____ to _____ inches outside diameter by _____ Company
 Made by _____ For _____ Company

NOTE: Any omission of analyses by heat, if authorized, must be accounted for by notation hereon reading "The prescribed certificate of the manufacturer of material has been secured, found satisfactory, and placed on file," or by attaching a copy of the certificate.

Test No.	Heat No.	Check analysis No.	Cylinders represented (serial Nos.)	Chemical analysis													
				C	P	S	Si	Mn	Ni	Cr	Mo	Zr					

The analyses were made by _____ (Signed) _____
 _____ (Place) _____
 _____ (Date) _____

RECORD OF PHYSICAL TESTS OF MATERIAL FOR CYLINDERS

Numbered _____ to _____ inclusive, inches long
 Size _____ to _____ inches outside diameter by _____ Company
 Made by _____ For _____ Company

Test No.	Cylinders represented by test (serial Nos.)	Yield strength at 0.2 percent offset (pounds per square inch)	Tensile strength (pounds per square inch)	Elongation (percent in 8 inches)	Reduction of area (percent)	Flattening test

The analyses were made by _____ (Signed) _____
 _____ (Place) _____
 _____ (Date) _____

RECORD OF HYDROSTATIC TESTS ON CYLINDERS

Numbered _____ to _____ inclusive, inches long
 Size _____ to _____ inches outside diameter by _____ Company
 Made by _____ For _____ Company

Serial Nos. of cylinders tested arranged numerically	Actual test pressure (pounds per square inch)	Total expansion (cubic centimeters) ¹	Permanent expansion (cubic centimeters) ¹	Percent ratio of permanent expansion to total expansion ¹	Tare weight (pounds) ¹	Volumetric capacity

¹ If the tests are made by a method involving the measurement of the amount of liquid forced into the cylinder by the test pressure, then the basic data, on which the calculations are made, such as the pump factors, temperature of liquid, coefficient of compressibility of liquid, etc., must also be given.
² Do not include removable cap but state whether with or without valve. These weights must be accurate to a tolerance of 1 percent.

_____ (Signed) _____

Marks stamped into the shoulder of the cylinder are:
 Specification ICC _____ to _____ inclusive.
 Serial numbers _____ to _____ inclusive.
 Identifying symbol (registered) _____
 Test date _____
 Tare weights (yes or no) _____
 Other marks (if any) _____
 These cylinders were made by process of _____

The cylinders were heat treated by the process of _____
 The _____ (neckings—footings) per-
 mitted in § 78.37-9 were attached by process of _____
 (welding—brazing)
 The material used was identified by the following _____
 (heat-purchase order)

The material used was verified as to chemical analysis and record thereof is attached hereto. The heat numbers _____ (were—were not) marked on the material.

All material, such as plates, billets and seamless tubing, was inspected and each cylinder was inspected both before and after closing in the ends; all that was accepted was found free from seams, cracks, laminations, and other defects which might prove injurious to the strength of the cylinder. The processes of manufacture and heat treatment of cylinders were supervised and found to be efficient and satisfactory.

The cylinder walls were measured and the minimum thickness noted was _____ inch. The outside diameter was determined by a close approximation to be _____ inches. The wall stress was calculated to be _____ pounds per square inch under an internal pressure of _____ pounds per square inch.

Hydrostatic tests, flattening tests, tensile tests of material, and other tests, as prescribed in specification No. ICC-3AA were made in the presence of the inspector and all material and cylinders accepted were found to be in compliance with the requirements of that specification. Records thereof are attached hereto.

I hereby certify that all of these cylinders proved satisfactory in every way and comply with the requirements of Interstate Commerce Commission specification No. 3AA except as follows:
 Exceptions: _____

_____ (Signed) _____
 _____ Inspector.

move defective material, tapping and plugging.

§ 78.37-20 Marking.
 (a) Marking on each cylinder by stamping plainly and permanently on shoulder, top head, or neck as follows:
 (1) ICC-3AA followed by the service pressure (for example, ICC-3AA1800, etc.).

(2) A serial number and an identifying symbol (letters); location of number to be just below the ICC mark; location of symbol to be just below the number. The symbol and numbers must be those of purchaser, user or maker. The symbol must be registered with the Bureau of Explosives; duplications unauthorized.

(3) Inspector's official mark near serial number; date of test (such as 5-50 for May 1950, so placed that dates of subsequent tests can be easily added; and word "SPUN" or "PLUG" near ICC mark when an end closure in the finished cylinder has been welded by the spinning process, or effected by plugging.

§ 78.37-21 Size of marks.
 (a) At least 1/4" high if space permits.

§ 78.37-22 Inspector's report.
 (a) Required to be clear, legible, and in the following form:

(Place) _____
 (Date) _____
 Gas Cylinders
 Manufactured for _____ Company
 Location at _____
 Manufactured by _____ Company
 Location at _____
 Company _____
 Location at _____
 Company _____
 Location at _____
 Company _____
 Quantity _____
 Size _____ inches outside diameter
 by _____ inches long

¹ Lot numbers, not over 500 cylinders in each lot, authorized for cylinders not over 2 inches outside diameter and for cylinders over 2 inches outside diameter when the volumetric capacity does not exceed 60 cubic inches.
² Symbol in front of or following the number with ample space between is also authorized. Other variation in location authorized only when necessitated by lack of space.
 Example: ICC-3AA1800
 1234
 XX

§ 78.38 Specification 3B; seamless steel cylinders.

§ 78.38-1 Compliance.

(a) Required in all details.

§ 78.38-2 Type, size, and service pressure.

(a) *Type and size.* Seamless; not over 1,000 pounds water capacity (nominal).

(b) *Service pressure.*¹ At least 150 to not over 500 pounds per square inch.

§ 78.38-3 Inspection by whom and where.

(a) By competent inspector; chemical analyses and tests, as specified, to be made within limits of the United States. Interested inspectors are authorized.

§ 78.38-4 Duties of inspector.

(a) Inspect all material and reject any not complying with requirements; for cylinders made by billet-piercing process, billets to be inspected after nick and cold break.

(b) Verify chemical analysis of each heat of material by analysis or by obtaining certified analysis: *Provided*, That a certificate from the manufacturer thereof, giving sufficient data to indicate compliance with requirements, is acceptable when verified by check analyses of samples taken from one cylinder out of each lot of 200 or less.

(c) Verify compliance of cylinders with all requirements including markings; inspect inside before closing in both ends; verify heat treatment as proper; obtain samples for all tests and check chemical analyses; witness all tests; verify threads by gauge; report volumetric capacity and tare weight (see report form) and minimum thickness of wall noted.

(d) Render complete report (§ 78.38-22) to purchaser, cylinder maker, and the Bureau of Explosives.

§ 78.38-5 Steel.

(a) Open-hearth or electric steel of uniform quality. Content percent for the following not over: Carbon, 0.55; phosphorus, 0.045; sulphur, 0.050.

§ 78.38-6 Identification of material.

(a) Required; any suitable method except that plates and billets for hot-drawn cylinders shall be marked with heat number.

§ 78.38-7 Defects.

(a) Material with seams, racks, laminations, or other injurious defects, not authorized.

§ 78.38-8 Manufacture.

(a) By best appliances and methods; dirt and scale to be removed as necessary to afford proper inspection; no fissure or other defect acceptable that is likely to weaken the finished cylinder appreciably; reasonably smooth and uniform surface finish required. If not originally free from such defects, the surface may be machined or otherwise treated to eliminate these defects. The thickness

¹ The "service pressure" limits the use of the cylinder. It is shown by marks on cylinder; for example, ICC-3B300 indicates the service pressure as 300 pounds per square inch.

of the bottoms of cylinders welded or formed by spinning is, under no condition, to be less than two times the minimum wall thickness of the cylindrical shell; such bottom thicknesses to be measured within an area bounded by a line representing the points of contact between the cylinder and floor when the cylinder is in a vertical position.

§ 78.38-9 Welding or brazing.

(a) Welding or brazing for any purpose whatsoever is prohibited except as follows:

(1) Welding or brazing is authorized for the attachment of neckrings and footrings which are non-pressure parts, and only to the tops and bottoms of cylinders having a service pressure of 500 pounds per square inch or less. Cylinders, neckrings, and footrings must be made of weldable steel, carbon content of which must not exceed 0.25 percent except in the case of 4130X steel which may be used with proper welding procedure.

(2) As permitted in § 78.38-8.

§ 78.38-10 Wall thickness.

(a) The wall stress shall not exceed 24,000 pounds per square inch. Minimum wall 0.090" for any cylinder over 6" outside diameter.

(b) Calculation must be made by the formula:

$$S = \frac{P(1.3D^2 + 0.4d^2)}{D^2 - d^2}$$

where

S=wall stress in pounds per square inch;
P=minimum test pressure prescribed for water jacket test or 450 pounds per square inch whichever is the greater;
D=outside diameter in inches;
d=inside diameter in inches.

§ 78.38-11 Heat treatment.

(a) The completed cylinders must be uniformly and properly heat-treated prior to tests.

§ 78.38-12 Openings in cylinders and connections (valves, fuse plugs, etc.) for those openings.

(a) Threads required, to be clean cut, even, without checks, and to gauge.

(b) Taper threads when used, to be of length not less than as specified for American Standard taper pipe threads.

(c) Straight threads having at least 4 engaged threads are authorized; to have tight fit and calculated shear strength at least 10 times the test pressure of the cylinder; gaskets required, adequate to prevent leakage.

§ 78.38-13 Safety devices and protection for valves, safety devices, and other connections, if applied.

(a) Must be as required by the Interstate Commerce Commission's regulations that apply (see §§ 73.34 (f), 73.301 (i) and 73.124(a) of this chapter).

§ 78.38-14 Hydrostatic test.

(a) By water-jacket, or other suitable method, operated so as to obtain accurate data. Pressure gauge must permit reading to accuracy of 1 percent. Expansion gauge must permit reading of total expansion to accuracy either of 1 percent or 0.1 cubic centimeter.

(b) Pressure must be maintained for 30 seconds and sufficiently longer to in-

sure complete expansion. Any internal pressure applied after heat-treatment and previous to the official test must not exceed 90 percent of the test pressure. If, due to failure of the test apparatus, the test pressure cannot be maintained, the test may be repeated at a pressure increased by 10 percent or 100 pounds per square inch, whichever is the lower.

(c) Permanent volumetric expansion must not exceed 10 percent of total volumetric expansion at test pressure.

(d) Cylinders must be tested as follows:

(1) Each cylinder; to at least 2 times service pressure.

(2) Or, 1 cylinder out of each lot of 200 or less; to at least 3 times service pressure. Others must be examined under pressure of 2 times service pressure and show no defect.

§ 78.38-15 Flattening test.

(a) Between knife edges, wedge shaped, 60° angle, rounded to 1/2" radius; test 1 cylinder¹ taken at random out of each lot of 200 or less, after hydrostatic test.

§ 78.38-16 Physical test.

(a) To determine yield strength, tensile strength, elongation, and reduction of area of material. Required on 2 specimens cut from 1¹ cylinder taken at random out of each lot of 200 or less.

(b) Specimens must be: Gauge length 8 inches with width not over 1 1/2 inches; or, gauge length 2 inches with width not over 1 1/2 inches: *Provided*, That gauge length at least 24 times thickness with width not over 6 times thickness is authorized when cylinder wall is not over 3/16 inch thick. The specimen, exclusive of grip ends, must not be flattened. Grip ends may be flattened to within one inch of each end of the reduced section. When size of cylinder does not permit securing straight specimens, the specimens may be taken in any location or direction and may be straightened or flattened cold, by pressure only, not by blows; when specimens are so taken and prepared, the inspector's report must show in connection with record of physical tests detailed information in regard to such specimens. Heating of specimen for any purpose is not authorized.

(c) The yield strength in tension shall be the stress corresponding to a permanent strain of 0.2 percent of the gauge length.

(1) The yield strength shall be determined by either the "offset" method or the "extension under load" method as prescribed in ASTM Standard E8-57T.

(2) In using the "extension under load" method, the total strain (or "extension under load") corresponding to the stress at which the 0.2 percent permanent strain occurs may be determined with sufficient accuracy by calculating the elastic extension of the gauge length under appropriate load and adding thereto 0.2 percent of the gauge length. Elastic extension calculations shall be based on an elastic modulus of 30,000,000.

¹ For lots of 30 or less physical and flattening tests are authorized to be made on a ring at least 8 inches long cut from each cylinder and subjected to same heat treatment as the finished cylinder.

In the event of controversy, the entire stress-strain diagram shall be plotted and the yield strength determined from the 0.2 percent offset.

(3) For the purpose of strain measurement, the initial strain shall be set while the specimen is under a stress of 12,000 pounds per square inch, the strain indicator reading being set at the calculated corresponding strain.

(4) Cross-head speed of the testing machine shall not exceed 1/8 inch per minute during yield strength determination.

§ 78.38-17 Acceptable results for physical and flattening tests.

(a) Either of the following:

(1) Elongation at least 40 percent for 2-inch gauge length or at least 20 percent in other cases; yield strength not over 73 percent of tensile strength; flattening test not required.

(2) Elongation at least 20 percent for 2-inch gauge length or 10 percent in other cases; yield strength not over 73 percent of tensile strength; flattening required, without cracking, to 6 times wall thickness.

§ 78.38-18 Leakage test.

(a) All spun cylinders and plugged cylinders (see Notes 1 and 2) must be tested for leakage by gas or air pressure after the bottom has been cleaned and is free from all moisture. Pressure, approximately the same as but no less than service pressure, must be applied to one side of the finished bottom over an area of at least 1/16 of the total area of the bottom but not less than 3/4 inch in diameter, including the closure, for at least one minute, during which time the other side of the bottom exposed to pressure must be covered with water and closely examined for indications of leakage. Leakers must be rejected. (See Note 1 to § 78.38-19.)

NOTE 1: A spun cylinder is one in which an end closure in the finished cylinder has been welded by the spinning process.

NOTE 2: A spun cylinder is one in which a permanent closure in the bottom of a finished cylinder has been effected by a plug.

NOTE 3: As a safety precaution, if the manufacturer elects to make this test before the hydrostatic test, he should design his apparatus so that the pressure is applied to the smallest area practicable, around the point of closure, and so as to use the smallest possible volume of air or gas.

§ 78.38-19 Rejected cylinders.

(a) Reheat treatment authorized; subsequent thereto, acceptable cylinders must pass all prescribed tests. Repair by welding or spinning is not authorized.

NOTE 1: Spun cylinders rejected under the provisions of § 78.38-18 may be removed from

the spun cylinder category by drilling to remove defective material, tapping and plugging.

§ 78.38-20 Marking.

(a) Marking on each cylinder by stamping plainly and permanently on shoulder, top head, or neck as follows:

(1) ICC-3B followed by the service pressure (for example, ICC-3B300, etc.).

(2) A serial number and an identifying symbol (letters); location of number to be just below the ICC mark; location of symbol to be just below the number. The symbol and numbers must be those of purchaser, user, or maker. The symbol must be registered with the Bureau of Explosives; duplications unauthorized.

(3) Inspector's official mark near serial number; date of test (such as 5-50 for May 1950), so placed that dates of subsequent tests can be easily added; and word "SPUN" or "PLUG" near ICC mark when an end closure in the finished cylinder has been welded by the spinning process, or effected by plugging.

(b) Marking stamped into the side-walls of cylinders having a service pressure of 150 psi is permitted only if all of the following conditions are met:

(1) Wall stress at test pressure shall not exceed 24,000 psi.

(2) Minimum wall thickness shall be not less than 0.090".

(3) Depth of stamping shall be no greater than 15 percent of the minimum wall thickness, but at no time shall it exceed 0.015".

(4) Maximum outside diameter of cylinder shall not exceed 5".

(5) Carbon content of cylinder shall not exceed 0.25 percent. If the carbon content exceeds 0.25 percent, the complete cylinder must be normalized after stamping.

(6) Stamping shall be adjacent to top head.

§ 78.38-21 Size of marks.

(a) At least 1/4" high if space permits.

§ 78.38-22 Inspector's report.

(a) Required to be clear, legible, and in following form:

¹ Lot numbers, not over 500 cylinders in each lot, authorized for cylinders not over 2 inches outside diameter and for cylinders over 2 inches outside diameter when the volumetric capacity does not exceed 170 cubic inches.

² Symbol in front of or following the number with ample space between is also authorized. Other variation in location authorized only when necessitated by lack of space.

Example:

ICC-3B300
1234
XY

(Place) _____
(Date) _____

Gas cylinders

Manufactured for _____ Company

Location at _____

Manufactured by _____ Company

Location at _____

Consigned to _____ Company

Location at _____

Quantity _____

Size _____ inches outside diameter by _____ inches long.

Marks stamped into the shoulder of the cylinder are:

Specification ICC- _____

Serial numbers _____ to _____ inclusive.

Inspector's mark _____

Identifying symbol (registered) _____

Test date _____

Tare weights (yes or no) _____

Other marks (if any) _____

These cylinders were made by process of _____

_____ permitted

(neckrings—footrings)

in § 78.38-9 were attached by process of _____

(welding—brazing)

The material used was identified by the following _____ numbers

(heat-purchase order)

The material used was verified as to chemical analysis and record thereof is attached hereto. The heat numbers _____

(were—were not)

marked on the material.

All material, such as plates, billets and seamless tubing, was inspected and each cylinder was inspected both before and after closing in the ends; all that was accepted was found free from seams, cracks, laminations, and other defects which might prove injurious to the strength of the cylinder. The processes of manufacture and heat treatment of cylinders were supervised and found to be efficient and satisfactory.

The cylinder walls were measured and the minimum thickness noted was _____ inch. The outside diameter was determined by a close approximation to be _____ inches. The wall stress was calculated to be _____ pounds per square inch under an internal pressure of _____ pounds per square inch.

Hydrostatic tests, flattening tests, tensile tests of material, and other tests, as prescribed in specification No. ICC-3B were made in the presence of the inspector and all material and cylinders accepted were found to be in compliance with the requirements of that specification. Records thereof are attached hereto.

I hereby certify that all of these cylinders proved satisfactory in every way and comply with the requirements of Interstate Commerce Commission specification No. 3B except as follows:

Exceptions _____

(Signed) _____ Inspector

(Place).....
(Date).....

RECORD OF CHEMICAL ANALYSIS OF MATERIAL FOR CYLINDERS

Numbered.....to.....inclusive.
Size.....inches outside diameter by.....inches long
Made by.....Company
For.....Company

NOTE: Any omission of analyses by heats, if authorized, must be accounted for by notation hereon reading "The prescribed certificate of the manufacturer of material has been secured, found satisfactory, and placed on file," or by attaching a copy of the certificate.

Test No.	Heat No.	Check analysis No.	Cylinders represented (serial Nos.)	Chemical analysis						
				C	P	S	Si	Mn	Ni	Cr

The analyses were made by.....

(Signed).....

(Place).....
(Date).....

RECORD OF PHYSICAL TESTS OF MATERIAL FOR CYLINDERS

Numbered.....to.....inclusive.
Size.....inches outside diameter by.....inches long
Made by.....Company
For.....Company

Test No.	Cylinders represented by test (Serial Nos.)	Yield strength (pounds per square inch)	Tensile strength (pounds per square inch)	Elongation (percent in 8 inches)	Reduction of area (percent)	Flattening test

(Signed).....

(Place).....
(Date).....

RECORD OF HYDROSTATIC TESTS ON CYLINDERS

Numbered.....to.....inclusive.
Size.....inches outside diameter by.....inches long
Made by.....Company
For.....Company

Serial numbers of cylinders tested arranged numerically	Actual test pressure (pounds per square inch)	Total expansion (cubic centimeters) ¹	Permanent expansion (cubic centimeters) ¹	Percent ratio of permanent expansion to total expansion ¹	Tare weight (pounds) ¹	Volumetric capacity ¹

NOTE: When specifications require test for only 1 out of each lot of 200 or less cylinders, the check on the others must be indicated by a notation hereon reading, "Each cylinder was subjected to a pressure of.....pounds per square inch and showed no defect."

¹ If the tests are made by a method involving the measurement of the amount of liquid forced into the cylinder by the test pressure, then the basic data, on which the calculations are made, such as the pump factors, temperature of liquid, coefficient of compressibility of liquid, etc., must also be given.

² Do not include removable cap but state whether with or without valve. These weights must be accurate to a tolerance of 1 percent.

³ Report approximate maximum and minimum volumetric capacity for the lot.

(Signed).....

§ 78.39 Specification 3BN; seamless nickel cylinders.

§ 78.39-1 Compliance.

(a) Required in all details.

§ 78.39-2 Type, size and service pressure.

(a) Type and size. Seamless; not over 125 pounds water capacity (nominal).

(b) Service pressure.¹ At least 150 to not over 500 pounds per square inch.

¹ The "service pressure" limits the use of the cylinder. It is shown by marks on cylinder; for example, ICC-3BN400 indicates the service pressure as 400 pounds per square inch.

§ 78.39-3 Inspection by whom and where.

(a) By competent inspector; chemical analyses and tests, as specified, to be made within limits of the United States. Interested inspectors are authorized.

§ 78.39-4 Duties of inspector.

(a) Inspect all material and reject any not complying with requirements.

(b) Verify chemical analysis of each heat of material by analysis or by obtaining certified analysis: *Provided*, That a certificate from the manufacturer thereof, giving sufficient data to indicate compliance with requirements, is acceptable when verified by check analyses of sam-

ples taken from one cylinder out of each lot of 200 or less.

(c) Verify compliance of cylinders with all requirements including markings; inspect inside before closing in both ends; verify heat treatment as proper; obtain samples for all tests and check chemical analyses; witness all tests, verify threads by gauge; report volumetric capacity and tare weight (see report form) and minimum thickness of wall noted.

(d) Render complete report (§ 78.39-21) to purchaser, cylinder maker, and the Bureau of Explosives.

§ 78.39-5 Nickel.

(a) At least 99.0 percent pure nickel plus cobalt.

§ 78.39-6 Identification of material.

(a) Required; any suitable method except that plates and billets for hot-drawn cylinders shall be marked with heat number.

§ 78.39-7 Defects.

(a) Material with seams, cracks, laminations, or other injurious defects, not authorized.

§ 78.39-8 Manufacture.

(a) By best appliances and methods; dirt and scale to be removed as necessary to afford proper inspection; no defect acceptable that is likely to weaken the finished cylinder appreciably; reasonably smooth and uniform surface finish required. Cylinders closed in by spinning process not authorized.

§ 78.39-9 Welding or brazing.

(a) Welding or brazing for any purpose whatsoever is prohibited except that welding is authorized for the attachment of neckrings and footrings which are nonpressure parts, and only to the tops and bottoms of cylinders. Neckrings and footrings must be of weldable material, carbon content of which must not exceed 0.25 percent Nickel welding rod must be used.

§ 78.39-10 Wall thickness.

(a) The wall stress shall not exceed 15,000 pounds per square inch. Minimum wall 0.100" for any cylinder over 5" outside diameter.

(b) Calculation must be made by the formula:

$$S = \frac{P(1.3D^2 + 0.4d^2)}{D^2 - d^2}$$

where

S=wall stress in pounds per square inch;
P=minimum test pressure prescribed for water jacket test or 450 pounds per square inch whichever is the greater;
D=outside diameter in inches;
d=inside diameter in inches.

§ 78.39-11 Heat treatment.

(a) The completed cylinders must be uniformly and properly heat-treated prior to tests.

§ 78.39-12 Openings in cylinders and connections (valves, fuse plugs, etc.) for those openings.

(a) Threads required, to be clean cut, even, without checks, and to gauge.

(b) Taper threads, when used, to be of length not less than as specified for American Standard taper pipe threads.

(c) Straight threads having at least 6 engaged threads are authorized; to have tight fit and calculated shear strength at least 10 times the test pressure of the cylinder; gaskets required, adequate to prevent leakage.

§ 78.39-13 Safety devices and protection for valves, safety devices, and other connections, if applied.

(a) Must be as required by the Interstate Commerce Commission's regulations that apply (see §§ 73.34(f) and 73.301(i) of this chapter).

§ 78.39-14 Hydrostatic test.

(a) By water-jacket, or other suitable method, operated so as to obtain accurate data. Pressure gauge must permit reading to accuracy of 1 percent. Expansion gauge must permit reading of total expansion to accuracy either of 1 percent or 0.1 cubic centimeter.

(b) Pressure must be maintained for 30 seconds and sufficiently longer to insure complete expansion. Any internal pressure applied after heat-treatment and previous to the official test must not exceed 90 percent of the test pressure. If, due to failure of the test apparatus, the test pressure cannot be maintained, the test may be repeated at a pressure increased by 10 percent or 100 pounds per square inch, whichever is the lower.

(c) Permanent volumetric expansion must not exceed 10 percent of total volumetric expansion at test pressure.

(d) Each cylinder must be tested to at least 2 times service pressure.

§ 78.39-15 Flattening test.

(a) Between knife edges, wedge shaped, 60° angle, rounded to 1/2" radius; test 1 cylinder taken at random out of each lot of 200 or less, after hydrostatic test.

§ 78.39-16 Physical test.

(a) To determine yield strength, tensile strength, elongation, and reduction of area of material: Required on 2 specimens cut from 1 cylinder taken at random out of each lot of 200 or less.

(b) Specimens must be: Gauge length 8 inches with width not over 1 1/2 inches; or, gauge length 2 inches with width not over 1 1/2 inches: Provided, That gauge length at least 24 times thickness with width not over 6 times thickness is authorized when cylinder wall is not over 1/16 inch thick. The specimen, exclusive of grip ends, must not be flattened. Grip ends may be flattened to within one inch of each end of the reduced section. When size of cylinder does not permit securing straight specimens, the specimens may be taken in any location or direction and may be straightened or flattened cold, by pressure only, not by blows; when specimens are so taken and prepared, the inspector's report must show in connection with record of physical tests detailed information in regard

¹ For lots of 30 or less physical and flattening tests are authorized to be made on a ring at least 8 inches long cut from each cylinder and subjected to same heat treatment as the finished cylinder.

to such specimens. Heating of specimen for any purpose is not authorized.

(c) The yield strength in tension shall be the stress corresponding to a permanent strain of 0.2 percent of the gauge length.

(1) The yield strength shall be determined by either the "offset" method or the "extension under load" method as prescribed in ASTM Standard E8-57T.

(2) In using the "extension under load" method, the total strain (or "extension under load") corresponding to the stress at which the 0.2 percent permanent strain occurs may be determined with sufficient accuracy by calculating the elastic extension of the gauge length under appropriate load and adding thereto 0.2 percent of the gauge length. Elastic extension calculations shall be based on an elastic modulus of 30,000,000. In the event of controversy, the entire stress-strain diagram shall be plotted and the yield strength determined from the 0.2 percent offset.

(3) For the purpose of strain measurement, the initial strain shall be set while the specimen is under a stress of 12,000 pounds per square inch, the strain indicator reading being set at the calculated corresponding strain.

(4) Cross-head speed of the testing machine shall not exceed 1/8 inch per minute during yield strength determination.

§ 78.39-17 Acceptable results for physical and flattening tests.

(a) Either of the following:

(1) Elongation at least 40 percent for 2" gauge length or at least 20 percent in other cases; yield point not over 50 percent of tensile strength; flattening test not required.

(2) Elongation at least 20 percent for 2" gauge length or 10 percent in other cases; yield point not over 50 percent of tensile strength; flattening required, without cracking, to 6 times wall thickness.

§ 78.39-18 Rejected cylinders.

(a) Reheat treatment authorized; subsequent thereto, acceptable cylinders must pass all prescribed tests. Repair by welding not authorized.

§ 78.39-19 Marking.

(a) Marking on each cylinder by stamping plainly and permanently on shoulder, top head, or neck as follows:

(1) ICC-3BN followed by service pressure (for example ICC-3BN400, etc.).

(2) A serial number and an identifying symbol (letters); location of number to be just below the ICC mark; location of symbol to be just below the number. The symbol and numbers must be those of purchaser, user, or maker.

¹ Lot numbers, not over 500 cylinders in each lot, authorized for cylinders not over 2 inches outside diameter.

² Symbol in front of or following the number with ample space between is also authorized. Other variation in location authorized only when necessitated by lack of space.

Example:

ICC-3BN400
1234
XY

The symbol must be registered with the Bureau of Explosives; duplications unauthorized.

(3) Inspector's official mark, near serial number; date of test (such as 5-50 for May 1950), so placed that dates of subsequent tests can be easily added.

§ 78.39-20 Size of marks.

(a) At least 1/4" high if space permits.

§ 78.39-21 Inspector's report.

(a) Required to be clear, legible, and in following form:

(Place) _____
(Date) _____

Gas cylinders

Manufactured for _____ Company
Location at _____
Manufactured by _____ Company
Location at _____
Consigned to _____ Company
Location at _____
Quantity _____
Size _____ inches outside diameter by _____ inches long.
Marks stamped into the shoulder of the cylinder are:
Specification ICC-_____ inclusive.
Serial numbers _____ to _____ inclusive.
Inspector's mark _____
Identifying symbol (registered) _____
Test date _____
Tare weights (yes or no) _____
Other marks (if any) _____

These cylinders were made by process of _____

The _____ permitted in (neckrings—footrings)

§ 78.39-9 were attached by process of _____ (welding-brazing)

The material used was identified by the following _____ numbers (heat-purchase order)

The material used was verified as to chemical analysis and record thereof is attached hereto. The heat numbers _____ (were—were not) marked on the material.

All material, such as plates, billets and seamless tubing, was inspected and each cylinder was inspected both before and after closing in the ends; all that was accepted was found free from seams, cracks, laminations, and other defects which might prove injurious to the strength of the cylinder. The processes of manufacture and heat treatment of cylinders were supervised and found to be efficient and satisfactory.

The cylinder walls were measured and the minimum thickness noted was _____ inch. The outside diameter was determined by a close approximation to be _____ inches. The wall stress was calculated to be _____ pounds per square inch under an internal pressure of _____ pounds per square inch.

Hydrostatic tests, flattening tests, tensile tests of material, and other tests, as prescribed in specification No. ICC-3BN, were made in the presence of the inspector and all material and cylinders accepted were found to be in compliance with the requirements of that specification. Records thereof are attached hereto.

I hereby certify that all of these cylinders proved satisfactory in every way and comply with the requirements of Interstate Commerce Commission specification No. 3BN except as follows:

Exceptions _____

(Signed) _____
Inspector.

(Place) _____
(Date) _____

RECORD OF CHEMICAL ANALYSIS OF MATERIAL FOR CYLINDERS

Numbered _____ to _____ inclusive.
Size _____ inches outside diameter by _____ inches long
Made by _____ Company
For _____ Company

NOTE: Any omission of analyses by heats, if authorized, must be accounted for by notation hereon reading "The prescribed certificate of the manufacturer of material has been secured, found satisfactory, and placed on file," or by attaching a copy of the certificate.

Test No.	Heat No.	Check analysis No.	Cylinders represented (serial Nos.)	Chemical analysis						
				C	P	S	Si	Mn	Ni	Cr

The analyses were made by _____
(Signed) _____
(Place) _____
(Date) _____

RECORD OF PHYSICAL TESTS OF MATERIAL FOR CYLINDERS

Numbered _____ to _____ inclusive.
Size _____ inches outside diameter by _____ inches long
Made by _____ Company
For _____ Company

Test No.	Cylinders represented by test (Serial Nos.)	Yield strength (pounds per square inch)	Tensile strength (pounds per square inch)	Elongation (percent in 8 inches)	Reduction of area (percent)	Flattening test

(Signed) _____
(Place) _____
(Date) _____

RECORD OF HYDROSTATIC TESTS ON CYLINDERS

Numbered _____ to _____ inclusive.
Size _____ inches outside diameter by _____ inches long
Made by _____ Company
For _____ Company

Serial Nos. of cylinders tested, arranged numerically	Actual test pressure (pounds per square inch)	Total expansion (cubic centimeters) ¹	Permanent expansion (cubic centimeters) ¹	Percent ratio of permanent expansion to total expansion ¹	Tare weight (pounds) ²	Volumetric capacity

¹ If the tests are made by a method involving the measurement of the amount of liquid forced into the cylinder by the test pressure, then the basic data, on which the calculations are made, such as the pump factors, temperature of liquid, coefficient of compressibility of liquid, etc., must also be given.

² Do not include removable cap but state whether with or without valve. These weights must be accurate to a tolerance of 1 percent.

(Signed) _____

§ 78.40 Specification 3C; seamless steel cylinders.

§ 78.40-1 Compliance.

(a) Required in all details.

§ 78.40-2 Type, size, and service pressure.

(a) *Type and size.* Seamless; not over 1,000 pounds water capacity (nominal).

(b) *Service pressure.*¹ At least 90 to not over 300 pounds per square inch.

§ 78.40-3 Inspection by whom and where.

(a) By competent inspector; chemical analyses and tests, as specified, to be

¹ The "service pressure" limits the use of the cylinder. It is shown by marks on cylinder; for example, IOC-30300 indicates the service pressure as 300 pounds per square inch.

made within limits of the United States. Interested inspectors are authorized.

§ 78.40-4 Duties of inspector.

(a) Inspect all material and reject any not complying with requirements; for cylinders made by billet-piercing process, billets to be inspected after nick and cold break.

(b) Verify chemical analysis of each heat of material by analysis or by obtaining certified analysis: *Provided*, That a certificate from the manufacturer thereof, giving sufficient data to indicate compliance with requirements, is acceptable when verified by check analyses of samples taken from one cylinder out of each lot of 200 or less.

(c) Verify compliance of cylinders with all requirements including markings; inspect inside before closing in both ends; verify heat treatment as

proper; obtain samples for all tests and check chemical analyses; witness all tests; verify threads by gauge; report volumetric capacity and tare weight (see report form) and minimum thickness of wall noted.

(d) Render complete report (§ 78.40-22) to purchaser, cylinder maker, and the Bureau of Explosives.

§ 78.40-5 Steel.

(a) Open-hearth or electric steel of uniform quality. Content percent for the following not over: Carbon, 0.55; phosphorus, 0.045; sulphur, 0.050.

§ 78.40-6 Identification of material.

(a) Required; any suitable method except that plates and billets for hot-drawn cylinders shall be marked with heat number.

§ 78.40-7 Defects.

(a) Material with seams, cracks, laminations, or other injurious defects, not authorized.

§ 78.40-8 Manufacture.

(a) By best appliances and methods; dirt and scale to be removed as necessary to afford proper inspection; no fissure or other defect acceptable that is likely to weaken the finished cylinder appreciably; reasonably smooth and uniform surface finish required. If not originally free from such defects, the surface may be machined or otherwise treated to eliminate these defects. The thickness of the bottoms of cylinders welded or formed by spinning is, under no condition, to be less than two times the minimum wall thickness of the cylindrical shell; such bottom thickness to be measured within an area bounded by a line representing the points of contact between the cylinder and floor when the cylinder is in a vertical position.

§ 78.40-9 Welding or brazing.

(a) Welding or brazing for any purpose whatsoever is prohibited except as follows:

(1) Welding or brazing is authorized for the attachment of neckrings and footrings which are non-pressure parts, and only to the tops and bottoms of cylinders having a service pressure of 500 pounds per square inch or less. Cylinders, neckrings, and footrings must be made of weldable steel, carbon content of which must not exceed 0.25 percent except in the case of 4130X steel which may be used with proper welding procedure.

(2) As permitted in § 78.40-8.

§ 78.40-10 Wall thickness.

(a) The wall stress shall not exceed 24,000 pounds per square inch. Minimum wall 0.090" for any cylinder over 5" outside diameter.

(b) Calculation must be made by the formula:

$$S = \frac{P(1.3D^2 + 0.4d^2)}{D^2 - d^2}$$

where

- S=wall stress in pounds per square inch;
- P=minimum test pressure prescribed for water jacket test or 450 pounds per square inch whichever is the greater;
- D=outside diameter in inches;
- d=inside diameter in inches.

§ 78.40-11 Heat treatment.

(a) The completed cylinders must be uniformly and properly heat-treated prior to tests.

§ 78.40-12 Openings in cylinders and connections (valves, fuse plugs, etc.) for those openings.

(a) Threads required, to be clean cut, even, without checks, and to gauge.

(b) Taper threads, when used, to be of length not less than as specified for American Standard taper pipe threads.

(c) Straight threads having at least 6 engaged threads are authorized; to have tight fit and calculated shear strength at least 10 times the test pressure of the cylinder; gaskets required, adequate to prevent leakage.

§ 78.40-13 Safety advices and protection for valves, safety devices, and other connections, if applied.

(a) Must be as required by the Interstate Commerce Commission's regulations that apply (see §§ 73.34(f) and 73.301(d) of this chapter).

§ 78.40-14 Hydrostatic test.

(a) By water-jacket, or other suitable method, operated so as to obtain accurate data. Pressure gauge must permit reading to accuracy of 1 percent. Expansion gauge must permit reading of total expansion to accuracy either of 1 percent or 0.1 cubic centimeter.

(b) Pressure must be maintained for 30 seconds and sufficiently longer to insure complete expansion. Any internal pressure applied after heat-treatment and previous to the official test must not exceed 90 percent of the test pressure. If, due to failure of the test apparatus, the test pressure cannot be maintained, the test may be repeated at a pressure increased by 10 percent or 100 pounds per square inch, whichever is the lower.

(c) Permanent volumetric expansion must not exceed 10 percent of total volumetric expansion at test pressure.

(d) Cylinders must be tested as follows: 1 cylinder out of each lot of 200 or less; to at least 3 times service pressure. Others must be examined under pressure of 2 times service pressure and show no defect. If tested cylinder fails, each cylinder in the lot may be tested; those passing are acceptable.

§ 78.40-15 Flattening test.

(a) Between knife edges, wedge shaped, 60° angle, rounded to 1/2" radius; test 1 cylinder¹ taken at random out of each lot of 200 or less, after hydrostatic test.

§ 78.40-16 Physical test.

(a) To determine yield strength, tensile strength, elongation, and reduction of area of material. Required on 2 specimens cut from 1¹ cylinder taken at random out of each lot of 200 or less.

(b) Specimens must be gauge length 8 inches with width not over 1 1/2 inches; or, gauge length 2 inches with width not over 1 1/2 inches; Provided, That gauge

length at least 24 times thickness with width not over 6 times thickness is authorized when cylinder wall is not over 3/16 inch thick. The specimen, exclusive of grip ends, must not be flattened. Grip ends may be flattened to within one inch of each end of the reduced section. When size of cylinder does not permit securing straight specimens, the specimens may be taken in any location or direction and may be straightened or flattened cold, by pressure only, not by blows; when specimens are so taken and prepared, the inspector's report must show in connection with record of physical tests detailed information in regard to such specimens. Heating of specimen for any purpose is not authorized.

(c) The yield strength in tension shall be the stress corresponding to a permanent strain of 0.2 percent of the gauge length.

(1) The yield strength shall be determined by either the "offset" method or the "extension under load" method as prescribed in ASTM Standard E8-57T.

(2) In using the "extension under load" method, the total strain (or "extension under load") corresponding to the stress at which the 0.2 percent permanent strain occurs may be determined with sufficient accuracy by calculating the elastic extension of the gauge length under appropriate load and adding thereto 0.2 percent of the gauge length. Elastic extension calculations shall be based on an elastic modulus of 30,000,000. In the event of controversy, the entire stress-strain diagram shall be plotted and the yield strength determined from the 0.2 percent offset.

(3) For the purpose of strain measurement, the initial strain shall be set while the specimen is under a stress of 12,000 pounds per square inch, the strain indicator reading being set at the calculated corresponding strain.

(4) Cross-head speed of the testing machine shall not exceed 1/8 inch per minute during yield strength determination.

§ 78.40-17 Acceptable results for physical and flattening tests.

(a) Either of the following:

(1) Elongation at least 40 percent for 2 inch gauge length or at least 20 percent in other cases; yield strength not over 73 percent of tensile strength; flattening test not required.

(2) Elongation at least 20 percent for 2 inch gauge length or 10 percent in other cases; yield strength not over 73 percent of tensile strength; flattening required, without cracking, to 6 times wall thickness.

§ 78.40-18 Leakage test.

(a) All spun cylinders and plugged cylinders (see Notes 1 and 2) must be tested for leakage by gas or air pressure after the bottom has been cleaned and is free from all moisture. Pressure, approximately the same as but no less than service pressure, must be applied to one side of the finished bottom over an area of at least 1/8 of the total area of the bottom but not less than 3/4 inch in diameter, including the closure, for at least one minute, during which time the other side of the bottom exposed to pressure must be

covered with water and closely examined for indications of leakage. Leakers must be rejected. (See Note 1 § 78.40-19.)

NOTE 1: A spun cylinder is one in which an end closure in the finished cylinder has been welded by the spinning process.

NOTE 2: A plugged cylinder is one in which a permanent closure in the bottom of a finished cylinder has been effected by a plug.

NOTE 3: As a safety precaution, if the manufacturer elects to make this test before the hydrostatic test, he should design his apparatus so that the pressure is applied to the smallest area practicable, around the point of closure, and so as to use the smallest possible volume of air or gas.

§ 78.40-19 Rejected cylinders.

(a) Reheat treatment authorized; subsequent thereto, acceptable cylinders must pass all prescribed tests. Repair by welding or spinning is not authorized.

NOTE 1: Spun cylinders rejected under the provisions of § 78.40-18 may be removed from the spun cylinder category by drilling to remove defective material, tapping and plugging.

§ 78.40-20 Marking.

(a) Marking on each cylinder by stamping plainly and permanently on shoulder, top head, or neck as follows:

(1) ICC-3C followed by the service pressure (for example ICC-3C300, etc.).

(2) A serial¹ number and an identifying symbol (letters); location² of number to be just below the ICC mark; location³ of symbol to be just below the number. The symbol and numbers must be those of purchaser, user, or maker. The symbol must be registered with the Bureau of Explosives; duplications unauthorized.

(3) Inspector's official mark near serial number; date of test (such as 5-50 for May 1950), so placed that dates of subsequent tests can be easily added; and word "SPUN" or "PLUG" near ICC mark when an end closure in the finished cylinder has been welded by the spinning process, or effected by plugging.

§ 78.40-21 Size of marks.

(a) At least 1/4" high if space permits.

§ 78.40-22 Inspector's report.

(a) Required to be clear, legible, and in following form:

(Place) _____
 (Date) _____
 Gas cylinders
 Manufactured for _____ Company
 Location at _____
 Manufactured by _____ Company
 Location at _____
 Consigned to _____ Company
 Location at _____
 Quantity _____
 Size _____ inches outside diameter by _____

¹ Lot numbers, not over 500 cylinders in each lot, authorized for cylinders not over 2 inches outside diameter and for cylinders over 2 inches outside diameter when the volumetric capacity does not exceed 60 cubic inches.

² Symbol in front of or following the number with ample space between is also authorized. Other variation in location authorized only when necessitated by lack of space.

Example:
 ICC-3C300
 1234
 XY

¹ For lots of 30 or less physical and flattening tests are authorized to be made on a ring at least 8 inches long cut from each cylinder and subjected to same heat treatment as the finished cylinder.

The material used was verified as to chemical analysis and record thereof is attached hereto. The heat numbers _____ (were—were not) marked on the material.

All material, such as plates, billets and seamless tubing, was inspected and each cylinder was inspected both before and after closing in the ends; all that was accepted was found free from seams, cracks, laminations, and other defects which might prove injurious to the strength of the cylinder. The processes of manufacture and heat treatment of cylinders were supervised and found to be efficient and satisfactory.

The cylinder walls were measured and the minimum thickness noted was _____ inch. The outside diameter was determined by a close approximation to be _____ inches. The wall stress was calculated to be _____

pounds per square inch under an internal pressure of _____ pounds per square inch. Hydrostatic tests, flattening tests, tensile tests of material, and other tests, as prescribed in specification No. ICC-3C were made in the presence of the inspector and all material and cylinders accepted were found to be in compliance with the requirements of that specification. Records thereof are attached hereto.

I hereby certify that all of these cylinders proved satisfactory in every way and comply with the requirements of Interstate Commerce Commission specification No. 3C except as follows:

Exceptions: _____

 (Signed) _____
 Inspector.

(Place) _____
 (Date) _____

RECORD OF CHEMICAL ANALYSIS OF MATERIAL FOR CYLINDERS

Numbered _____ to _____ inclusive.
 Size _____ inches outside diameter by _____ inches long
 Made by _____ Company
 For _____ Company

NOTE: Any omission of analyses by heats, if authorized, must be accounted for by notation hereon reading "The prescribed certificate of the manufacturer of material has been secured, found satisfactory, and placed on file," or by attaching a copy of the certificate.

Test No.	Heat No.	Check analysis No.	Cylinders represented (serial Nos.)	Chemical analysis							
				C	P	S	Si	Mn	Ni	Cr	

The analyses were made by _____
 (Signed) _____
 (Place) _____
 (Date) _____

RECORD OF PHYSICAL TESTS OF MATERIAL FOR CYLINDERS

Numbered _____ to _____ inclusive.
 Size _____ inches outside diameter by _____ inches long
 Made by _____ Company
 For _____ Company

Test No.	Cylinders represented by test (Serial Nos.)	Yield strength (pounds per square inch)	Tensile strength (pounds per square inch)	Elongation (percent in 8 inches)	Reduction of area (percent)	Flattening test

(Signed) _____
 (Place) _____
 (Date) _____

RECORD OF HYDROSTATIC TESTS ON CYLINDERS

Numbered _____ to _____ inclusive.
 Size _____ inches outside diameter by _____ inches long
 Made by _____ Company
 For _____ Company

Serial numbers of cylinders tested arranged numerically	Actual test pressure (pounds per square inch)	Total expansion (cubic centimeters) ¹	Permanent expansion (cubic centimeters) ¹	Percent ratio of permanent expansion to total expansion ¹	Tare weight (pounds) ²	Volumetric capacity ³

NOTE: When specifications require test for only 1 out of each lot of 200 or less cylinders, the check on the others must be indicated by a notation hereon reading, "Each cylinder was subjected to a pressure of _____ pounds per square inch and showed no defect."

¹ If the tests are made by a method involving the measurement of the amount of liquid forced into the cylinder by the test pressure, then the basic data, on which the calculations are made, such as the pump factors, temperature of liquid, coefficient of compressibility of liquid, etc., must also be given.

² Do not include removable cap but state whether with or without valve. These weights must be accurate to a tolerance of 1 percent.

³ Report approximate maximum and minimum volumetric capacity for the lot.

(Signed) _____

§ 78.41 Specification 3D; seamless steel cylinders.

§ 78.41-1 Compliance.

(a) Required in all details.

§ 78.41-2 Type, size, and service pressure.

(a) *Type and size.* Seamless; not over 125 pounds water capacity (nominal); closing of bottom ends by spinning or swedging not authorized.

(b) *Service pressure.*¹ Must be 480 pounds per square inch.

§ 78.41-3 Inspection by whom and where.

(a) By competent and disinterested inspector acceptable to the Bureau of Explosives; chemical analyses and tests, as specified, to be made within limits of the United States.

§ 78.41-4 Duties of inspector.

(a) Inspect all material and reject any not complying with requirements; for cylinders made by billet-piercing process, billets to be inspected after nick and cold break.

(b) Verify chemical analysis of each heat of material by analysis or by obtaining certified analysis: *Provided*, That a certificate from the manufacturer thereof, giving sufficient data to indicate compliance with requirements, is acceptable when verified by check analyses of samples taken from one cylinder out of each lot of 200 or less.

(c) Verify compliance of cylinders with all requirements including markings; inspect inside before closing in both ends; verify heat treatment as proper; obtain samples for all tests and check chemical analyses; witness all tests; verify threads by gauge; report volumetric capacity and tare weight (see report form) and minimum thickness of wall noted. Inspection of valves and protection caps is required.

(d) Render complete report (§ 78.41-21) to purchaser, cylinder maker, and the Bureau of Explosives.

§ 78.41-5 Steel.

(a) Open-hearth or electric steel of uniform quality. Content percent for the following not over: Carbon, 0.55; phosphorus, 0.045; sulphur, 0.050.

§ 78.41-6 Identification of material.

(a) Required; any suitable method except that plates and billets for hot-drawn cylinders shall be marked with heat number.

§ 78.41-7 Defects.

(a) Material with seams, cracks, laminations, or other injurious defects, not authorized.

§ 78.41-8 Manufacture.

(a) By best appliances and methods; dirt and scale to be removed as necessary to afford proper inspection; no defect acceptable that is likely to weaken the finished cylinder appreciably; reasonably

¹ The "service pressure" limits the use of the cylinder. It is shown by marks on cylinder; for example, ICC-3D480 indicates the service pressure as 480 pounds per square inch.

smooth and uniform surface finish required.

(b) Extension ring: Top end of cylinder over 5" outside diameter must be fitted with section of tubing shrunk on, not welded to cylinder, and extending at least 4" below shoulder and above neck; thickness of ring as prescribed for cylinder wall; drain holes required.

(c) Valve and protection cap of metal substantially noncorrodible.

(d) Valve body and other parts subject to gas pressure when closed to be of forged, drawn, or extruded metal. Plug instead of valve is authorized.

(e) Protection cap must be at least 3/16" thick, gas tight, with 3/16" faced seat for gasket, and with United States standard form thread; it must not project beyond extension ring.

(f) Assembly of valves to cylinder: Selective method required so that at least 1 thread is left disengaged when screwed home. Efficient luting material required. Assembly by shippers is permitted without supervision by inspector.

§ 78.41-9 Welding or brazing.

(a) Welding or brazing is authorized, but only for the sealing of neckrings which must be threaded on the external neck of cylinders of not over 500 cubic inches capacity. Cylinders and neckrings must be weldable steel, the carbon content of which must not exceed 0.25 percent except that the use of 4130X steel is authorized. The weld free from moisture must be tested with gas or air at not less than 800 pounds per square inch.

§ 78.41-10 Wall thickness.

(a) The wall stress shall not exceed 16,000 pounds per square inch. Minimum wall 0.100" for any cylinder over 5" outside diameter.

(b) Calculation must be made by the formula:

$$s = \frac{P(1.3D^2 + 0.4d^2)}{D^2 - d^2}$$

where

- S=wall stress in pounds per square inch;
- P=800 pounds per square inch;
- D=outside diameter in inches;
- d=inside diameter in inches.

§ 78.41-11 Heat treatment.

(a) The completed cylinders must be uniformly and properly heat-treated prior to tests.

§ 78.41-12 Openings in cylinders and connections (valves, fuse plugs, etc.) for those openings.

(a) Threads required to be clean cut, even, without checks, and to gauge.

(b) Taper threads, when used, to be of length not less than as specified for American Standard taper pipe threads.

§ 78.41-13 Safety devices and protection for valves, safety devices, and other connections, if applied.

(a) Must be as required by the Interstate Commerce Commission's regulations that apply (see §§ 73.34(f) and 73.301(i) of this chapter).

§ 78.41-14 Hydrostatic test.

(a) By water-jacket, or other suitable method, operated so as to obtain accurate data. Pressure gauge must permit reading to accuracy of 1 percent. Expansion gauge must permit reading of total expansion to accuracy either of 1 percent or 0.1 cubic centimeter.

(b) Pressure must be maintained for 30 seconds and sufficiently longer to insure complete expansion. Any internal pressure applied after heat-treatment and previous to the official test must not exceed 90 percent of the test pressure. If, due to failure of the test apparatus, the test pressure cannot be maintained, the test may be repeated at a pressure increased by 10 percent or 100 pounds per square inch, whichever is the lower.

(c) Permanent volumetric expansion must not exceed 10 percent of total volumetric expansion at test pressure.

(d) Each cylinder must be tested to at least 5/3 times service pressure.

§ 78.41-15 Flattening test.

(a) Between knife edges, wedge shaped, 60° angle, rounded to 1/2" radius; test 1 cylinder¹ taken at random out of each lot of 200 or less, after hydrostatic test.

§ 78.41-16 Physical test.

(a) To determine yield strength, tensile strength, elongation, and reduction of area of material. Required on 2 specimens cut from 1¹ cylinder taken at random out of each lot of 200 or less.

(b) Specimens must be: Gauge length 8 inches with width not over 1 1/2 inches; or, gauge length 2 inches with width not over 1 1/2 inches; provided, that gauge length at least 24 times thickness with width not over 6 times thickness is authorized when cylinder wall is not over 3/16 inch thick. The specimen, exclusive of grip ends, must not be flattened. Grip ends may be flattened to within one inch of each end of the reduced section. When size of cylinder does not permit securing straight specimens, the specimens may be taken in any location or direction and may be straightened or flattened cold, by pressure only, not by blows; when specimens are so taken and prepared, the inspector's report must show in connection with record of physical tests detailed information in regard to such specimens. Heating of specimen for any purpose is not authorized.

(c) The yield strength in tension shall be the stress corresponding to a permanent strain of 0.2 percent of the gauge length.

(1) The yield strength shall be determined by either the "offset" method or the "extension under load" method as prescribed in ASTM Standard E8-57T.

(2) In using the "extension under load" method, the total strain (or "ex-

¹ For lots of 30 or less, physical and flattening tests are authorized to be made on a ring at least 8 inches long cut from each cylinder and subjected to same heat treatment as the finished cylinder.

tension under load") corresponding to the stress at which the 0.2 percent permanent strain occurs may be determined with sufficient accuracy by calculating the elastic extension of the gauge length under appropriate load and adding thereto 0.2 percent of the gauge length. Elastic extension calculations shall be based on an elastic modulus of 30,000,000. In the event of controversy, the entire stress-strain diagram shall be plotted and the yield strength determined from the 0.2 percent offset.

(3) For the purpose of strain measurement, the initial strain shall be set while the specimen is under a stress of 12,000 pounds per square inch, the strain indicator reading being set at the calculated corresponding strain.

(4) Cross-head speed of the testing machine shall not exceed 1/8 inch per minute during yield strength determination.

§ 78.41-17 Acceptable results for physical and flattening tests.

(a) Either of the following:

(1) Elongation at least 40 percent for 2 inch gauge length or at least 20 percent in other cases; yield strength not over 73 percent of tensile strength; flattening test not required.

(2) Elongation at least 20 percent for 2 inch gauge length or 10 percent in other cases; yield strength not over 73 percent of tensile strength; flattening test is required, without cracking, to 4 times wall thickness.

§ 78.41-18 Rejected cylinders.

(a) Reheat treatment authorized; subsequent thereto, acceptable cylinders must pass all prescribed tests. Repair by welding is not authorized.

§ 78.41-19 Marking.

(a) Marking on each cylinder by stamping plainly and permanently on shoulder, top head, or neck, and also on extension ring, as follows:

(1) ICC-3D480.

(2) A serial¹ number and an identifying symbol (letters); location² of number to be just below the ICC mark; location³ of symbol to be just below the number. The symbol and numbers must be those of purchaser, user, or maker. The symbol must be registered with the Bureau of Explosives; duplications unauthorized.

(3) Inspector's official mark near serial number; date of test (such as 5-50 for May 1950), so placed that dates of subsequent tests can be easily added.

§ 78.41-20 Size of marks.

(a) At least 1/4" high if space permits.

¹ Lot numbers, not over 500 cylinders in each lot, authorized for cylinders not over 2 inches outside diameter.

² Symbol in front of or following the number with ample space between is also authorized. Other variation in location authorized only when necessitated by lack of space.

Example:

ICC-3D480
1234
XY

§ 78.41-21 Inspector's report.

(a) Required to be clear, legible, and in following form:

(Place) (Date)
Gas cylinders
Company
Location at
Manufactured by
Location at
Consigned to
Location at
Quantity
inches outside diameter by
inches long
Marks stamped into the shoulder of the cylinder are:
Specification ICC-
Serial numbers to
inclusive.
Inspector's mark
Identifying symbol (registered)
Test date
Tare weights (Yes or no)
Other marks (if any)
These cylinders were made by process of
The neckings
permitted in
§ 78.41-9 were attached by process of
(welding—brazing)
The material used was identified by the following
numbers
(heat-purchase order)

The material used was verified as to chemical analysis and record thereof is attached hereto. The heat numbers (were—were not) marked on the material.

All material, such as plates, billets and seamless tubing, was inspected and each cylinder was inspected both before and after closing in the ends; all that was accepted was found free from seams, cracks, laminations, and other defects which might prove injurious to the strength of the cylinder. The processes of manufacture and heat treatment of cylinders were supervised and found to be efficient and satisfactory.

The cylinder walls were measured and the minimum thickness noted was inch. The outside diameter was determined by a close approximation to be inches. The wall stress was calculated to be pounds per square inch under an internal pressure of pounds per square inch.

Hydrostatic tests, flattening tests, tensile tests of material, and other tests, as prescribed in specification No. ICC-3D were made in the presence of the inspector and all material and cylinders accepted were found to be in compliance with the requirements of that specification. Records thereof are attached hereto.

I hereby certify that all of these cylinders proved satisfactory in every way and comply with the requirements of Interstate Commerce Commission specification No. 3D except as follows:
Exceptions:
(Signed) Inspector.

RECORD OF CHEMICAL ANALYSIS OF MATERIAL FOR CYLINDERS

Numbered to inclusive. inches long
Size Made by inches outside diameter by Company
For

NOTE: Any omission of analyses by heats, if authorized, must be accounted for by notation hereon reading, "The prescribed certificate of the manufacturer of material has been secured, found satisfactory, and placed on file, or by attaching a copy of the certificate."

Table with columns: Test No., Heat No., Check analysis No., Cylinders represented (serial Nos.), Chemical analysis (C, P, S, Si, Mn, Ni, Or), and a signature line.

RECORD OF PHYSICAL TESTS OF MATERIAL FOR CYLINDERS

Numbered to inclusive. inches long
Size Made by inches outside diameter by Company
For

Table with columns: Test No., Cylinders represented by test (Serial Nos.), Yield strength (pounds per square inch), Tensile strength (pounds per square inch), Elongation (percent in 8 inches), Reduction of area (percent), and Flattening test.

RECORD OF HYDROSTATIC TESTS ON CYLINDERS

Numbered to inclusive. inches long
Size Made by inches outside diameter by Company
For

Table with columns: Serial Nos. of cylinders arranged numerically, Actual test pressure (pounds per square inch), Total expansion (cubic centimeters), Permanent expansion (cubic centimeters), Percent ratio of permanent expansion to total expansion, Tare weight (pounds), and Volumetric capacity.

If the tests are made by a method involving the measurement of the amount of liquid forced into the cylinder by the test pressure, then the basic data, on which the calculations are made, such as the pump factors, temperature of liquid, coefficient of compressibility of liquid, etc., must also be given.
Do not include removable cap but state whether with or without valve. These weights must be accurate to a tolerance of 1 percent.

§ 78.42 Specification 3E; seamless steel § 78.42-3 Inspection by whom and cylinders where.

§ 78.42-1 Compliance. (a) By competent inspector; chemical analyses and tests, as specified, to be made within limits of the United States. Interested inspectors are authorized.

§ 78.42-2 Type, size, and service pressure. (a) Type and size. Seamless. Must have outside diameter not greater than 2 inches nominal, length less than 2 feet. (b) Service pressure. Must be 1,800 pounds per square inch.

§ 78.42-4 Duties of inspector. (a) Inspect all material and reject any not complying with requirements; for cylinders made by billet-piercing process, billets to be inspected after nick and cold break. (b) Verify chemical analysis of each heat of steel by analysis or by obtaining certified analysis: Provided, That check analysis of samples taken from one cylinder out of each lot of 200 or less is acceptable.

(c) Verify compliance of cylinders with all requirements including markings; inspect inside before closing in both ends; verify heat treatment as proper; obtain samples for all tests and check chemical analyses; witness all tests; verify threads by gauge; report volumetric capacity and tare weight (see report form) and minimum thickness of wall noted.

(d) Render complete report (§ 78.42-15) to purchaser, cylinder maker, and the Bureau of Explosives.

§ 78.42-5 Steel.

(a) Open-hearth or electric steel of uniform quality. Content percent for the following not over: Carbon, 0.55; phosphorus, 0.045; sulphur, 0.050.

§ 78.42-6 Identification of steel.

(a) Required; any suitable method.

§ 78.42-7 Defects.

(a) Material with seams, cracks, laminations, or other injurious defects, not authorized.

§ 78.42-8 Manufacture.

(a) By best appliances and methods; dirt and scale to be removed as necessary to afford proper inspection; no defect acceptable that is likely to weaken the finished cylinder appreciably; reasonably smooth and uniform surface finish required. The thickness of the spun bottom is, under no condition, to be less than two times the minimum wall thickness of the cylindrical shell; such bottom thickness to be measured within an area bounded by a line representing the points of contact between the cylinder and floor when the cylinder is in a vertical position.

§ 78.42-9 Openings in cylinders and connections (valves, fuse plugs, etc.) for those openings.

(a) Threads required, to be clean cut, even, without checks, and to gauge.

(b) Taper threads, when used, to be of length not less than as specified for American Standard taper pipe threads.

(c) Straight threads having at least 4 engaged threads are authorized; to have tight fit and calculated shear strength at least 10 times the test pressure of the cylinder; gaskets required, adequate to prevent leakage.

§ 78.42-10 Safety devices and protection for valves, safety devices, and other connections, if applied.

(a) Must be as required by the Interstate Commerce Commission's regulations that apply (see §§ 73.34(f) and 73.301(i) of this chapter).

§ 78.42-11 Hydrostatic test.

(a) Cylinders must be tested as follows:

(1) One cylinder out of each lot of 500 or less to be subjected to hydrostatic pressure of 6,000 pounds per square inch or higher.

(2) The cylinder referred to in subparagraph (1) of this paragraph shall burst at a pressure higher than 6,000 pounds per square inch without frag-

menting or otherwise showing lack of ductility, or shall hold a pressure of 12,000 pounds per square inch for 30 seconds without bursting, in which case it shall be subjected to a flattening test without cracking to six times wall thickness between knife edges, wedge shaped, 60 degree angle, rounded out to 1/2 inch radius.

NOTE 1: Inspector's report shall be suitably changed to show results of latter alternate and flattening test.

(3) Other cylinders must be examined under pressure of at least 3,000 pounds per square inch and not to exceed 3,600 pounds per square inch and show no defect. The pressure must be maintained for at least 30 seconds and sufficiently longer to insure complete examination.

§ 78.42-12 Leakage test.

(a) All spun cylinders and plugged cylinders (See Notes 1 and 2) must be tested for leakage by gas or air pressure after the bottom has been cleaned and is free from all moisture. Pressure, approximately the same as but no less than service pressure, must be applied to one side of the finished bottom over an area of at least 1/16 of the total area of the bottom but not less than 3/4 inch in diameter, including the closure, for at least one minute, during which time the other side of the bottom exposed to pressure must be covered with water and closely examined for indications of leakage. Leakers must be rejected. (See Note 1 to § 78.42-13.)

NOTE 1: A spun cylinder is one in which an end closure in the finished cylinder has been welded by the spinning process.

NOTE 2: A plugged cylinder is one in which a permanent closure in the bottom of a finished cylinder has been effected by a plug.

NOTE 3: As a safety precaution, if the manufacturer elects to make this test before the hydrostatic test, he should design his apparatus so that the pressure is applied to the smallest area practicable, around the point of closure, and so as to use the smallest possible volume of air or gas.

§ 78.42-13 Rejected cylinders.

(a) Reheat treatment authorized; subsequent thereto, acceptable cylinders must pass all prescribed tests. Repair by welding or spinning is not authorized.

NOTE 1: Spun cylinders rejected under the provisions of § 78.42-12 may be removed from the spun cylinder category by drilling to remove defective material, tapping and plugging.

§ 78.42-14 Marking.

(a) Marking on each cylinder by stamping plainly and permanently as follows:

(1) ICC-3E1800.

(2) An identifying symbol (letters); location to be just following or below the ICC mark. The symbol must be that of purchaser, user or maker. The symbol must be registered with the Bureau of Explosives; duplications unauthorized.

Example:

ICC-3E1800
XY

(3) Date of test (such as 5-50 for May 1950).

§ 78.42-15 Inspector's report.

(a) Required to be clear, legible, and in following form:

(Place) _____
(Date) _____

Steel gas cylinders

Manufactured for _____ Company
Location at _____
Manufactured by _____ Company
Location at _____
Consigned to _____ Company
Location at _____
Quantity _____
Size _____ inches outside diameter by _____ inches long

Marks stamped into the shoulder of the cylinder are:

Specification ICC-3E1800
Serial numbers to _____ inclusive (if numbered).
Identifying symbol (registered) _____
Test date _____

These cylinders were made by process of _____

The steel used was identified by the following _____ numbers. _____ (heat-purchase order)

The steel used was verified as to chemical analysis and record thereof is attached hereto.

All material, such as plates, billets, and seamless tubing, was inspected and each cylinder was inspected both before and after closing in the ends; all that was accepted was found free from seams, cracks, laminations, and other defects which might prove injurious to the strength of the cylinder. The processes of manufacture and heat treatment were supervised and found to be efficient and satisfactory.

The cylinder walls were measured and the minimum thickness noted was _____ inch. The tare weight per cylinder without valve is _____ (approx.). The volumetric capacity per cylinder is _____ (approx.).

Each and every cylinder was properly tapped with a taper thread; the threads were inspected and found to be clean-cut, of proper length, and correct as to gauge.

One finished cylinder out of each lot of 500 or less was taken at random and burst by interior pressure with the following results:

Date of test	Pressure at which cylinder ruptured

Each and every cylinder with bottom closed in by spinning was subjected to an interior gas pressure of at least 1,800 pounds per square inch and showed no leakage.

Each and every cylinder was subjected to an interior pressure of at least 3,000 pounds per square inch and showed no defect.

I hereby certify that all of these cylinders proved satisfactory in every way and comply with the requirements of Interstate Commerce Commission specification No. 3E except as follows:

Exceptions _____

(Signed) _____
(Inspector)

(Place).....
(Date).....

RECORD OF CHEMICAL ANALYSIS OF STEEL FOR CYLINDERS

Number to inclusive.
Size inches outside diameter by inches long
Made by Company
For Company

Test No.	Heat No.	Check analysis No.	Cylinders represented Serial Nos.	Chemical analysis						
				C	P	S	Si	Mn	Ni	Cr

The analyses were made by
(Signed).....
(Place).....
(Date).....

RECORD OF PHYSICAL TESTS OF MATERIAL FOR CYLINDERS

Numbered to inclusive.
Size inches outside diameter by inches long
Made by Company
For Company

Test No.	Cylinders represented by test (serial Nos.)	Yield strength (pounds per square inch)	Tensile strength (pounds per square inch)	Elongation (percent in 8 inches)	Reduction of area (percent)	Flattening test

(Signed).....
(Place).....
(Date).....

RECORD OF HYDROSTATIC TESTS ON CYLINDERS

Numbered to inclusive.
Size inches outside diameter by inches long
Made by Company
For Company

Serial numbers of cylinders tested arranged numerically	Actual test pressure (pounds per square inch)	Total expansion (cubic centimeters) ¹	Permanent expansion (cubic centimeters) ¹	Percent ratio of permanent expansion to total expansion ¹	Tare weight (pounds) ²	Volumetric capacity

NOTE: When specifications require test for only 1 out of each lot of 200 or less cylinders, the check on the others must be indicated by a notation hereon reading, "Each cylinder was subjected to a pressure of pounds per square inch and showed no defect."

¹ If the tests are made by a method involving the measurement of the amount of liquid forced into the cylinder by the test pressure, then the basic data, on which the calculations are made, such as the pump factors, temperature of liquid, coefficient of compressibility of liquid, etc., must also be given.
² Do not include removable cap but state whether with or without valve. These weights must be accurate to a tolerance of 1 percent.

(Signed).....

§ 78.43 Specification 3A480X; seamless steel cylinders.

§ 78.43-1 Compliance.

(a) Required in all details.

§ 78.43-2 Type, size, and service pressure.

(a) *Type and size.* Seamless, having not more than 278 pounds nominal water capacity.

(b) *Service pressure.*¹ 480 pounds per square inch.

§ 78.43-3 Inspection by whom and where.

(a) By competent and disinterested inspector acceptable to the Bureau of

¹ The "service pressure" limits the use of the cylinder. It is shown by marks on cylinder; for example, ICC-3A480X indicates the service pressure as 480 pounds per square inch.

Explosives; chemical analyses and tests, as specified, to be made within limits of the United States.

§ 78.43-4 Duties of inspector.

(a) Inspect all material and reject any not complying with requirements; for cylinders made by billet-piercing process, billets to be inspected after nick and cold break.

(b) Verify chemical analysis of each heat of material by analysis or by obtaining certified analysis: *Provided*, That a certificate from the manufacturer thereof, giving sufficient data to indicate compliance with requirements, is acceptable when verified by check analyses of samples taken from one cylinder out of each lot of 200 or less.

(c) Verify compliance of cylinders with all requirements including markings; inspect inside before closing in both ends; verify heat treatment as

proper; obtain samples for all tests and check chemical analyses; witness all tests; verify threads by gauge; report volumetric capacity and tare weight (see report form) and minimum thickness of wall noted.

(d) Render complete report (§ 78.43-22) to purchaser, cylinder maker, and the Bureau of Explosives.

§ 78.43-5 Steel.

(a) Open-hearth or electric steel of uniform quality. Content percent for the following not over: carbon, 0.40; phosphorus, 0.045; sulphur, 0.050.

§ 78.43-6 Identification of material.

(a) Required; any suitable method except that plates and billets for hot-drawn cylinders shall be marked with heat number.

§ 78.43-7 Defects.

(a) Material with seams, cracks, laminations, or other injurious defects, not authorized.

§ 78.43-8 Manufacture.

(a) By best appliances and methods; dirt and scale to be removed as necessary to afford proper inspection; no fissure or other defect acceptable that is likely to weaken the finished cylinder appreciably; reasonably smooth and uniform surface finish required. If not originally free from such defects, the surface may be machined or otherwise treated to eliminate these defects. The thickness of the bottoms of cylinders welded or formed by spinning is, under no condition, to be less than two times the minimum wall thickness of the cylindrical shell; such bottom thicknesses to be measured within an area bounded by a line representing the points of contact between the cylinder and floor when the cylinder is in a vertical position.

§ 78.43-9 Neckrings and footings.

(a) Welding for any purpose whatever is prohibited except as follows:

(1) Welding is authorized for the attachment of neckrings and footings which are nonpressure parts, and only to the tops and bottoms. Cylinders, neckrings, and footings must be made of weldable steel, carbon content of which must not exceed 0.25 percent.

(2) As permitted in § 78.43-8.

NOTE 1: Cylinders used solely in anhydrous ammonia service may have a 1/2 inch diameter bar welded within their concave bottoms in accordance with the foregoing requirements.

§ 78.43-10 Wall thickness.

(a) Minimum wall 0.100" for any cylinder over 5" outside diameter. Wall stress shall not exceed 40,000 pounds per square inch.

(b) Calculation must be made by the formula:

$$S = \frac{P(1.3D^3 + 0.4d^3)}{D^3 - d^3}$$

where
S=wall stress in pounds per square inch;
P=800 pounds per square inch;
D=Outside diameter in inches.
d=inside diameter in inches.

§ 78.43-11 Heat treatment.

(a) The completed cylinders must be uniformly and properly heat-treated prior to tests.

§ 78.43-12 Openings in cylinders and connections (valves, fuse plugs, etc.) for those openings.

(a) Threads required, to be clean cut, even, without checks, and to gauge.

(b) Taper threads, when used, to be of length not less than as specified for American Standard taper pipe threads.

(c) Straight threads having at least 6 engaged threads are authorized; to have tight fit and calculated shear strength at least 10 times the test pressure of the cylinder; gaskets required, adequate to prevent leakage.

§ 78.43-13 Safety devices and protection for valves, safety devices, and other connections, if applied.

(a) Devices must be as required by the Interstate Commerce Commission's regulations that apply (see §§ 73.34(f) and 73.301(i) of this chapter).

§ 78.43-14 Hydrostatic test.

(a) By water-jacket, or other suitable method, operated so as to obtain accurate data. Pressure gauge must permit reading to accuracy of 1 percent. Expansion gauge must permit reading of total expansion to accuracy either of 1 percent or 0.1 cubic centimeter.

(b) Pressure must be maintained for 30 seconds and sufficiently longer to insure complete expansion. Any internal pressure applied after heat-treatment and previous to the official test must not exceed 90 percent of the test pressure. If, due to failure of the test apparatus, the test pressure cannot be maintained, the test may be repeated at a pressure increased by 10 percent or 100 pounds per square inch, whichever is the lower.

(c) Permanent volumetric expansion must not exceed 10 percent of total volumetric expansion at test pressure.

(d) Each cylinder must be tested to at least 5/3 times service pressure.

§ 78.43-15 Flattening test.

(a) Between knife edges, wedge shaped, 60° angle, rounded to 1/2" radius; test 1 cylinder¹ taken at random out of each lot of 200 or less, after hydrostatic test.

§ 78.43-16 Physical test.

(a) To determine yield strength, tensile strength, elongation, and reduction of area of material. Required on 2 specimens cut from 1¹ cylinder taken at random out of each lot of 200 or less.

(b) Specimens must be: Gauge length 8 inches with width not over 1 1/2 inches; or, gauge length 2 inches with width not over 1 1/2 inches: *Provided*, That gauge length at least 24 times thickness with width not over 6 times thickness is authorized when cylinder wall is not over 3/16 inch thick. The specimen, exclusive of grip ends, must not be flattened. Grip ends may be flattened to within one inch

of each end of the reduced section. When size of cylinder does not permit securing straight specimens, the specimens may be taken in any location or direction and may be straightened or flattened cold, by pressure only, not by blows; when specimens are so taken and prepared, the inspector's report must show in connection with record of physical tests detailed information in regard to such specimens. Heating of specimen for any purpose is not authorized.

(c) The yield strength in tension shall be the stress corresponding to a permanent strain of 0.2 percent of the gauge length.

(1) The yield strength shall be determined by either the "offset" method or the "extension under load" method as prescribed in ASTM Standard E8-57T.

(2) In using the "extension under load" method, the total strain (or "extension under load") corresponding to the stress at which the 0.2 percent permanent strain occurs may be determined with sufficient accuracy by calculating the elastic extension of the gauge length under appropriate load and adding thereto 0.2 percent of the gauge length. Elastic extension calculations shall be based on an elastic modulus of 30,000,000. In the event of controversy, the entire stress-strain diagram shall be plotted and the yield strength determined from the 0.2 percent offset.

(3) For the purpose of strain measurement, the initial strain shall be set while the specimen is under a stress of 12,000 pounds per square inch, the strain indicator reading being set at the calculated corresponding strain.

(4) Cross-head speed of the testing machine shall not exceed 1/8 inch per minute during yield strength determination.

§ 78.43-17 Acceptable results for physical and flattening tests.

(a) Either of the following:

(1) Elongation at least 40 percent for 2 inch gauge length or at least 20 percent in other cases; yield strength not over 73 percent of tensile strength; flattening test not required.

(2) Elongation at least 20 percent for 2 inch gauge length or 10 percent in other cases; yield strength not over 73 percent of tensile strength; flattening required, without cracking, to 6 times wall thickness.

§ 78.43-18 Leakage test.

(a) All spun cylinders and plugged cylinders (see Notes 1 and 2) must be tested for leakage by gas or air pressure after the bottom has been cleaned and is free from all moisture. Pressure, approximately the same as but no less than service pressure, must be applied to one side of the finished bottom over an area of at least 1/16 of the total area of the bottom but not less than 3/4 inch in diameter, including the closure, for at least one minute, during which time the other side of the bottom exposed to pressure must be covered with water and closely examined for indications of leakage. Leakers must be rejected. (See Note 1 to § 78.43-19.)

NOTE 1: A spun cylinder is one in which an end closure in the finished cylinder has been welded by the spinning process.

NOTE 2: A plugged cylinder is one in which a permanent closure in the bottom of a finished cylinder has been effected by a plug.

NOTE 3: As a safety precaution, if the manufacturer elects to make this test before the hydrostatic test, he should design his apparatus so that the pressure is applied to the smallest area practicable, around the point of closure, and so as to use the smallest possible volume of air or gas.

§ 78.43-19 Rejected cylinders.

(a) Reheat treatment authorized; subsequent thereto, acceptable cylinders must pass all prescribed tests. Repair by welding or spinning is not authorized.

NOTE 1: Spun cylinders rejected under the provisions of § 78.43-18 may be removed from the spun cylinder category by drilling to remove defective material, tapping and plugging.

§ 78.43-20 Marking.

(a) Marking on each cylinder by stamping plainly and permanently on shoulder, top head, or neck as follows:

(1) ICC-3A480X.

(2) A serial number and an identifying symbol (letters); location¹ of number to be just below the ICC mark; location¹ of symbol to be just below the number. The symbol and numbers must be those of purchaser, user, or maker. The symbol must be registered with the Bureau of Explosives; duplications unauthorized.

(3) Inspector's official mark near serial number; date of test (such as 5-50 for May 1950), so placed that dates of subsequent tests can be easily added; and word "SPUN" or "PLUG" near ICC mark when an end closure in the finished cylinder has been welded by the spinning process, or effected by plugging.

§ 78.43-21 Size of marks.

(a) At least 1/4 inch high if space permits.

§ 78.43-22 Inspector's report.

(a) Required to be clear, legible, and in following form:

(Place) _____
(Date) _____

Gas cylinders

Manufactured for _____ Company
Location at _____
Manufactured by _____ Company
Location at _____
Consigned to _____ Company
Location at _____
Quantity _____
Size _____ inches outside diameter by _____ inches long.

Marks stamped into the shoulder of the cylinder are:

Specification ICC- _____
Serial numbers _____ to _____ inclusive.
Inspector's mark _____
Identifying symbol (registered) _____
Test date _____
Tare weights (yes or no) _____
Other marks (if any) _____
These cylinders were made by process of _____

¹ Symbol in front of or following the number with ample space between is also authorized. Other variation in location authorized only when necessitated by lack of space.

Example:

ICC-3A480X
1234
XY

¹ For lots of 30 or less, physical and flattening tests are authorized to be made on a ring at least 8 inches long cut from each cylinder and subjected to same heat treatment as the finished cylinder.

The footings ----- welded
 (were—were not)
 as permitted in § 78.43-9.
 The material used was identified by the
 following ----- numbers
 (heat-purchase order)

The material used was verified as to chemical
 analysis and record thereof is attached
 hereto. The heat numbers -----
 (were—were not)
 marked on the material.

All material, such as plates, billets and
 seamless tubing, was inspected and each
 cylinder was inspected both before and after
 closing in the ends; all that was accepted
 was found free from seams, cracks, lamina-
 tions, and other defects which might prove
 injurious to the strength of the cylinder.
 The processes of manufacture and heat treat-
 ment of cylinders were supervised and found
 to be efficient and satisfactory.

The cylinder walls were measured and the
 minimum thickness noted was ----- inch.

The outside diameter was determined by a
 close approximation to be ----- inches.
 The wall stress was calculated to be -----
 pounds per square inch under an internal
 pressure of ----- pounds per square inch.

Hydrostatic tests, flattening tests, tensile
 tests of material, and other tests, as pre-
 scribed in specification No. ICC-3A480X were
 made in the presence of the inspector and all
 material and cylinders accepted were found
 to be in compliance with the requirements
 of that specification. Records thereof are
 attached hereto.

I hereby certify that all of these cylinders
 proved satisfactory in every way and comply
 with the requirements of Interstate Com-
 merce Commission specification No. 3A480X
 except as follows:

Exceptions: -----

 (Signed) -----
 Inspector.

(Place) -----
 (Date) -----

RECORD OF CHEMICAL ANALYSIS OF MATERIAL FOR CYLINDERS

Numbered ----- to ----- inclusive.
 Size ----- inches outside diameter by ----- inches long
 Made by ----- Company
 For ----- Company
 NOTE: Any omission of analyses by heats, if authorized, must be accounted for by notation hereon reading "The prescribed certificate of the manufacturer of material has been secured, found satisfactory, and placed on file," or by attaching a copy of the certificate.

Test No.	Heat No.	Check analysis No.	Cylinders represented (serial Nos.)	Chemical analysis						
				C	P	S	Si	Mn	Ni	Cr

The analyses were made by -----
 (Signed) -----
 (Place) -----
 (Date) -----

RECORD OF PHYSICAL TESTS OF MATERIAL FOR CYLINDERS

Numbered ----- to ----- inclusive.
 Size ----- inches outside diameter by ----- inches long
 Made by ----- Company
 For ----- Company

Test No.	Cylinders represented by test (Serial Nos.)	Yield strength (pounds per square inch)	Tensile strength (pounds per square inch)	Elongation (percent in 8 inches)	Reduction of area (percent)	Flattening test

(Signed) -----
 (Place) -----
 (Date) -----

RECORD OF HYDROSTATIC TESTS ON CYLINDERS

Numbered ----- to ----- inclusive.
 Size ----- inches outside diameter by ----- inches long
 Made by ----- Company
 For ----- Company

Serial Nos. of cylinders tested arranged numerically	Actual test pressure (pounds per square inch)	Total expansion (cubic centimeters) ¹	Permanent expansion (cubic centimeters) ¹	Percent ratio of permanent expansion to total expansion ¹	Tare weight (pounds) ²	Volumetric capacity

¹ If the tests are made by a method involving the measurement of the amount of liquid forced into the cylinder by the test pressure, then the basic data, on which the calculations are made, such as the pump factors, temperature of liquid, coefficient of compressibility of liquid, etc., must also be given.
² Do not include removable cap but state whether with or without valve. These weights must be accurate to a tolerance of 1 percent.

(Signed) -----

§ 78.44 Specification 3HT; inside con-
 tainers, seamless steel cylinders for
 aircraft use made of definitely pre-
 scribed steel.

§ 78.44-1 Compliance.

(a) Required in all details.

§ 78.44-2 Type, size and service pressure.

(a) Type and size. Seamless; not
 over 150 pounds water capacity (nom-
 inal).

(b) Service pressure.¹ At least 900
 pounds per square inch.

§ 78.44-3 Inspection by whom and where.

(a) By competent and disinterested
 inspector acceptable to the Bureau of Ex-
 plosives; chemical analyses and tests, as
 specified, to be made within limits of the
 United States.

§ 78.44-4 Duties of inspector.

(a) Inspect all material and reject any
 not complying with requirements; for
 cylinders made by billet-piercing process,
 billets to be inspected after nick and
 cold break.

(b) Verify chemical analysis of each
 heat of material by analysis or by obtain-
 ing certified analysis: Provided, That a
 certificate from the manufacturer
 thereof, giving sufficient data to indicate
 compliance with requirements, is accept-
 able when verified by check analyses of
 samples taken from one cylinder out of
 each lot of 200 or less.

(c) Verify compliance of cylinders
 with all requirements including mark-
 ings; inspect inside before closing in both
 ends; verify heat treatment as proper;
 obtain samples for all tests and check
 chemical analyses; witness all tests; ver-
 ify threads by gauge; report volumetric
 capacity and tare weight (see report
 form) and minimum thickness of wall
 noted.

(d) Render complete report (§ 78.44-
 25) to purchaser, cylinder maker, and
 the Bureau of Explosives.

§ 78.44-5 Authorized steel.

(a) Open hearth or electric furnace
 steel of uniform quality. Steel of the
 following chemical analysis is authorized
 (see notes 1 and 2):

Designation	AISI 4130 (percent)
Carbon	0.28/0.33.
Manganese	0.40/0.60.
Phosphorus	0.040 maximum.
Sulfur	0.040 maximum.
Silicon	0.20/0.35.
Chromium	0.80/1.10.
Molybdenum	0.15/0.25.

NOTE 1: A heat of steel made under the
 above specification, check chemical analysis
 of which is slightly out of the specified range,
 is acceptable, if satisfactory in all other re-
 spects, provided the tolerances published by
 the American Iron and Steel Institute in
 Table 6-4 of "Supplementary Information
 July 1958, Alloy Steel: Semifinished; Hot
 Rolled and Cold Finished Bars, July 1955," are
 not exceeded, or provided the variation in
 chemical analysis is approved by the Bureau
 of Explosives.

¹ The "service pressure" limits the use of
 the cylinder. It is shown by marks on cylin-
 der; for example, ICC-3HT2000 indicates the
 service pressure as 2,000 pounds per square
 inch.

NOTE 2: Grain size 6 or finer according to ASTM Spec. E19-46.

§ 78.44-6 Identification of material.

(a) Required; any suitable method. Steel stamping of heat identifications shall not be made in any area which will eventually become the side wall of the cylinder. Depth of stamping shall not encroach upon the minimum prescribed wall thickness of the cylinder.

§ 78.44-7 Defects.

(a) Material with seams, cracks, laminations, severe inclusions, numerous or severe draw marks, or any other injurious defect not authorized.

§ 78.44-8 Manufacture.

(a) By best appliances and methods; dirt and scale to be removed as necessary to afford proper inspection; no fissure or other defect acceptable that is likely to weaken the finished container appreciably; the general surface finish shall not exceed a roughness of 250 RMS. Individual irregularities such as draw marks, scratches, pits, etc., should be held to a minimum consistent with good high stress pressure vessel manufacturing practices. If the cylinder is not originally free of such defects or does not meet the finish requirements, the surface may be machined or otherwise treated to eliminate these defects. The point of closure of cylinders closed by spinning is not to be less than two times the prescribed wall thickness of the cylindrical shell. Cylinder end contour shall be hemispherical or ellipsoidal with a ratio of major to minor axis not exceeding two to one and with concave side to pressure.

§ 78.44-9 Welding or brazing.

(a) Welding or brazing for any purpose whatsoever is prohibited except as follows:

(1) Welding by spinning is permitted to close the bottom of spun cylinders. Machining or grinding to produce proper surface finish at point of closure is required.

§ 78.44-10 Wall thickness.

(a) Minimum wall thickness for any cylinder shall be 0.050 inch.

(b) Minimum wall thickness shall be such that the wall stress at the minimum specified test pressure shall not exceed 75 percent of the minimum tensile strength of the steel as determined from the physical tests required in § 78.44-18 and shall not be over 105,000 psi.

(c) Calculations must be made by the formula:

$$S = \frac{P(1.3D^2 + 0.4d^2)}{D^2 - d^2}$$

where

P = wall stress in pounds per square inch;

D = minimum test pressure prescribed for water jacket test;

d = outside diameter in inches;

S = inside diameter in inches.

(d) Wall thickness of hemispherical bottoms only permitted to 90 percent of minimum wall thickness of cylinder side-wall but shall not be less than 0.050 inch. In all other cases, thickness to be no less than prescribed minimum wall.

§ 78.44-11 Heat treatment.

(a) The completed cylinders must be uniformly and properly heated prior to tests. Heat treatment of the cylinders of the authorized analysis shall be as follows:

(1) All cylinders must be oil quenched except as noted in subparagraph 4 of this paragraph.

(2) The steel temperature on quenching shall be that recommended for the steel analysis, but in no case shall it exceed 1750° F.

(3) The steel shall be tempered at a temperature most suitable for the particular steel analysis but not less than 850° F.

(4) Quenching in a molten salt bath maintained at a temperature of not less than 375° F. is permitted.

§ 78.44-12 Openings in cylinders and connections (valves, fuse plugs, etc.) for those openings.

(a) Threads required to be clean cut, even, without cracks, and to gauge.

(b) Taper threads, when used, to be of length not less than as specified for National Gas Tapered Thread (NGT) as required by American Standard Compressed Gas Cylinder Valve Outlet and Inlet Connections.¹

(c) Straight threads having at least 6 engaged threads are authorized; to have tight fit and a calculated shear stress of at least 10 times the test pressure of the cylinder; gaskets required, adequate to prevent leakage.

§ 78.44-13 Safety devices and protection for valves, safety devices, and other connections, if applied.

(a) Must be as required by the Interstate Commerce Commission's regulations that apply (see §§ 73.34(f) and 73.301(i) of this chapter).

§ 78.44-14 Hydrostatic test.

(a) By water-jacket, or other suitable method, operated so as to obtain accurate data. Pressure gauge must permit reading to accuracy of 1 percent. Expansion gauge must permit reading of total expansion to accuracy either of 1 percent or 0.1 cubic centimeter.

(b) Pressure must be maintained for 30 seconds and sufficiently longer to insure complete expansion. Any internal pressure applied after heat treatment and previous to the official test must not exceed 90 percent of the test pressure. If, due to failure of the test apparatus, the test pressure cannot be maintained, the test may be repeated at a pressure increased by 10 percent or 100 pounds per square inch, whichever is the lower.

(c) Permanent volumetric expansion must not exceed 10 percent of total volumetric expansion at test pressure.

(d) Each cylinder must be tested to at least 5/3 times service pressure.

§ 78.44-15 Cycling tests.

(a) Prior to the initial shipment of any specific cylinder design, cyclic pres-

surization tests shall have been performed on at least three representative samples without failure as follows:

(1) Pressurization shall be performed hydrostatically between approximately zero psig and the service pressure at a rate not in excess of 10 cycles per minute. Adequate recording instrumentation shall be provided if equipment is to be left unattended for periods of time.

(b) Tests prescribed in paragraph (a)(1) of this section shall be repeated on one random sample out of each lot of cylinders. Cylinder may then be subjected to burst test.

(c) A lot is defined as a group of cylinders fabricated from the same heat of steel, manufactured by the same process and heat treated in the same equipment under the same conditions of time, temperature, and atmosphere, and shall not exceed a quantity of 200 cylinders.

(d) All cylinders used in cycling tests must be destroyed.

§ 78.44-16 Burst test.

(a) One cylinder taken at random out of each lot of cylinders shall be hydrostatically tested to destruction.

§ 78.44-17 Flattening test.

(a) Between knife edges, wedge shaped, 60° angle, rounded to 1/2 inch radius, test one cylinder taken at random out of each lot of cylinders after hydrostatic test. Axis of cylinder must be at 90° angle to knife edges.

§ 78.44-18 Physical tests.

(a) To determine yield strength, tensile strength, elongation, and reduction of area of material. Required on 2 specimens cut from 1 cylinder taken at random out of each lot of cylinders.

(b) Specimens must be: Gauge length at least 24 times thickness with width not over six times thickness. The specimens, exclusive of grip ends, must not be flattened. Grip ends may be flattened to within one inch of each end of the reduced section. When size of cylinder does not permit securing straight specimens, the specimens may be taken in any location or direction and may be straightened or flattened cold, by pressure only, not by blows; when specimens are so taken and prepared, the inspector's report must show in connection with record of physical tests detailed information in regard to such specimens. Heating of specimen for any purpose is not authorized.

(c) The yield strength in tension shall be the stress corresponding to a permanent strain of 0.2 percent of the gauge length.

(1) The yield strength shall be determined by either the "offset" method or the "extension under load" method as prescribed in ASTM Standard E8-57T.

(2) In using the "extension under load" method, the total strain (or "extension under load") corresponding to the stress at which the 0.2 percent permanent strain occurs may be determined with sufficient accuracy by calculating the elastic extension of the gauge length under appropriate load and adding thereto 0.2 percent of the gauge length. Elastic extension calculations shall be based on an elastic modulus of 30,000,000.

¹ Available for a nominal charge from the American Standards Association, 70 East 45th Street, New York 17, New York and the Compressed Gas Association, Inc., 500 Fifth Avenue, New York 36, New York.

In the event of controversy, the entire stress-strain diagram shall be plotted and the yield strength determined from the 0.2 percent offset.

(3) For the purpose of strain measurement, the initial strain shall be set while the specimen is under a stress of 12,000 pounds per square inch, the strain indicator reading being set at the calculated corresponding strain.

(4) Cross-head speed of the testing machine shall not exceed 1/8 inch per minute during yield strength determination.

§ 78.44-19 Magnetic particle inspection.

(a) Inspection shall be performed on inside of container before closing and externally on the finished container after heat treatment. Evidence of discontinuities, which in the opinion of a qualified inspector may appreciably weaken or decrease the durability of the cylinder, shall be cause for rejection.

§ 78.44-20 Leakage test.

(a) All spun cylinders and plugged cylinders (see Notes 1 and 2) must be tested for leakage by dry gas or dry air pressure after the bottom has been cleaned and is free from all moisture. Pressure, approximately the same as but no less than service pressure, must be applied to one side of the finished bottom over an area of at least 1/16 of the total area of the bottom but not less than 3/4 inch in diameter, including the closure, for at least one minute, during which time the other side of the bottom exposed to pressure must be covered with water and closely examined for indications of leakage. Leakers must be rejected (see Notes 1, 2, and 3 and § 78.44-22).

NOTE 1: A spun cylinder is one in which an end closure in the finished cylinder has been welded by the spinning process.

NOTE 2: A plugged cylinder is one in which a permanent closure in the bottom of a finished cylinder has been effected by a plug.

NOTE 3: As a safety precaution, if the manufacturer elects to make this test before the hydrostatic test, he should design his apparatus so that the pressure is applied to the smallest area practicable, around the point of closure, and so as to use the smallest possible volume of air or gas.

§ 78.44-21 Acceptable results of tests.

(a) Flattening required without cracking to ten times the wall thickness of the cylinder.

(b) Physical tests:

(1) Elongation at least 6 percent in gauge length of 24 times wall thickness.

(2) Tensile strength shall not exceed 160,000 pounds per square inch.

(c) Burst pressure shall be at least 4/3 times the test pressure.

(d) Cycling—at least 10,000 pressurizations.

§ 78.44-22 Rejected cylinders.

(a) Reheat treatment authorized; subsequent thereto, acceptable cylinders must pass all prescribed tests. Repair by welding or spinning is not authorized.

§ 78.44-23 Marking.

(a) Cylinders shall be marked by low stress type steel stamping in an area and to a depth which will insure that the wall thickness measured from the root of the stamping to the interior surface is equal to or greater than the minimum prescribed wall thickness. Stamping must be permanent and legible. Stamping on side wall not authorized. The following markings shall appear:

(1) ICC-3HT followed by the service pressure (for example, ICC-3HT1800, etc.).

(2) A serial number and an identifying symbol (letters); location¹ of number to be just below the ICC mark; location of symbol to be just below the number. The symbol and numbers must be those of purchaser, user, or maker. The symbol must be registered with the Bureau of Explosives; duplications unauthorized.

(3) Inspector's official mark near serial number; date of test such as 5-59 for May 1959, so placed that dates of subsequent tests can be easily added; and word "SPUN" or "PLUG" near ICC mark when an end closure in the finished cylinder has been welded by the spinning process, or affected by plugging.

(4) Elastic expansion in cubic centimeters to the nearest 1 percent near the date of test.

§ 78.44-24 Name plates.

(a) Authorized, provided that they can be permanently and securely attached to the cylinder. Attachment by either brazing or welding is not permitted. Attachment by soldering is permitted provided steel temperature does not exceed 500° F.

§ 78.44-25 Inspector's report.

(a) Required to be clear, legible, and in the following form:

(Place) -----
(Date) -----

Gas Cylinders

Manufactured for ----- Company
Location at -----
Manufactured by ----- Company
Location at -----

¹ Symbol in front of or following the number with ample space between is also authorized. Other variation in location authorized only when necessitated by lack of space.

Example: ICC-3HT1800

1234
XY

Consigned to ----- Company
Location at -----
Quantity -----
Size ----- inches outside
diameter by ----- inches long
Marks stamped into the shoulder of the cylinder are:

Specification ICC -----
Serial numbers ----- to ----- inclusive
Inspector's mark -----
Identifying symbol (registered) -----

Test date -----
Tare weights (yes or no) -----
Other marks (if any) -----
These cylinders were made by process of -----

The cylinders were heat treated by the process of -----
The material used was identified by the following -----

(Heat-purchase order)

numbers -----
The material used was verified as to chemical analysis and record thereof is attached hereto. The heat numbers ----- marked on the material. (were—were not)

All material, such as plates, billets and seamless tubing, was inspected and each cylinder was inspected both before and after closing in the ends; all that was accepted was found free from seams, cracks, laminations, and other defects which might prove injurious to the strength of the cylinder. The processes of manufacture and heat treatment of cylinders were supervised and found to be efficient and satisfactory.

The cylinder walls were measured and the minimum thickness noted was ----- inch. The outside diameter was determined by a close approximation to be ----- inches. The wall stress was calculated to be ----- pounds per square inch under an internal pressure of ----- pounds per square inch.

Hydrostatic tests, flattening tests, tensile tests of material, and other tests, as prescribed in specification No. ICC-3HT were made in the presence of the inspector and all material and cylinders accepted were found to be in compliance with the requirements of that specification. Records thereof are attached hereto.

I hereby certify that all of these cylinders proved satisfactory in every way and comply with the requirements of Interstate Commerce Commission specification No. 3HT except as follows:

Exceptions: -----

(Signed) -----
(Inspector)

(Place) -----
(Date) -----

RECORD OF CHEMICAL ANALYSIS OF MATERIAL FOR CYLINDERS

Numbered ----- to ----- inclusive
Size ----- inches outside
diameter by ----- inches long
Made by ----- Company
For ----- Company

NOTE: Any omission of analyses by heats, if authorized, must be accounted for by notation hereon reading "The prescribed certificate of the manufacturer of material has been secured, found satisfactory, and placed on file," or by attaching a copy of the certificate.

Test No.	Heat No.	Check analysis No.	Cylinders represented (Serial Nos.)	Chemical analysis								
				C	P	S	Si	Mn	Ni	Cr	Mo	Zr

The analyses were made by _____
 (Signed) _____
 (Place) _____
 (Date) _____

RECORD OF PHYSICAL TESTS OF MATERIAL FOR CYLINDERS

Numbered _____ to _____ inclusive.
 Size _____ inches outside diameter by _____ inches long.
 Made by _____ Company
 For _____ Company

Test No.	Cylinders represented by test (Serial Nos.)	Yield strength at 0.2 percent offset (pounds per square inch)	Tensile strength (pounds per square inch)	Elongation (percent in 8 inches)	Reduction of area (percent)	Flattening test

(Signed) _____
 (Place) _____
 (Date) _____

RECORD OF HYDROSTATIC TESTS ON CYLINDERS

Numbered _____ to _____ inclusive.
 Size _____ inches outside diameter by _____ inches long.
 Made by _____ Company
 For _____ Company

Serial Nos. of cylinders tested arranged numerically	Actual test pressure (pounds per square inch)	Total expansion (cubic centimeters) ¹	Permanent expansion (cubic centimeters) ¹	Percent ratio of permanent expansion to total expansion ¹	Tare weight (pounds) ²	Volumetric capacity

¹ If the tests are made by a method involving the measurement of the amount of liquid forced into the cylinder by the test pressure, then the basic data, on which the calculations are made, such as the pump factors, temperature of liquid, coefficient of compressibility of liquid, etc., must also be given.

² Do not include removable cap but state whether with or without valve. These weights must be accurate to a tolerance of 1 percent.

(Signed) _____

§ 78.47 Specification 4DS; inside containers, welded stainless steel for aircraft use.

§ 78.47-1 Compliance.

(a) Required in all details.

§ 78.47-2 Type, size and service pressure.

(a) Type and size, welded stainless steel spheres (two seamless hemispheres) or circumferentially welded cylinders not over 100 pounds water capacity.

(b) Service pressure.¹ At least 500 to not over 900 pounds per square inch.

§ 78.47-3 Inspection by whom and where.

(a) By competent and disinterested inspector acceptable to the Bureau of Explosives; chemical analyses and tests, as specified, to be made within the limits of the United States.

§ 78.47-4 Duties of inspector.

(a) Inspect all material and reject any not complying with requirements.

¹ The "service pressure" limits the use of the container. It is shown by marks on container; for example ICC-4DS500 indicates the service pressure as 500 pounds per square inch.

(b) Verify chemical analysis of each heat of material by analysis or by obtaining certified analysis; provided, that a certificate from the manufacturer thereof, giving sufficient data to indicate compliance with requirements, is acceptable when verified by check analyses of samples taken from one container out of each lot of 200 or less.

(c) Verify compliance of containers with all requirements including markings; inspect inside before closing; verify heat treatment and welding procedure as proper; obtain samples for all tests and check chemical analyses; witness all tests; verify threads by gage; report volumetric capacity and tare weight and minimum thickness of wall noted. Verify that all tests are conducted at temperatures between 60° F. and 90° F.

(d) Render complete report to purchaser, container maker, and the Bureau of Explosives.

§ 78.47-5 Steel.

(a) Types 304, 321 and 347 stainless steel are authorized with proper welding procedure and complying with the following analyses:

	Stainless steels		
	304 (percent)	321 (percent)	347 (percent)
Carbon (maximum).....	0.08	0.08	0.08
Manganese (maximum).....	2.00	2.00	2.00
Phosphorus (maximum).....	.030	.030	.030
Sulfur (maximum).....	.030	.030	.030
Silicon (maximum).....	.75	.75	.75
Nickel.....	8.0/11.0	9.0/13.0	9.0/13.0
Chromium.....	18.0/20.0	17.0/20.0	17.0/20.0
Molybdenum.....		(1)	
Titanium.....			(2)
Columbium.....			

¹ Titanium shall be not less than 5 x C and not more than 0.60%.

² Columbium shall be not less than 10 x C and not more than 1.0%.

§ 78.47-6 Identification of material.

(a) Required; any suitable method.

§ 78.47-7 Defects.

(a) Material with seams, cracks, laminations, or other injurious defects, not authorized. Defects in welded joints shall not exceed the limits specified in § 78.47-16 covering radiographic inspection.

§ 78.47-8 Manufacture.

(a) By best appliances and methods; dirt and scale to be removed as necessary to afford proper inspection; no defect acceptable that is likely to weaken the finished container appreciably, reasonably smooth and uniform surface finish required. No abrupt change in wall thickness permitted. Certification of welders and/or process required in accordance with the sections that apply of Compressed Gas Association Standard for Welding and Brazing on Thin Walled Containers (CGA Pamphlet C-3-1954).¹

(b) All seams of the sphere or cylinder must be fusion welded. Seams shall be of the butt type and means must be provided for accomplishing complete penetration of the joint.

§ 78.47-9 Attachments.

(a) Attachments to the container are authorized by fusion welding provided that such attachments are made of weldable stainless steel in accordance with § 78.47-5.

§ 78.47-10 Wall thickness.

(a) The minimum wall thickness shall be such that the wall stress at the minimum specified test pressure shall not be over 60,000 psi. Minimum wall 0.040 inch for any diameter container.

(b) Calculation for sphere must be made by the formula:

$$S = \frac{PD}{4tE}$$

where

S = Wall stress in pounds per square inch;
 P = Test pressure prescribed for water jacket test, i.e., at least two times service pressure, in pounds per square inch;

¹ Available from the Compressed Gas Association, Inc., 500 Fifth Avenue, New York 36, New York.

- D=Outside diameter in inches;
- t=Minimum wall thickness in inches;
- E=0.85 (provides 85 percent weld efficiency factor which must be applied in the girth weld area and heat zones which zone shall extend a distance of 6 times wall thickness from center of weld);
- E=1.0 (for all other areas).

(c) Calculation for a cylinder must be made by the formula:

$$S = \frac{P(1.3D^2 + 0.4d^2)}{D^2 - d^2}$$

where

- S=Wall stress in pounds per square inch;
- P=Test pressure prescribed for water jacket test, i.e., at least two times service pressure, in pounds per square inch;
- D=Outside diameter in inches;
- d=Inside diameter in inches.

§ 78.47-11 Heat treatment.

(a) The seamless hemispheres and cylinders may be stress relieved or annealed for forming. Welded container shall be stress relieved at a temperature of 775° F. ±25° after process treatment and before hydrostatic test.

§ 78.47-12 Openings in container.

(a) Each opening in the container must be provided with a fitting, boss, or pad of weldable stainless steel securely attached to the container by fusion welding.

(b) Attachments to a fitting, boss, or pad must be adequate to prevent leakage. Threads must comply with the following:

- (1) Threads must be clean cut, even, without checks, and tapped to gauge.
- (2) Taper threads to be of length not less than as specified for American Standard taper pipe threads.
- (3) Straight threads having at least 4 engaged threads, to have tight fit and calculated shear strength at least 10 times the test pressure of the container; gaskets required, adequate to prevent leakage.

§ 78.47-13 Safety relief devices.

(a) Safety relief devices must be as required by Interstate Commerce Commission Regulations (see § 73.34(f) of this chapter).

§ 78.47-14 Process treatment.

(a) Each container shall be hydraulically pressurized in a water jacket to at least 100 percent, but not more than 110 percent, of the test pressure and maintained at this pressure for a minimum of 3 minutes. Total and permanent expansion shall be recorded and included in the inspector's report.

§ 78.47-15 Hydrostatic test.

(a) By water-jacket, operated so as to obtain accurate data. Pressure gage must permit reading to an accuracy of 1 percent. Expansion gage must permit reading of total expansion to accuracy either of 1 percent or 0.1 cubic centimeter.

(b) Pressure must be maintained for 30 seconds and sufficiently longer to insure complete expansion. If, due to failure of the test apparatus, the test pressure cannot be maintained, the test may be repeated at a pressure increased

by 10 percent or 100 pounds per square inch, whichever is the lower.

(c) Permanent volumetric expansion must not exceed 10 percent of total volumetric expansion at test pressure.

(d) Each container must be tested to at least 2 times service pressure.

(e) Container will then be inspected. Wall thickness lower than that required by § 78.47-10 shall be cause for rejection. Bulges and cracks shall be cause for rejection. Weld joint defects exceeding requirements of § 78.47-16 shall be cause for rejection.

§ 78.47-16 Radiographic inspection.

(a) Required on all welded joints which are subjected to internal pressure, except that at the discretion of the disinterested inspector, openings less than 25 percent of the container diameter need not be subjected to radiographic inspection. Evidence of any defects likely to seriously weaken the container shall be cause for rejection.

(b) Radiographic inspection shall be performed subsequent to hydrostatic test.

§ 78.47-17 Burst test.

(a) One container taken at random out of 200 or less shall be hydrostatically tested to destruction. Rupture pressure shall be included as part of the inspector's report.

§ 78.47-18 Flattening test.

(a) *Flattening test for spheres.* At the weld between parallel steel plates on a press with welded seam at right angles to the plates, test one sphere taken at random out of each lot of 200 or less after hydrostatic test. Any projecting appurtenances may be cut off (by mechanical means only) prior to crushing.

(b) *Flattening test for cylinders.* Between knife edges, wedge shaped, 60° angle, rounded to ½-inch radius; test one cylinder taken at random out of each lot of 200 or less, after hydrostatic test.

§ 78.47-19 Acceptable results for flattening and burst tests.

(a) Flattening required to 50 percent of the original outside diameter without cracking.

(b) Burst pressure shall be at least 3 times service pressure.

§ 78.47-20 Rejected containers.

(a) Repair of welded seams by welding prior to process treatment authorized; subsequent thereto containers must be heat treated and pass all prescribed tests.

§ 78.47-21 Marking.

(a) Marking on each container by stamping plainly and permanently only on a permanent attachment or on a metal nameplate permanently secured to the container by means other than soft solder, as follows:

(1) ICC-4DS followed by the service pressure (for example: ICC-4DS900).

(2) A serial number and an identifying symbol (letters) location of a number to be just below the ICC mark; location of symbol to be just below the number. The symbols and numbers

must be those of purchaser, user, or maker. The symbol must be registered with the Bureau of Explosives, duplications unauthorized;

Example: ICC-4DS900
1234
XY

(3) Inspector's official mark, near serial number, date of test (such as 8-61 for August 1961) so placed that dates of subsequent tests can be easily added.

§ 78.47-22 Size of marks.

(a) Of sufficient size to be legible.

§ 78.47-23 Inspector's report.

(a) Required to be clear, legible, and in the following form:

(Place) -----
(Date) -----
Gas -----
(Spheres-cylinders)
Manufactured for ----- Company
Location at -----
Manufactured by ----- Company
Location at -----
Consigned to ----- Company
Location at -----
Quantity -----
Size ----- inches outside diameter by ----- inches long
Marks stamped into the -----

(Shoulder-metal plate, § 78.47-21)
Specification ICC -----
Serial numbers ----- Inclusive
Inspector's mark -----
Identifying symbol (registered) -----
Test date -----
Tare weights (yes or no) -----
Other marks (if any) -----
These containers were made by process of -----

The material used was verified as to chemical analysis and record thereof is attached hereto. The heat numbers -----

(Were—were not) -----
marked on the material.

All material, such as plates and seamless tubing, was inspected and each container was inspected both before and after closing in the ends; all that were accepted were found free from seams, cracks, laminations, and other defects which might prove injurious to the strength of the container. The processes of manufacture of containers were supervised and found to be efficient and satisfactory.

The container walls were measured and the minimum thickness noted was ----- inch. The outside diameter was determined by a close approximation to be ----- inches. The wall stress was calculated to be ----- pounds per square inch under an internal pressure of ----- pounds per square inch.

Hydrostatic tests, flattening tests and other tests, as prescribed in specification No. ICC-4DS were made in the presence of the inspector and all material and containers accepted were found to be in compliance with the requirements of that specification. Records thereof are attached hereto.

I hereby certify that all of these containers proved satisfactory in every way and comply with the requirements of Interstate Commerce Commission specification No. 4DS except as follows:

Exceptions: -----

(Signed) -----
(Inspector)

(Place) -----
(Date) -----

Made by ----- Company
For ----- Company

RECORD OF CHEMICAL ANALYSIS OF MATERIAL FOR CONTAINERS

Numbered ----- inclusive
Size ----- inches outside diameter
by ----- inches long

NOTE: Any omission of analysis by heats, if authorized, must be accounted for by notation hereon reading "The prescribed certificate of the manufacturer of material has been secured, found satisfactory, and placed on file," or by attaching a copy of the certificate.

Test No.	Heat No.	Check analysis No.	Containers represented (serial Nos.)	Chemical analysis						
				C	P	S	Si	Mn	Ni	Cr

The analyses were made by -----
(Signed) -----

RECORD OF PHYSICAL TESTS OF MATERIAL FOR CONTAINERS

Numbered ----- inclusive
Size ----- inches outside diameter by ----- inches long
Made by ----- Company
For ----- Company

§ 78.48-3 Inspection by whom and where.

(a) By competent and disinterested inspector acceptable to the Bureau of Explosives; chemical analyses and tests, as specified, to be made within limits of the United States.

§ 78.48-4 Duties of inspector.

(a) Inspect all material and reject any not complying with requirements; for cylinders made by billet-piercing process, billets to be inspected after nick and cold break.

(b) Verify chemical analysis of each heat of material by analysis or by obtaining certified analysis; *Provided*, That a certificate from the manufacturer thereof, giving sufficient data to indicate compliance with requirements, is acceptable when verified by check analyses of samples taken from one cylinder out of each lot of 200 or less.

(c) Verify compliance of cylinders with all requirements including markings; inspect inside before closing in both ends; verify heat treatment as proper; obtain samples for all tests and check chemical analyses; witness all tests; verify threads by gauge; report volumetric capacity and tare weight (see report form) and minimum thickness of wall noted.

(d) Render complete report (§ 78.48-21) to purchaser, cylinder maker, and the Bureau of Explosives.

§ 78.48-5 Steel.

(a) Open-hearth or electric steel of uniform quality. Content percent for the following not over: Carbon, 0.25; phosphorus, 0.045; sulphur, 0.050; *Provided*, That Bessemer steel with phosphorus not over 0.11 percent is authorized when carbon content is 0.20 percent or less.

§ 78.48-6 Identification of material.

(a) Required; any suitable method.

§ 78.48-7 Defects.

(a) Material with seams, cracks, laminations, or other injurious defects, not authorized.

§ 78.48-8 Manufacture.

(a) By best appliances and methods; dirt and scale to be removed as necessary

to afford proper inspection; no fissure or other defect acceptable that is likely to weaken the finished cylinder appreciably; reasonably smooth and uniform surface finish required. Cylinders closed in by spinning process not authorized.

§ 78.48-9 Brazing or welding.

(a) The attachment to the tops and bottoms only of cylinders by welding or brazing of neckrings, footrings, handles, bosses, pads, and valve protection rings is authorized: *Provided*, That such attachments and the portion of the container to which they are attached are made of weldable steel, the carbon content of which must not exceed 0.25 percent except in the case of 4130X steel which may be used with proper welding procedure.

§ 78.48-10 Wall thickness.

(a) The wall stress shall not exceed 18,000 pounds per square inch. Minimum wall 0.100" for any cylinder over 5" outside diameter.

(b) Calculation must be made by the formula:

$$S = \frac{P(1.3D^2 + 0.4d^2)}{D^2 - d^2}$$

where

- S = wall stress in pounds per square inch;
- P = 700 pounds per square inch;
- D = outside diameter in inches;
- d = inside diameter in inches.

§ 78.48-11 Heat treatment.

(a) The completed cylinders must be uniformly and properly heat treated. Heat treatment after tests is authorized.

§ 78.48-12 Openings in cylinders and connections (valves, fuse plugs, etc.) for those openings.

(a) Threads required, to be clean cut, even, without checks, and to gauge.

(b) Taper threads required; to be of length not less than as specified for American Standard taper pipe threads.

§ 78.48-13 Safety devices and protection for valves, safety devices, and other connections, if applied.

(a) Must be as required by the Interstate Commerce Commission's regulations that apply (see §§ 73.34(f) and 73.301(i) of this chapter).

§ 78.48-14 Hydrostatic test.

(a) By water-jacket, or other suitable method, operated so as to obtain accurate data. Pressure gauge must permit reading to accuracy of 1 percent. Expansion gauge must permit reading of total expansion to accuracy either of 1 percent or 0.1 cubic centimeter.

(b) Pressure must be maintained for 30 seconds and sufficiently longer to insure complete expansion. Any internal pressure applied after heat-treatment and previous to the official test must not exceed 90 percent of the test pressure. If, due to failure of the test apparatus, the test pressure cannot be maintained, the test may be repeated at a pressure increased by 10 percent or 100 pounds per square inch, whichever is the lower.

(c) Permanent volumetric expansion must not exceed 10 percent of total volumetric expansion at test pressure.

RECORD OF HYDROSTATIC TESTS ON CONTAINERS

Numbered ----- inclusive
Size ----- inches outside diameter by ----- inches long
Made by ----- Company
For ----- Company

Serial numbers of containers tested arranged numerically	Process pressure (pounds per square inch)	Total expansion at process pressure (cubic centimeters)	Permanent expansion at process pressure (cubic centimeters)	Actual test pressure (pounds per square inch)	Total expansion at test pressure (cubic centimeters)	Permanent expansion at test pressure (cubic centimeters)	Percent ratio of permanent expansion to total expansion	Tare weight (pounds)	Volumetric capacity

NOTE: When specifications require test for only one out of each lot of 200 or less containers, the check on the others must be indicated by a notation hereon reading, "Each container was subjected to a pressure of ----- pounds per square inch and shows no defect."

(Signed) -----

§ 78.48 Specification 4; forge welded steel cylinders.

§ 78.48-1 Compliance.

(a) Required in all details.

§ 78.48-2 Type, size, and service pressure.

(a) *Type and size.* Must be welded type; forge lap-welded seams required; not over 1,000 pounds water capacity (nominal).

(b) *Service pressure.* Must be 300 pounds per square inch.

(d) Each cylinder must be tested to pressure of at least 700 pounds per square inch.

§ 78.48-15 Flattening test.

(a) Between knife edges, wedge shaped, 60° angle, rounded to 1/2" radius; test 1 cylinder¹ taken at random out of each lot of 200 or less, after hydrostatic test.

§ 78.48-16 Physical test.

(a) To determine yield strength, tensile strength, elongation, and reduction of area of material. Required on 2 specimens cut from 1³ cylinder, or part thereof heat-treated as required, taken at random out of each lot of 200 or less.

(b) Specimens must be: Gauge length 8 inches with width not over 1 1/2 inches; or, gauge length 2 inches with width not over 1 1/2 inches: *Provided*, That gauge length at least 24 times thickness with width not over 6 times thickness is authorized when cylinder wall is not over 3/8 inch thick. The specimen, exclusive of grip ends, must not be flattened. Grip ends may be flattened to within one inch of each end of the reduced section. When size of cylinder does not permit securing straight specimens, the specimens may be taken in any location or direction and may be straightened or flattened cold, by pressure only, not by blows; when specimens are so taken and prepared, the inspector's report must show in connection with record of physical tests detailed information in regard to such specimens. Heating of specimen for any purpose is not authorized.

(c) The yield strength in tension shall be the stress corresponding to a permanent strain of 0.2 percent of the gauge length.

(1) The yield strength shall be determined by either the "offset" method or the "extension under load" method as prescribed in ASTM Standard E8-57T.

(2) In using the "extension under load" method, the total strain (or "extension under load") corresponding to the stress at which the 0.2 percent permanent strain occurs may be determined with sufficient accuracy by calculating the elastic extension of the gauge length under appropriate load and adding thereto 0.2 percent of the gauge length. Elastic extension calculations shall be based on an elastic modulus of 30,000,000. In the event of controversy, the entire stress-strain diagram shall be plotted and the yield strength determined from the 0.2 percent offset.

¹ For lots of 30 or less, physical and flattening tests are authorized to be made on a ring at least 8 inches long cut from each cylinder and subjected to same heat treatment as the finished cylinder.

(3) For the purpose of strain measurement, the initial strain shall be set while the specimen is under a stress of 12,000 pounds per square inch, the strain indicator reading being set at the calculated corresponding strain.

(4) Cross-head speed of the testing machine shall not exceed 1/8 inch per minute during yield strength determination.

§ 78.48-17 Acceptable results for physical and flattening tests.

(a) Elongation at least 40 percent for 2 inch gauge length or at least 20 percent in other cases; yield strength not over 73 percent of tensile strength; flattening test not required.

Exception: Flattening test is required, without cracking, to 6 times wall thickness when cylinders are made of lap-welded pipe; in such case rings (crop ends) cut from each end of pipe must be tested with weld 45° or less from point of greatest stress; if a ring fails, another from the same end of pipe may be tested.

§ 78.48-18 Rejected cylinders.

(a) Reheat treatment authorized; subsequent thereto, acceptable cylinders must pass all prescribed tests. Repair by welding is authorized.

§ 78.48-19 Marking.

(a) Marking on each cylinder by stamping plainly and permanently on shoulder, top head, or neck, provided that cylinders not less than 0.090" thick may be stamped on the side wall adjacent to the top head, as follows:

- (1) ICC-4.
- (2) A serial¹ number and an identifying symbol (letters); location² of number to be just below the ICC mark; location³ of symbol to be just below the serial number. The symbol and numbers must be those of purchaser, user, or maker. The symbol must be registered with the Bureau of Explosives; duplications unauthorized.

(3) Inspector's official mark near serial number; date of test (such as 5-50 for May 1950), so placed that dates of subsequent tests can be easily added.

§ 78.48-20 Size of marks.

(a) At least 1/4" high if space permits.

¹ Lot numbers, not over 500 cylinders in each lot, authorized for cylinders not over 2 inches outside diameter.

² Symbol in front of or following the number with ample space between is also authorized. Other variations in location authorized only when necessitated by lack of space.

Example:

ICC-4
1234
XY

§ 78.48-21 Inspector's report.

(a) Required to be clear, legible, and in following form:

(Place)-----
(Date)-----
Gas cylinders
Manufactured by-----Company
Location at-----
Manufactured by-----Company
Location at-----
Consigned to-----Company
Location at-----
Quantity-----
Size-----inches outside diameter by-----
inches long.
Marks stamped into the shoulder of the cylinder are:
Specification ICC-----
Serial numbers-----to-----inclusive.
Inspector's mark-----
Identifying symbol (registered)-----
Test date-----
Tare weights (yes or no)-----
Other marks (if any)-----
These cylinders were made by process of-----

The-----permitted
(neckrings, footrings, etc)
in § 78.48-9 were attached by process of-----
(welding—brazing)
The material used was identified by the following-----
(heat-purchase order)

numbers-----
The material used was verified as to chemical analysis and record thereof is attached hereto. The heat numbers-----
(were—were not)

marked on the material.
All material, such as plates, billets and seamless tubing, was inspected and each cylinder was inspected both before and after closing in the ends; all that was accepted was found free from seams, cracks, laminations, and other defects which might prove injurious to the strength of the cylinder. The processes of manufacture and heat treatment of cylinders were supervised and found to be efficient and satisfactory.

The cylinder walls were measured and the minimum thickness noted was-----inch. The outside diameter was determined by a close approximation to be-----inches. The wall stress was calculated to be-----pounds per square inch under an internal pressure of-----pounds per square inch.

Hydrostatic tests, flattening tests, tensile tests of material, and other tests, as prescribed in specification No. ICC-4 were made in the presence of the inspector and all material and cylinders accepted were found to be in compliance with the requirements of that specification. Records thereof are attached hereto.

I hereby certify that all of these cylinders proved satisfactory in every way and comply with the requirements of Interstate Commerce Commission specification No. 4 except as follows:

Exceptions-----

(Signed)-----
Inspector.

(Place)
(Date)

RECORD OF CHEMICAL ANALYSIS OF MATERIAL FOR CYLINDERS

Numbered to inclusive.
Size inches outside diameter by inches long
Made by Company
For Company
NOTE: Any omission of analyses by heats, if authorized, must be accounted for by notation hereon reading "The prescribed certificate of the manufacturer of material has been secured, found satisfactory, and placed on file," or by attaching a copy of the certificate.

Test No.	Heat No.	Check analysis No.	Cylinders represented (serial Nos.)	Chemical analysis						
				C	P	S	Si	Mn	Ni	Cr

The analyses were made by
(Signed)
(Place)
(Date)

RECORD OF PHYSICAL TESTS OF MATERIAL FOR CYLINDERS

Numbered to inclusive.
Size inches outside diameter by inches long
Made by Company
For Company

Test No.	Cylinders represented by test (Serial Nos.)	Yield strength (pounds per square inch)	Tensile strength (pounds per square inch)	Elongation (percent in 8 inches)	Reduction of area (percent)	Flattening test

(Signed)
(Place)
(Date)

RECORD OF HYDROSTATIC TESTS ON CYLINDERS

Numbered to inclusive.
Size inches outside diameter by inches long
Made by Company
For Company

Serial numbers of cylinders tested arranged numerically	Actual test pressure (pounds per square inch)	Total expansion (cubic centimeters) ¹	Permanent expansion (cubic centimeters) ¹	Percent ratio of permanent expansion to total expansion ¹	Tare weight (pounds) ²	Volumetric capacity ³

¹ If the tests are made by a method involving the measurement of the amount of liquid forced into the cylinder by the test pressure, then the basic data, on which the calculations are made, such as the pump factors, temperature of liquid, coefficient of compressibility of liquid, etc., must also be given.
² Do not include removable cap but state whether with or without valve. These weights must be accurate to a tolerance of 1 percent.
³ Volumetric capacity on 2 percent of the cylinders is acceptable.

(Signed)

§ 78.49 Specification 4A; forge welded steel cylinders.

§ 78.49-1 Compliance.

(a) Required in all details.

§ 78.49-2 Type, size, and service pressure.

(a) *Type and size.* Must be welded type; forge lap-welded seams required; not over 1,000 pounds water capacity (nominal).

(b) *Service pressure.*¹ At least 150 to not over 500 pounds per square inch.

¹ The "service pressure" limits the use of the cylinder. It is shown by marks on cylinder; for example, ICC-4A300 indicates the service pressure as 300 pounds per square inch.

§ 78.49-3 Inspection by whom and where.

(a) By competent and disinterested inspector acceptable to the Bureau of Explosives; chemical analyses and tests, as specified, to be made within limits of the United States.

§ 78.49-4 Duties of inspector.

(a) Inspect all material and reject any not complying with requirements; for cylinders made by billet-piercing process, billets to be inspected after nick and cold break.

(b) Verify chemical analysis of each heat of material by analysis or by obtaining certified analysis: *Provided*, That a certificate from the manufacturer thereof, giving sufficient data to indicate

compliance with requirements, is acceptable when verified by check analyses of samples taken from one cylinder out of each lot of 200 or less.

(c) Verify compliance of cylinders with all requirements including markings; inspect inside before closing in both ends; verify heat treatment as proper; obtain samples for all tests and check chemical analyses; witness all tests; verify threads by gauge; report volumetric capacity and tare weight (see report form) and minimum thickness of wall noted.

(d) Render complete report (§ 78.49-21) to purchaser, cylinder maker, and the Bureau of Explosives.

§ 78.49-5 Steel.

(a) Open-hearth or electric steel of uniform quality. Content percent for the following not over: Carbon, 0.25; phosphorus, 0.045; sulphur, 0.050.

§ 78.49-6 Identification of material.

(a) Required; any suitable method.

§ 78.49-7 Defects.

(a) Material with seams, cracks, laminations, or other injurious defects, not authorized.

§ 78.49-8 Manufacture.

(a) By best appliances and methods; dirt and scale to be removed as necessary to afford proper inspection; no fissure or other defect acceptable that is likely to weaken the finished cylinder appreciably; reasonably smooth and uniform surface finish required. Cylinders closed in by spinning process not authorized.

§ 78.49-9 Welding or brazing.

(a) The attachment to the tops and bottoms only of cylinders by welding or brazing of neckrings, footrings, handles, bosses, pads, and valve protection rings is authorized provided that such attachments and the portion of the container to which they are attached are made of weldable steel, the carbon content of which must not exceed 0.25 percent except in the case of 4130X steel which may be used with proper welding procedure.

§ 78.49-10 Wall thickness.

(a) The wall stress shall not exceed 18,000 pounds per square inch for cylinders with longitudinal side seam nor 24,000 pounds per square inch for cylinders without such seam. Minimum wall 0.100" for any cylinder over 5" outside diameter.

(b) Calculation must be made by the formula:

$$S = \frac{P(1.3D^2 + 0.4d^2)}{D^2 - d^2}$$

where

S=wall stress in pounds per square inch;
P=minimum test pressure prescribed for water jacket test or 450 pounds per square inch whichever is the greater;
D=outside diameter in inches;
d=inside diameter in inches.

§ 78.49-11 Heat treatment.

(a) Body and heads formed by drawing or pressing must be uniformly and properly heat treated prior to tests.

§ 78.49-12 Openings in cylinders and connections (valves, fuse plugs, etc.) for those openings.

(a) Threads required, to be clean cut, even, without checks, and to gauge.

(b) Taper threads, when used, to be of length not less than as specified for American Standard taper pipe threads.

(c) Straight threads having at least 6 engaged threads are authorized; to have tight fit and calculated shear strength at least 10 times the test pressure of the cylinder; gaskets required, adequate to prevent leakage.

§ 78.49-13 Safety devices and protection for valves, safety devices, and other connections, if applied.

(a) Devices must be as required by the Interstate Commerce Commission's regulations that apply (see §§ 73.34(f) and 73.301(i) of this chapter).

§ 78.49-14 Hydrostatic test.

(a) By water-jacket, or other suitable method, operated so as to obtain accurate data. Pressure gauge must permit reading to accuracy of 1 percent. Expansion gauge must permit reading of total expansion to accuracy either of 1 percent or 0.1 cubic centimeter.

(b) Pressure must be maintained for 30 seconds and sufficiently longer to insure complete expansion. Any internal pressure applied after heat-treatment and previous to the official test must not exceed 90 percent of the test pressure. If, due to failure of the test apparatus, the test pressure cannot be maintained, the test may be repeated at a pressure increased by 10 percent or 100 pounds per square inch, whichever is the lower.

(c) Permanent volumetric expansion must not exceed 10 percent of total volumetric expansion at test pressure.

(d) Each cylinder must be tested to at least $\frac{3}{4}$ times service pressure.

§ 78.49-15 Flattening test.

(a) Between knife edges, wedge shaped, 60° angle, rounded to $\frac{1}{2}$ " radius; test 1 cylinder¹ taken at random out of each lot of 200 or less, after hydrostatic test.

§ 78.49-16 Physical test.

(a) To determine yield strength, tensile strength, elongation, and reduction of area of material. Required on 2 specimens cut from 1¹ cylinder, or part thereof of heat-treated as required, taken at random out of each lot of 200 or less.

(b) Specimens must be: Gauge length 8 inches with width not over 1½ inches; or, gauge length 2 inches with width not over 1½ inches: *Provided*, That gauge length at least 24 times thickness with width not over 6 times thickness is authorized when cylinder wall is not over $\frac{3}{8}$ inch thick. The specimen, exclusive of grip ends, must not be flattened. Grip ends may be flattened to within one inch of each end of the re-

¹ For lots of 30 or less, physical and flattening tests are authorized to be made on a ring at least 8 inches long cut from each cylinder and subjected to same heat treatment as the finished cylinder.

duced section. When size of cylinder does not permit securing straight specimens, the specimens may be taken in any location or direction and may be straightened or flattened cold, by pressure only, not by blows; when specimens are so taken and prepared, the inspector's report must show in connection with record of physical tests detailed information in regard to such specimens. Heating of specimen for any purpose is not authorized.

(c) The yield strength in tension shall be the stress corresponding to a permanent strain of 0.2 percent of the gauge length.

(1) The yield strength shall be determined by either the "offset" method or the "extension under load" method as prescribed in ASTM Standard E8-57T.

(2) In using the "extension under load" method, the total strain (or "extension under load") corresponding to the stress at which the 0.2 percent permanent strain occurs may be determined with sufficient accuracy by calculating the elastic extension of the gauge length under appropriate load and adding thereto 0.2 percent of the gauge length. Elastic extension calculations shall be based on an elastic modulus of 30,000,000. In the event of controversy, the entire stress-strain diagram shall be plotted and the yield strength determined from the 0.2 percent offset.

(3) For the purpose of strain measurement, the initial strain shall be set while the specimen is under a stress of 12,000 pounds per square inch, the strain indicator reading being set at the calculated corresponding strain.

(4) Cross-head speed of the testing machine shall not exceed $\frac{1}{8}$ inch per minute during yield strength determination.

§ 78.49-17 Acceptable results for physical and flattening tests.

(a) Elongation at least 40 percent for 2 inch gauge length or at least 20 percent in other cases; yield strength not over 73 percent of tensile strength; flattening test not required.

Exception: Flattening test is required, without cracking, to 6 times wall thickness when cylinders are made of lap-welded pipe; in such case rings (crop ends) cut from each end of pipe must be tested with weld 45° or less from point of greatest stress; if a ring fails, another from the same end of pipe may be tested.

§ 78.49-18 Rejected cylinders.

(a) Reheat treatment authorized; subsequent thereto, acceptable cylinders must pass all prescribed tests. Repair by welding is authorized.

§ 78.49-19 Marking.

(a) Marking on each cylinder by stamping plainly and permanently on shoulder, top head, or neck, provided that cylinders not less than 0.090" thick may be stamped on the side wall adjacent to the top head, as follows:

(1) ICC-4A followed by the service pressure (for example, ICC-4A300, etc.)

(2) A serial¹ number and an identifying symbol (letters); location² of number to be just below the ICC mark; location³ of symbol to be just below the number. The symbol and numbers must be those of purchaser, user, or maker. The symbol must be registered with the Bureau of Explosives; duplications unauthorized.

(3) Inspector's official mark near serial number; date of test (such as 5-50 for May 1950), so placed that dates of subsequent tests can be easily added.

§ 78.49-20 Size of marks.

(a) At least $\frac{1}{4}$ " high if space permits.

§ 78.49-21 Inspector's report.

(a) Required to be clear, legible, and in following form:

(Place) _____
 (Date) _____
Gas cylinders
 Manufactured for _____ Company
 Location at _____
 Manufactured by _____ Company
 Location at _____
 Consigned to _____ Company
 Location at _____
 Quantity _____
 Size _____ inches outside diameter by _____ inches long
 Marks stamped into the shoulder of the cylinder are:
 Specification ICC- _____
 Serial numbers _____ to _____ inclusive.
 Inspector's mark _____
 Identifying symbol (registered) _____
 Test date _____
 Tare weights (yes or no) _____
 Other marks (if any) _____
 These cylinders were made by process of _____

The _____ permitted in (neckrings, footrings, etc.)

§ 78.49-9 were attached by process of _____

(welding—brazing)
 The material used was identified by the following _____ numbers _____ (heat-purchase order)

The material used was verified as to chemical analysis and record thereof is attached hereto. The heat numbers _____ (were—were not)

marked on the material.

All material, such as plates, billets and seamless tubing, was inspected and each cylinder was inspected both before and after closing in the ends; all that was accepted was found free from seams, cracks, laminations, and other defects which might prove injurious to the strength of the cylinder. The processes of manufacture and heat treatment of cylinders were supervised and found to be efficient and satisfactory.

The cylinder walls were measured and the minimum thickness noted was _____ inch. The outside diameter was determined by a close approximation to be _____ inches. The wall stress was calculated to be _____ pounds

¹ Lot numbers, not over 500 cylinders in each lot, authorized for cylinders not over 2 inches outside diameter and for cylinders over 2 inches outside diameter when the volumetric capacity does not exceed 60 cubic inches.

² Symbol in front of or following the number with ample space between is also authorized. Other variation in location authorized only when necessitated by lack of space.

Example:

ICC-4A300
 1234
 XY

per square inch under an internal pressure of _____ pounds per square inch.
 Hydrostatic tests, flattening tests, tensile tests of material, and other tests, as prescribed in specification No. ICC-4A were made in the presence of the inspector and all material and cylinders accepted were found to be in compliance with the requirements of that specification. Records thereof are attached hereto.

I hereby certify that all of these cylinders proved satisfactory in every way and comply with the requirements of Interstate Commerce Commission specification No. 4A except as follows:

Exceptions _____

 (Signed) _____

Inspector.

(Place) _____
 (Date) _____

RECORD OF CHEMICAL ANALYSIS OF MATERIAL FOR CYLINDERS

Numbered _____ to _____ inclusive.
 Size _____ inches outside diameter by _____ inches long
 Made by _____ Company
 For _____ Company
 NOTE: Any omission of analyses by heats, if authorized, must be accounted for by notation hereon reading "The prescribed certificate of the manufacturer of material has been secured, found satisfactory, and placed on file," or by attaching a copy of the certificate.

Test No.	Heat No.	Check analysis No.	Cylinders represented (serial Nos.)	Chemical analysis						
				C	P	S	Si	Mn	Ni	Cr

The analyses were made by _____
 (Signed) _____
 (Place) _____
 (Date) _____

RECORD OF PHYSICAL TESTS OF MATERIAL FOR CYLINDERS

Numbered _____ to _____ inclusive.
 Size _____ inches outside diameter by _____ inches long
 Made by _____ Company
 For _____ Company

Test No.	Cylinders represented by test (Serial Nos.)	Yield strength (pounds per square inch)	Tensile strength (pounds per square inch)	Elongation (percent in 8 inches)	Reduction of area (percent)	Flattening test

(Signed) _____
 (Place) _____
 (Date) _____

RECORD OF HYDROSTATIC TESTS ON CYLINDERS

Numbered _____ to _____ inclusive.
 Size _____ inches outside diameter by _____ inches long
 Made by _____ Company
 For _____ Company

Serial Nos. of cylinders tested arranged numerically	Actual test pressure (pounds per square inch)	Total expansion (cubic centimeters) ¹	Permanent expansion (cubic centimeters) ¹	Percent ratio of permanent expansion to total expansion ¹	Tare weight (pounds) ²	Volumetric capacity

¹ If the tests are made by a method involving the measurement of the amount of liquid forced into the cylinder by the test pressure, then the basic data, on which the calculations are made, such as the pump factors, temperature of liquid, coefficient of compressibility of liquid, etc., must also be given.
² Do not include removable cap but state whether with or without valve. These weights must be accurate to a tolerance of 1 percent.

(Signed) _____

§ 78.50 Specification 4B; welded and brazed steel cylinders.

§ 78.50-1 Compliance.

(a) Required in all details.

§ 78.50-2 Type, size, and service pressure.

(a) *Type and size.* Must be welded or brazed type; longitudinal seams must be forge lap-welded or brazed; not over

1,000 pounds water capacity (nominal). Cylinders closed in by spinning process not authorized.

(b) *Service pressure.*¹ At least 150 to not over 500 pounds per square inch.

¹ The "service pressure" limits the use of the cylinder. It is shown by marks on cylinder; for example, ICC-4B300 indicates the service pressure as 300 pounds per square inch.

§ 78.50-3 Inspection by whom and where.

(a) By competent inspector; chemical analyses and tests, as specified, to be made within limits of the United States. Interested inspectors are authorized.

§ 78.50-4 Duties of inspector.

(a) Inspect all material and reject any not complying with requirements; for cylinders made by billet-piercing process, billets to be inspected after nick and cold break.

(b) Verify chemical analysis of each heat of material by analysis or by obtaining certified analysis: *Provided*, That a certificate from the manufacturer thereof, giving sufficient data to indicate compliance with requirements, is acceptable when verified by check analyses of samples taken from one cylinder out of each lot of 200 or less.

(c) Verify compliance of cylinders with all requirements including markings; inspect inside before closing in both ends; verify heat treatment as proper; obtain samples for all tests and check chemical analyses; witness all tests; verify threads by gauge; report volumetric capacity and tare weight (see report form) and minimum thickness of wall noted.

(d) Render complete report (§ 78.50-21) to purchaser, cylinder maker, and the Bureau of Explosives.

§ 78.50-5 Steel.

(a) Open-hearth, electric or basic oxygen process steel of uniform quality. Content percent for the following not over: Carbon, 0.25; phosphorus, 0.045; sulphur, 0.050.

§ 78.50-6 Identification of material.

(a) Required; any suitable method except that plates and billets for hot-drawn cylinders shall be marked with heat number.

§ 78.50-7 Defects.

(a) Material with seams, cracks, laminations, or other injurious defects, not authorized.

§ 78.50-8 Manufacture.

(a) By best appliances and methods; dirt and scale to be removed as necessary to afford proper inspection; no defect acceptable that is likely to weaken the finished cylinder appreciably; reasonably smooth and uniform surface finish required. Exposed bottom welds on cylinders over 18" long must be protected by footings. Seams must be made as follows:

(1) Circumferential seams: By welding or by brazing. Heads attached by brazing must have a driving fit with the shell, unless the shell is crimped, swedged, or curled over the skirt or flange of the head, and be thoroughly brazed until complete penetration by the brazing material of the brazed joint is secured. Depth of brazing from end of shell must be at least four times the thickness of shell metal.

(2) Longitudinal seams in shells: By forged lap welding, by copper brazing, by copper alloy brazing, or by silver alloy brazing. Copper alloy composition must

be: Copper, 95 percent minimum; Silicon, 1.5 percent to 3.85 percent; Manganese, 0.25 percent to 1.10 percent. The melting point of the silver alloy brazing material must be in excess of 1000° F. When brazed, the plate edge must be lapped at least eight times the thickness of plate, laps being held in position, substantially metal to metal, by riveting or electric spot-welding; brazing must be done by using a suitable flux and by placing brazing material on one side of seam and applying heat until this material shows uniformly along the seam of the other side.

§ 78.50-9 Welding or brazing.

(a) The attachment to the tops and bottoms only of cylinders by welding or brazing of neckrings, footrings, handles, bosses, pads, and valve protection rings is authorized: *Provided*, That such attachments and the portion of the container to which they are attached are made of weldable steel, the carbon content of which must not exceed 0.25 percent except in the case of 4130X steel which may be used with proper welding procedure.

§ 78.50-10 Wall thickness.

(a) For outside diameters over 6" the minimum wall thickness shall be 0.090 inch. In any case the minimum wall thickness shall be such that calculated wall stress at minimum test pressure (§ 78.50-14(d)) shall not exceed the following values:

(1) 24,000 pounds per square inch for cylinders without longitudinal seam;

(2) 22,800 pounds per square inch for cylinders having copper brazed or silver alloy brazed longitudinal seam;

(3) 18,000 pounds per square inch for cylinders having forged lapped welded longitudinal seam.

(b) Calculation must be made by the formula:

$$S = \frac{P(1.3D^2 + 0.4d^2)}{D^2 - d^2}$$

where

S = wall stress in pounds per square inch;

P = minimum test pressure prescribed for water jacket test or 450 pounds per square inch whichever is the greater;

D = outside diameter in inches;

d = inside diameter in inches.

§ 78.50-11 Heat treatment.

(a) Body and heads formed by drawing or pressing must be uniformly and properly heat treated prior to tests.

§ 78.50-12 Opening in cylinders.

(a) Each opening in cylinders, except those for safety devices, must be provided with a fitting, boss, or pad, securely attached to cylinder by brazing or by welding or by threads. Fitting, boss, or pad must be of steel suitable for the method of attachment employed, and which need not be identified or verified as to analysis, except that if attachment is by welding, carbon content must not exceed 0.25 percent. If threads are used, they must comply with the following:

(1) Threads must be clean cut, even, without checks, and tapped to gauge.

(2) Taper threads to be of length not less than as specified for American Standard taper pipe threads.

(3) Straight threads, having at least 4 engaged threads, to have tight fit and calculated shear strength at least 10 times the test pressure of the cylinder; gaskets required, adequate to prevent leakage.

NOTE 1: A brass fitting may be brazed to the steel boss or flange on cylinders used as component parts of hand fire extinguishers.

(b) Closure of fitting, boss, or pad must be adequate to prevent leakage.

§ 78.50-13 Safety devices and protection for valves, safety devices, and other connections, if applied.

(a) Must be as required by the Interstate Commerce Commission's regulations that apply (see §§ 73.34(f), 73.301 (i) and 73.124(a) of this chapter.)

§ 78.50-14 Hydrostatic test.

(a) By water-jacket, or other suitable method, operated so as to obtain accurate data. Pressure gauge must permit reading to accuracy of 1 percent. Expansion gauge must permit reading of total expansion to accuracy either of 1 percent or 0.1 cubic centimeter.

(b) Pressure must be maintained for 30 seconds and sufficiently longer to insure complete expansion. Any internal pressure applied after heat-treatment and previous to the official test must not exceed 90 percent of the test pressure. If, due to failure of the test apparatus, the test pressure cannot be maintained, the test may be repeated at a pressure increased by 10 percent or 100 pounds per square inch, whichever is the lower.

(c) Permanent volumetric expansion must not exceed 10 percent of total volumetric expansion at test pressure.

(d) Cylinders must be tested as follows:

(1) At least one cylinder selected at random out of each lot of 200 or less shall be tested as outlined in paragraphs (a), (b), and (c) of this section to at least two times service pressure.

(2) All cylinders not tested as outlined in subparagraph (1) of this paragraph must be examined under pressure of at least two times service pressure and show no defect.

§ 78.50-15 Flattening test.

(a) Between knife edges, wedge shaped, 60° angle, rounded to 1/2" radius; test 1 cylinder¹ taken at random out of each lot of 200 or less, after hydrostatic test.

§ 78.50-16 Physical test.

(a) To determine yield strength, tensile strength, elongation, and reduction of area of material. Required on 2 specimens cut from 1¹ cylinder, or part thereof heat-treated as required, taken at random out of each lot of 200 or less.

(b) Specimens must be: Gauge length 8 inches with width not over 1 1/2 inches; or, gauge length 2 inches with width not over 1 1/2 inches; provided, that gauge length at least 24 times thickness with

¹ For lots of 30 or less, physical and flattening tests are authorized to be made on a ring at least 8 inches long cut from each cylinder and subjected to same heat treatment as the finished cylinder.

width not over 6 times thickness is authorized when cylinder wall is not over 3/16 inch thick. The specimen, exclusive of grip ends, must not be flattened. Grip ends may be flattened to within one inch of each end of the reduced section. When size of cylinder does not permit securing straight specimens, the specimens may be taken in any location or direction and may be straightened or flattened cold, by pressure only, not by blows; when specimens are so taken and prepared, the inspector's report must show in connection with record of physical tests detailed information in regard to such specimens. Heating of specimen for any purpose is not authorized.

(c) The yield strength in tension shall be the stress corresponding to a permanent strain of 0.2 percent of the gauge length.

(1) The yield strength shall be determined by either the "offset" method or the "extension under load" method as prescribed in ASTM Standard E8-57T.

(2) In using the "extension under load" method, the total strain (or "extension under load") corresponding to the stress at which the 0.2 percent permanent strain occurs may be determined with sufficient accuracy by calculating the elastic extension of the gauge length under appropriate load and adding thereto 0.2 percent of the gauge length. Elastic extension calculations shall be based on an elastic modulus of 30,000,000. In the event of controversy, the entire stress-strain diagram shall be plotted and the yield strength determined from the 0.2 percent offset.

(3) For the purpose of strain measurement, the initial strain shall be set while the specimen is under a stress of 12,000 pounds per square inch, the strain indicator reading being set at the calculated corresponding strain.

(4) Cross-head speed of the testing machine shall not exceed 1/8 inch per minute during yield strength determination.

§ 78.50-17 Acceptable results for physical and flattening tests.

(a) Elongation at least 40 percent for 2 inch gauge length or at least 20 percent in other cases; yield strength not over 73 percent of tensile strength; flattening test not required.

Exception: Flattening test is required, without cracking, to 6 times wall thickness when cylinders are made of lap-welded pipe; in such case rings (crop ends) cut from each end of pipe must be tested with weld 45° or less from point of greatest stress; if a ring fails, another from the same end of pipe may be tested.

§ 78.50-18 Rejected cylinders.

(a) Reheat treatment authorized; subsequent thereto, acceptable cylinders must pass all prescribed tests. Repair of brazed seams by brazing and welded seams by welding is authorized.

§ 78.50-19 Marking.

(a) Marking on each cylinder by stamping plainly and permanently on shoulder, top head, neck or valve protection collar which is permanently attached to the cylinders and forming an integral part thereof, provided that cyl-

inders not less than 0.090 inches thick may be stamped on the side wall adjacent to top head, as follows:

- (1) ICC-4B followed by the service pressure (for example, ICC-4B300, etc.).
(2) A serial number and an identifying symbol (letters); location of number to be just below the ICC mark; location of symbol to be just below the serial number. The symbol and numbers must be those of purchaser, user, or maker. The symbol must be registered with the Bureau of Explosives; duplications unauthorized.

(3) Inspector's official mark, near serial number; date of test (such as 5-50 for May 1950), so placed that date of subsequent test can be easily added.

§ 78.50-20 Size of marks.

(a) At least 1/4" high if space permits.

§ 78.50-21 Inspector's report.

(a) Required to be clear, legible, and in following form:

(Place)
(Date)
Gas cylinders
Manufactured for... Company
Location at...
Manufactured by... Company
Location at...
Consigned to... Company
Location at...
Quantity...
Size... inches outside diameter by... inches long.
Marks stamped into the shoulder of the cylinder are:
Specification ICC...
Serial numbers... to... inclusive.
Inspector's mark...
Identifying symbol (registered)...
Test date...
Tare weights (yes or no)...
Other marks (if any)...
These cylinders were made by process of...

The... permitted in (neckrings, footrings, etc)
§ 78.50-9 were attached by process of... (welding—brazing)
The material used was identified by the following... numbers (heat-purchase order)

The material used was verified as to chemical analysis and record thereof is attached hereto. The heat numbers... (were—were not) marked on the material.

All material, such as plates, billets and seamless tubing, was inspected and each cylinder was inspected both before and after

closing in the ends; all that was accepted was found free from seams, cracks, laminations, and other defects which might prove injurious to the strength of the cylinder. The processes of manufacture and heat treatment of cylinders were supervised and found to be efficient and satisfactory.

The cylinder walls were measured and the minimum thickness noted was... inch. The outside diameter was determined by a close approximation to be... inches. The wall stress was calculated to be... pounds per square inch under an internal pressure of... pounds per square inch.

Hydrostatic tests, flattening tests, tensile tests of material, and other tests, as pre-

scribed in specification No. ICC-4B were made in the presence of the inspector and all material and cylinders accepted were found to be in compliance with the requirements of that specification. Records thereof are attached hereto.

I hereby certify that all of these cylinders proved satisfactory in every way and comply with the requirements of Interstate Commerce Commission specification No. 4B except as follows:

Exceptions:
(Signed)
Inspector.

(Place)
(Date)

RECORD OF CHEMICAL ANALYSIS OF MATERIAL FOR CYLINDERS

Numbered... to... inclusive.
Size... inches outside diameter by... inches long
Made by... Company
For... Company

NOTE: Any omission of analyses by heats, if authorized, must be accounted for by notation hereon reading "The prescribed certificate of the manufacturer of material has been secured, found satisfactory, and placed on file," or by attaching a copy of the certificate.

Table with columns: Test No., Heat No., Check analysis No., Cylinders represented (serial Nos.), Chemical analysis (C, P, S, Si, Mn, Ni, Cr)

The analyses were made by... (Signed)
(Place)
(Date)

RECORD OF PHYSICAL TESTS OF MATERIAL FOR CYLINDERS

Numbered... to... inclusive.
Size... inches outside diameter by... inches long
Made by... Company
For... Company

Table with columns: Test No., Cylinders represented by test (Serial Nos.), Yield strength (pounds per square inch), Tensile strength (pounds per square inch), Elongation (percent in 8 inches), Reduction of area (percent), Flattening test

(Signed)
(Place)
(Date)

RECORD OF HYDROSTATIC TESTS ON CYLINDERS

Numbered... to... inclusive.
Size... inches outside diameter by... inches long
Made by... Company
For... Company

Table with columns: Serial numbers of cylinders tested arranged numerically, Actual test pressure (pounds per square inch), Total expansion (cubic centimeters), Permanent expansion (cubic centimeters), Percent ratio of permanent expansion to total expansion, Tare weight (pounds), Volumetric capacity

NOTE: When specifications require test for only 1 out of each lot of 200 or less cylinders, the check on the others must be indicated by a notation hereon reading, "Each cylinder was subjected to a pressure of... pounds per square inch and showed no defect."

1 If the tests are made by a method involving the measurement of the amount of liquid forced into the cylinder by the test pressure, then the basic data, on which the calculations are made, such as the pump factors, temperature of liquid, coefficient of compressibility of liquid, etc., must also be given.

2 Do not include removable cap but state whether with or without valve. These weights must be accurate to a tolerance of 1 percent.

3 Report approximate maximum and minimum volumetric capacity for the lot. (Signed)

1 Lot numbers, not over 500 cylinders in each lot, authorized for cylinders not over 2 inches outside diameter and for cylinders over 2 inches outside diameter when the volumetric capacity does not exceed 170 cubic inches.

2 Symbol in front of or following the number with ample space between or symbol and serial number stamped into welded or brazed-on valve spud directly above the ICC specification mark located on head of cylinder are also authorized. Other variations in location authorized only when necessitated by lack of space.

Example:

ICC-4B300-
1234
XY

§ 78.51 Specification 4BA; welded or brazed steel cylinders made of definitely prescribed steels.

§ 78.51-1 Compliance.

(a) Required in all details.

§ 78.51-2 Type, size, and service pressure.

(a) Must be welded or brazed type; not over 1,000 pounds water capacity (nominal); service pressure at least 225 and not over 500 pounds per square inch gauge. Closures welded by the spinning process not permitted.

§ 78.51-3 Inspection by whom and where.

(a) By competent inspector; chemical analyses and tests, as specified, to be made within limits of the United States. Interested inspectors are authorized.

§ 78.51-4 Duties of inspector.

(a) Inspect all material and reject any not complying with requirements of this specification. For cylinders made by the billet-piercing process, billets to be inspected after nick and cold break.

(b) Verify chemical analysis of each heat of material by analysis or by obtaining certified analysis: *Provided*, That a certificate from the manufacturer thereof, giving sufficient data to indicate compliance with requirements, is acceptable when verified by check analyses of samples taken from one cylinder out of each lot of 200 or less.

(c) Verify compliance of cylinders with specification requirements including: markings; condition of inside; tests; threads; heat treatment. Obtain samples for all tests, and check chemical analyses, witness all tests; report volumetric capacity, tare weight (see report form), and minimum thickness of wall noted.

(d) Render complete report (§ 78.51-21) to purchaser, cylinder maker, and the Bureau of Explosives.

§ 78.51-5 Steel.

(a) Designations and limited chemical compositions of steels authorized by this specification shall be as shown in § 78.51-20, Table I.

§ 78.51-6 Identification of material.

(a) Required; any suitable method except that plates and billets for hot-drawn cylinders shall be marked with the heat number.

§ 78.51-7 Defects.

(a) Material with seams, cracks, laminations, or other injurious defects, not authorized.

§ 78.51-8 Manufacture.

(a) By best appliances and methods; dirt and scale to be removed as necessary to afford proper inspection; no defect acceptable that is likely to weaken the finished cylinder appreciably; reasonably smooth and uniform surface finish required. Exposed bottom welds on cylinders over 18 inches long must be protected by footrings. Seams must be made as follows: Minimum thickness of heads and bottoms shall be not less than 90 percent of the required thickness of the side wall.

(b) Circumferential seams. By welding or by brazing. Heads attached by brazing must have a driving fit with the shell, unless the shell is crimped, swaged, or curled over the skirt or flange of the head, and must be thoroughly brazed until complete penetration by the brazing material of the brazed joint is secured. Depth of brazing from end of shell must be at least four times the thickness of shell metal.

(c) Longitudinal seams in shells: By copper brazing, copper alloy brazing, or by silver alloy brazing. Copper alloy composition must be: Copper 95 percent minimum, Silicon 1.5 percent to 3.85 percent, Manganese 0.25 percent to 1.10 percent. The melting point of the silver alloy brazing material must be in excess of 1,000° F. The plate edge must be lapped at least eight times the thickness of plate, laps being held in position, substantially metal to metal, by riveting or by electric spot-welding. Brazing must be done by using a suitable flux and by placing brazing material on one side of seam and applying heat until this material shows uniformly along the seam of the other side.

(1) Strength of longitudinal seam: Copper brazed longitudinal seam must have strength at least 3/2 times the strength of the steel wall.

§ 78.51-9 Welding and brazing.

(a) The attachment to the tops and bottoms only of cylinders by welding or brazing of neckrings, footrings, handles, bosses, pads, and valve protection rings is authorized provided that such attachments and the portion of the container to which they are attached are made of weldable steel, the carbon content of which must not exceed 0.25 percent except in the case of 4130X steel which may be used with proper welding procedure.

§ 78.51-10 Wall thickness.

(a) For outside diameters over 6" the minimum wall thickness shall be 0.078". In any case the minimum wall thickness shall be such that the calculated wall stress at minimum test pressure (§ 78.51-14) shall not exceed the lesser value of any of the following:

(1) The value shown in table I, § 78.51-20, for the particular material under consideration;

(2) One-half of the minimum tensile strength of the material determined as required in § 78.51-15;

(3) 35,000 pounds per square inch.

(4) Further provided that wall stress for cylinders having copper brazed longitudinal seams must not exceed 95 percent of any of the above values. Measured wall thickness shall not include galvanizing or other protective coating.

(b) Calculation must be made by the formula:

$$S = \frac{P(1.3D^2 + 0.4d^2)}{D^2 - d^2}$$

where

S = wall stress in pounds per square inch;
P = minimum test pressure prescribed for water jacket test;
D = outside diameter in inches;
d = inside diameter in inches.

(c) Cylinders with wall thickness less than 0.100 inch, the ratio of tangential

length to outside diameter shall not exceed 4.0.

§ 78.51-11 Heat treatment.

(a) Each cylinder must be uniformly and properly heat treated prior to test by the applicable method shown in § 78.51-20, Table 1. Heat treatment must be accomplished after all forming and welding operations, except that when brazed joints are used, heat treatment must follow any forming and welding operations, but may be done before, during or after the brazing operations.

(b) Heat treatment is not required after welding or brazing weldable low carbon parts to attachments of similar material which have been previously welded or brazed to the top or bottom of cylinders and properly heat treated, provided such subsequent welding or brazing does not produce a temperature in excess of 400° F. in any part of the top or bottom material.

§ 78.51-12 Openings in cylinders.

(a) All openings must be in the heads or bases.

(b) Each opening in cylinders, except those for safety devices, must be provided with a fitting, boss, or pad, securely attached to cylinder by brazing, by welding, or by threads. If threads are used they must comply with the following:

(1) Threads must be clean-cut, even, without checks and cut to gauge.

(2) Taper threads to be of length not less than as specified for American Standard taper pipe threads.

(3) Straight threads, having at least 4 engaged threads, to have tight fit and calculated shear strength at least 10 times the test pressure of the cylinder; gaskets required, adequate to prevent leakage.

(c) Closure of fitting, boss, or pad must be adequate to prevent leakage.

§ 78.51-13 Safety devices and protection for valves, safety devices, and other connections, if applied.

(a) Must be as required by the Interstate Commerce Commission's regulations that apply (see §§ 73.34(f), 73.124(a), and 73.301(i) of this chapter).

§ 78.51-14 Hydrostatic test.

(a) By water jacket, or other suitable method, operated so as to obtain accurate data. Pressure gauge must permit reading to accuracy of 1 percent. Expansion gauge must permit reading of total expansion to accuracy either of 1 percent or 0.1 cubic centimeter.

(b) Pressure must be maintained for 30 seconds and sufficiently longer to insure complete expansion. Any internal pressure applied after heat treatment and previous to the official test must not exceed 90 percent of the test pressure.

(c) Permanent volumetric expansion must not exceed 10 percent of the total volumetric expansion at test pressure.

(d) Cylinders must be tested as follows:

(1) At least one cylinder selected at random out of each lot of 200 or less shall be tested as outlined in paragraphs (a), (b), and (c) of this section to at least two times service pressure.

(2) All cylinders not tested as outlined in subparagraph (1) of this paragraph

must be examined under pressure of at least two times service pressure and show no defect.

§ 78.51-15 Physical test.

(a) To determine yield strength, tensile strength, elongation, and reduction of area of material. Required on 2 specimens cut from one cylinder having passed the hydrostatic test, or part thereof heat-treated as required, taken at random out of each lot of 200 or less.

(b) Specimens must be: Gauge length 8 inches with width not over 1½ inches; or, gauge length 2 inches with width not over 1½ inches, provided, that gauge length at least 24 times thickness with width not over 6 times thickness is authorized when cylinder wall is not over ⅜ inch thick. The specimen, exclusive of grip ends, must not be flattened. Grip ends may be flattened to within one inch of each end of the reduced section. When size of cylinder does not permit securing straight specimens, the specimens may be taken in any location or direction and may be straightened or flattened cold, by pressure only, not by blows; when specimens are so taken and prepared, the inspector's report must show in connection with record of physical tests detailed information in regard to such specimens. Heating of specimen for any purpose is not authorized.

(c) The yield strength in tension shall be the stress corresponding to a permanent strain of 0.2 percent of the gauge length.

(1) The yield strength shall be determined by either the "offset" method or the "extension under load" method as prescribed in ASTM Standard E8-57T.

(2) In using the "extension under load" method, the total strain (or "extension under load"), corresponding to the stress at which the 0.2 percent permanent strain occurs may be determined with sufficient accuracy by calculating the elastic extension of the gauge length under appropriate load and adding thereto 0.2 percent of the gauge length. Elastic extension calculations shall be based on an elastic modulus of 30,000,000. In the event of controversy, the entire stress-strain diagram shall be plotted and the yield strength determined from the 0.2 percent offset.

(3) For the purpose of strain measurement, the initial strain reference shall be set while the specimen is under a stress of 12,000 pounds per square inch, the strain indicator reading being set at the calculated corresponding strain.

(4) Cross-head speed of the testing machine shall not exceed ⅛ inch per minute during yield strength determination.

§ 78.51-16 Elongation.

(a) Physical test specimens must show at least 40 percent for 2-inch gauge

length length or at least 20 percent in other cases, except that these elongation percentages may be reduced numerically by 2 for 2-inch specimens, and by 1 in other cases, for each 7,500 pounds per square inch increment of tensile strength above 50,000 pounds per square inch to a maximum of four such increments.

§ 78.51-17 Tests of welds.

(Does not apply to brazed seams.)

(a) *Tests of welds. Tensile test.* A specimen shall be cut from one cylinder of each lot of 200 or less, or welded test plate.¹ The specimen shall be taken across the major seam and shall be prepared and tested in accordance with and must meet the requirements of the Compressed Gas Association's "Standards for Welding and Brazing on Thin Walled Containers" (CGA Pamphlet C-3-1954).² Should this specimen fail to meet the requirements, specimens may be taken from two additional cylinders or welded test plates from the same lot and tested. If either of the latter specimens fail to meet the requirements, the entire lot represented shall be rejected.

(b) *Guided bend test.* A "root" bend test specimen shall be cut from the cylinder or welded test plate, used for the tensile test specified in paragraph (b) of this section. Specimens shall be taken across the major seam and shall be prepared and tested in accordance with and shall meet the requirements of the Compressed Gas Association's "Standards for Welding and Brazing on Thin Walled Containers" (CGA Pamphlet C-3-1954).²

(c) *Alternate guided-bend test.* This test may be used and shall be as required by Compressed Gas Association's "Standards for Welding and Brazing on Thin Walled Containers" (CGA Pamphlet C-3-1954).² The specimen shall be bent until the elongation at the outer surface, adjacent to the root of the weld, between the lightly scribed gage lines a to b, shall be at least 20 percent, except that this percentage may be reduced for steels having a tensile strength in excess of 50,000 pounds per square inch, as provided in § 78.51-16(a).

§ 78.51-18 Rejected cylinders.

(a) Reheat treatment authorized; subsequent thereto, acceptable cylinders

¹The welded test plate shall be of one of the heats in the lot of 200 or less which it represents, in the same condition and approximately the same thickness as the cylinder wall except that in no case shall it be of lesser thickness than that required for a one-quarter size Charpy impact specimen. The weld must be made by the same procedure and subjected to the same heat treatment as the major weld on the cylinder.

²Available from the Compressed Gas Association, Inc., 500 Fifth Avenue, New York 36, New York.

must pass all prescribed tests. Repair of brazed seams by brazing and welded seams by welding is authorized.

§ 78.51-19 Marking.

(a) Marking on each cylinder stamped as follows:

(1) ICC-4BA followed by the service pressure (for example, ICC-4BA240, etc.).

(2) A serial number and an identifying symbol, both to be of the purchaser, user, or maker. The symbol must be registered with the Bureau of Explosives. Duplications unauthorized. Lot numbers in place of serial numbers authorized for cylinders not over 2 inches outside diameter or for cylinders with volumetric capacity not exceeding 60 cubic inches.

(3) Inspector's official mark.

(4) Date of test (such as 4-50 for April 50).

(5) Additional markings are permitted.

(b) Sequence of marks. Number shall be just below the ICC marking; identifying symbol shall be just below the number; inspector's official mark shall be near the serial number. Date of test shall be so placed that dates of subsequent test can easily be added. Symbol in front of or following the number, with space between, or symbol and serial number stamped into welded or brazed-on valve spud directly above the ICC mark located on head or cylinder are also authorized. Other variations in sequence of marks authorized only when necessitated by lack of space.

(c) Location of markings. Markings may be stamped plainly and permanently in the following locations on the cylinder:

(1) On shoulders and top heads not less than 0.087 inch thick.

(2) On side wall adjacent to top head for side walls not less than 0.090 inch thick.

(3) On neck, valve boss, valve protection sleeve, or similar part permanently attached to top end of cylinder.

(4) On a plate attached to the top of the cylinder or permanent part thereof; sufficient space must be left on the plate to provide for stamping at least six retest dates; the plate must be at least ⅛ inch thick and must be attached by welding, or by brazing at a temperature of at least 1100° F, throughout all edges of the plate.

(5) Variations in location of markings authorized only when necessitated by lack of space.

(d) Size of marks. Space permitting, at least ¼ inch high.

§ 78.51-20 Authorized steel.

(a) Open hearth or electric steel of uniform quality. The following chemical analyses are authorized. (See footnote 1):

RULES AND REGULATIONS

TABLE I—AUTHORIZED MATERIALS

Table with 14 columns for Designation (1315, HIS, MAY, NAX-1, COR, NAX-2, SCX, 4017, OTY, RDT, YOL, DYNA, GLX-50-W) and rows for various elements like Carbon, Manganese, Phosphorus, Sulfur, Silicon, Chromium, Molybdenum, Zirconium, Nickel, Copper, Aluminum, Columbium, Heat treatment authorized, and Maximum stress.

1 A heat of steel made under any of the above specifications, check chemical analysis of which is slightly out of the specified range, is acceptable, if satisfactory in all other respects, provided the tolerances published by the American Iron and Steel Institute in Table 6-4 of "Supplementary Information July 1953, Alloy Steel: Semi-finished; Hot Rolled and Cold Finished Bars, July 1953" are not exceeded or provided the variation in chemical analysis is approved by the Bureau of Explosives.

2 Any suitable heat treatment in excess of 1,100° F., except that liquid quenching is not permitted. 3 Addition of other elements to obtain alloying effect is not authorized. 4 Ferritic grain size 6 or finer, according to ASTM E-112-58T. 5 Only fully killed steel authorized.

§ 78.51-21 Inspector's report.

(a) Required to be clear, legible and in following form:

(Place) (Date) Steel gas cylinders Manufactured for Location at Manufactured by Location at Consigned to Location at Quantity Size inches outside diameter by inches long Marks stamped into the (Location of marking)

fication No. ICC-4BA were made in the presence of the inspector and all cylinders accepted were found to be in compliance with the requirements of that specification. Records thereof are attached hereto. Each cylinder (has-has not) been equipped with safety devices as follows: I hereby certify that all of these cylinders proved satisfactory in every way and comply

with the requirements of Interstate Commerce Commission specification No. 4BA except as follows: Exceptions (Manufacturer's name) Signed Inspector By

of the cylinder are: Specification ICC- Serial numbers to inclusive. Inspector's mark Identifying symbol (registered) Test date Tare weights (yes or no) Other marks

These cylinders were made by process of The material used was type authorized in table I of Spec. No. 4BA. The material used was identified by the following numbers (heat-purchase order)

The material used was verified as to chemical analysis and record thereof is attached hereto. The heat numbers (were-were not) marked on the material.

All material was inspected and all that was accepted was found free from seams, cracks, laminations and other injurious defects.

The compliance of cylinders with specification requirements was verified including markings, condition of inside, tests, threads, etc. All cylinders with defects which might prove injurious were rejected. The processes of manufacture and heat treatment were supervised and found to be efficient and satisfactory.

The cylinder walls were measured and the minimum thickness noted was inch. The outside diameter was determined by a close approximation to be inches. The wall stress was calculated to be pounds per square inch under an internal pressure of pounds per square inch.

Hydrostatic tests, tensile tests of material, and other tests as prescribed in speci-

RECORD OF CHEMICAL ANALYSIS OF STEEL FOR CYLINDERS

Numbered to inclusive. Size inches outside diameter by inches long Made by Company For Company

Table with columns for Test No., Heat No., Check analysis No., Cylinders represented (serial Nos.), and Chemical analysis (C, P, S, Si, Mn, Ni, Cr, Mo, Cu, Al, Zr).

Steel was manufactured by Company. The originals of the certified mill test reports are in the files of the manufacturer.

NOTE: Any omission of analyses by heats, if authorized, must be accounted for by notation hereon reading "The prescribed certificate of the manufacturer of material has been secured, found satisfactory, and placed on file," or by attaching a copy of the certificate.

Chemical analyses were made by (Place) (Date)

RECORD OF PHYSICAL TESTS OF MATERIAL FOR CYLINDERS

Numbered to inclusive. Size inches outside diameter by inches long Made by Company For Company

Table with columns for Test No., Cylinders represented by test (serial Nos.), Yield strength (pounds per square inch), Tensile strength (pounds per square inch), Elongation (percent in inches), Reduction of area (percent), Weld tensile test, and Weld bend test.

(Signed)

(Place).....
(Date).....

RECORD OF HYDROSTATIC TESTS ON CYLINDERS

Numbered to inclusive.
Size inches outside diameter by inches long
Made by Company
For Company

Serial Nos. of cylinders tested arranged numerically	Actual test pressure (pounds per square inch)	Total expansion (cubic centimeters) ¹	Permanent expansion (cubic centimeters) ¹	Percent ratio of permanent expansion to total expansion ¹	Tare weight (pounds) ²	Volumetric capacity ³

NOTE: When specifications require test for only 1 out of each lot of 200 or less cylinders, the check on the others must be indicated by a notation hereon reading, "Each cylinder was subjected to a pressure of.....pounds per square inch and showed no defect."

¹ If the tests are made by a method involving the measurement of the amount of liquid forced into the cylinder by the test pressure, then the basic data, on which the calculations are made, such as the pump factors, temperature of liquid, coefficient of compressibility of liquid, etc., must also be given.

² Do not include removable cap but state whether with or without valve. These weights must be accurate to a tolerance of 1 percent.

³ Report approximate maximum and minimum volumetric capacity for the lot.

(Signed).....

§ 78.52 Specification 4C; welded and brazed steel cylinders.

§ 78.52-1 Compliance.

(a) Required in all details.

§ 78.52-2 Type, size, and service pressure.

(a) *Type and size.* Must be welded or brazed type; longitudinal seams must be forge lap-welded or brazed; not over 1,000 pounds water capacity (nominal). Cylinders closed in by spinning process not authorized.

(b) *Service pressure.*¹ At least 90 to not over 300 pounds per square inch.

§ 78.52-3 Inspection by whom and where.

(a) By competent inspector; chemical analyses and tests, as specified, to be made within limits of the United States. Interested inspectors are authorized.

§ 78.52-4 Duties of inspector.

(a) Inspect all material and reject any not complying with requirements; for cylinders made by billet-piercing process, billets to be inspected after nick and cold break.

(b) Verify chemical analysis of each heat of material by analysis or by obtaining certified analysis: *Provided*, That a certificate from the manufacturer thereof, giving sufficient data to indicate compliance with requirements, is acceptable when verified by check analyses of samples taken from one cylinder out of each lot of 200 or less.

(c) Verify compliance of cylinders with all requirements including markings; inspect inside before closing in both ends; verify heat treatment as proper; obtain samples for all tests and check chemical analyses; witness all tests; verify threads by gauge; report volumetric capacity and tare weight (see report form) and minimum thickness of wall noted.

¹ The "service pressure" limits the use of the cylinder. It is shown by marks on cylinder; for example, ICC-4C300 indicates the service pressure as 300 pounds per square inch.

(d) Render complete report (§ 78.52-21) to purchaser, cylinder maker, and the Bureau of Explosives.

§ 78.52-5 Steel.

(a) Open-hearth or electric steel of uniform quality. Content percent for the following not over: Carbon, 0.25; phosphorus, 0.045; sulphur, 0.050.

§ 78.52-6 Identification of material.

(a) Required; any suitable method except that plates and billets for hot-drawn cylinders shall be marked with heat number.

§ 78.52-7 Defects.

(a) Material with seams, cracks, laminations, or other injurious defects, not authorized.

§ 78.52-8 Manufacture.

(a) By best appliances and methods; dirt and scale to be removed as necessary to afford proper inspection; no defect acceptable that is likely to weaken the finished cylinder appreciably; reasonably smooth and uniform surface finish required. Exposed bottom welds on cylinders over 18" long must be protected by footings. Seams must be made as follows:

(1) *Circumferential seams.* By welding or by brazing. Heads attached by brazing must have a driving fit with the shell, unless the shell is crimped, swedged, or curled over the skirt or flange of the head, and be thoroughly brazed until complete penetration by the brazing material of the brazed joint is secured. Depth of brazing from end of shell must be at least four times the thickness of shell metal.

(2) *Longitudinal seams in shells.* By forged lap welding or by copper brazing. When brazed, the plate edge must be lapped at least eight times the thickness of plate, laps being held in position, substantially metal to metal, by riveting or electric spot welding; brazing must be done by placing flux and brazing material on one side of seam and applying heat until this material shows uniformly along the seam on the other side.

§ 78.52-9 Welding or brazing.

(a) The attachment to the tops and bottoms only of cylinders by welding or brazing of neckrings, footrings, handles, bosses, pads, and valve protection rings is authorized provided that such attachments and the portion of the container to which they are attached are made of weldable steel, the carbon content of which must not exceed 0.25 percent except in the case of 4130X steel which may be used with proper welding procedure.

§ 78.52-10 Wall thickness.

(a) The wall stress shall not exceed 18,000 pounds per square inch for cylinders with longitudinal side seam nor 24,000 pounds per square inch for cylinders without such seam: *Provided*, That a wall stress of not over 22,800 pounds per square inch is authorized for cylinders with copper brazed side seam having strength at least 3/2 times the strength of the steel wall. Minimum wall 0.090 inch for any cylinder over 5" outside diameter.

(b) Calculation must be made by the formula:

$$S = \frac{P(1.3D^2 + 0.4d^2)}{D^2 - d^2}$$

where

S=wall stress in pounds per square inch;
P=test pressure prescribed for water jacket test or 348 pounds per square inch whichever is the greater;
D=outside diameter in inches;
d=inside diameter in inches.

§ 78.52-11 Heat treatment.

(a) Body and heads formed by drawing or pressing must be uniformly and properly heat treated prior to tests.

§ 78.52-12 Openings in cylinders and connections (valves, fuse plugs, etc.) for those openings.

(a) Threads required to be clean cut, even, without checks, and to gauge.

(b) Taper threads, when used, to be of length not less than as specified for American Standard taper pipe threads.

(c) Straight threads having at least 6 engaged threads are authorized; to have tight fit and calculated shear strength at least 10 times the test pressure of the cylinders; gaskets required, adequate to prevent leakage.

§ 78.52-13 Safety devices and protection for valves, safety devices, and other connections, if applied.

(a) Must be as required by the Interstate Commerce Commission's regulations that apply (see §§ 73.34(f) and 73.301(i) of this chapter).

§ 78.52-14 Hydrostatic test.

(a) By water-jacket, or other suitable method, operated so as to obtain accurate data. Pressure gauge must permit reading to accuracy of 1 percent. Expansion gauge must permit reading of total expansion to accuracy either of 1 percent or 0.1 cubic centimeter.

(b) Pressure must be maintained for 30 seconds and sufficiently longer to insure complete expansion. Any internal pressure applied after heat-treatment and previous to the official test must not exceed 90 percent of the test pressure.

If, due to failure of the test apparatus, the test pressure cannot be maintained, the test may be repeated at a pressure increased by 10 percent or 100 pounds per square inch, whichever is the lower.

(c) Permanent volumetric expansion must not exceed 10 percent of total volumetric expansion at test pressure.

(d) Cylinders must be tested as follows: 1 cylinder out of each lot of 200 or less; to 3 times service pressure. Others must be examined under pressure of 2 times service pressure and show no defect. If tested cylinder fails, each cylinder in the lot may be tested; those passing are acceptable.

§ 78.52-15 Flattening test.

(a) Between knife edges, wedge shaped, 60° angle, rounded to 1/2" radius; test 1 cylinder¹ taken at random out of each lot of 200 or less, after hydrostatic test.

§ 78.52-16 Physical test.

(a) Required on 2 specimens cut from 1¹ cylinder, or part thereof heat treated as required, taken at random out of each lot of 200 or less.

(b) Specimens must be: Gauge length 8 inches with width not over 1 1/2 inches; or, gauge length 2 inches with width not over 1 1/2 inches; provided, that gauge length at least 24 times thickness with width not over 6 times thickness is authorized when cylinder wall is not over 3/16 inch thick. The specimen, exclusive of grip ends, must not be flattened. Grip ends may be flattened to within one inch of each end of the reduced section. When size of cylinder does not permit securing straight specimens, the specimens may be taken in any location or direction and may be straightened or flattened cold, by pressure only, not by blows; when specimens are so taken and prepared, the inspector's report must show in connection with record of physical tests detailed information in regard to such specimens. Heating of specimen for any purpose is not authorized.

(c) The yield strength in tension shall be the stress corresponding to a permanent strain of 0.2 percent of the gauge length.

(1) The yield strength shall be determined by either the "offset" method or the "extension under load" method as prescribed in ASTM Standard E8-57T.

(2) In using the "extension under load" method, the total strain (or "extension under load") corresponding to the stress at which the 0.2 percent permanent strain occurs may be determined with sufficient accuracy by calculating the elastic extension of the gauge length under approximate load and adding thereto 0.2 percent of the gauge length. Elastic extension calcu-

¹ For lots of 30 or less, physical and flattening tests are authorized to be made on a ring at least 8 inches long cut from each cylinder and subjected to the same heat treatment as the finished cylinder.

lations shall be based on an elastic modulus of 30,000,000. In the event of controversy, the entire stress-strain diagram shall be plotted and the yield strength determined from the 0.2 percent offset.

(3) For the purpose of strain measurement, the initial strain shall be set while the specimen is under a stress of 12,000 pounds per square inch, the strain indicator reading being set at the calculated corresponding strain.

(4) Cross-head speed of the testing machine shall not exceed 1/2 inch per minute during yield strength determination.

§ 78.52-17 Acceptable results for physical and flattening tests.

(a) Elongation at least 40 percent for 2 inch gauge length or at least 20 percent in other cases; yield strength not over 73 percent of tensile strength; flattening test not required.

Exception: Flattening test is required, without cracking, to 6 times wall thickness when cylinders are made of lap-welded pipe; in such case rings (crop ends) cut from each end of pipe must be tested with weld 45° or less from point of greatest stress; if a ring fails, another from the same end of pipe may be tested.

§ 78.52-18 Rejected cylinder.

(a) Reheat treatment authorized; subsequent thereto, acceptable cylinders must pass all prescribed tests. Repair of brazed seams by brazing and welded seams by welding is authorized.

§ 78.52-19 Marking.

(a) Marking on each cylinder by stamping plainly and permanently on shoulder, top head, or neck, provided that cylinders not less than 0.090" thick may be stamped on the side wall adjacent to the top head, as follows:

(1) ICC-4C followed by the service pressure (for example, ICC-4C300, etc.).

(2) A serial¹ number and an identifying symbol (letters); location² of number to be just below the ICC mark; location² of symbol to be just below the number. The symbol and numbers must be those of purchaser, user, or maker. The symbol must be registered with the Bureau of Explosives; duplications unauthorized.

(3) Inspector's official mark near serial number; date of test (such as 5-50 for May 1950), so placed that dates of subsequent tests can be easily added.

¹ Lot numbers, not over 500 cylinders in each lot, authorized for cylinders not over 2 inches outside diameter and for cylinders over 2 inches outside diameter when the volumetric capacity does not exceed 60 cubic inches.

² Symbol in front of or following the number with ample space between is also authorized. Other variation in location authorized only when necessitated by lack of space.

Example: ICC-4C300
1234
XY

§ 78.52-20 Size of marks.

(a) At least 1/4" high if space permits.

§ 78.52-21 Inspector's report.

(a) Required to be clear, legible, and in following form:

(Place) -----
(Date) -----
Gas cylinders
Manufactured for ----- Company
Location at -----
Manufactured by ----- Company
Location at -----
Consigned to ----- Company
Location at -----
Quantity -----
Size ----- inches outside diameter by -----
inches long
Marks stamped into the shoulder of the cylinder are:
Specification ICC- -----
Serial numbers ----- to ----- inclusive.
Inspector's mark -----
Identifying symbol (registered) -----
Test date -----
Tare weights (yes or no) -----
Other marks (if any) -----
These cylinders were made by process of -----

The ----- permitted
(neckrings, footrings, etc.)
in § 78.52-9 were attached by process of -----
(welding—brazing)
The material used was identified by the following ----- numbers
(heat-purchase order)

The material used was verified as to chemical analysis and record thereof is attached hereto. The heat numbers -----
(were—were not)
marked on the material.

All material, such as plates, billets and seamless tubing, was inspected and each cylinder was inspected both before and after closing in the ends; all that was accepted was found free from seams, cracks, laminations, and other defects which might prove injurious to the strength of the cylinder. The processes of manufacture and heat treatment of cylinders were supervised and found to be efficient and satisfactory.

The cylinder walls were measured and the minimum thickness noted was ---- inch. The outside diameter was determined by a close approximation to be ---- inches. The wall stress was calculated to be ---- pounds per square inch under an internal pressure of ---- pounds per square inch.

Hydrostatic tests, flattening tests, tensile tests of material, and other tests, as prescribed in specification No. ICC-4C were made in the presence of the inspector and all material and cylinders accepted were found to be in compliance with the requirements of that specification. Records thereof are attached hereto.

I hereby certify that all of these cylinders proved satisfactory in every way and comply with the requirements of Interstate Commerce Commission specification No. 4C except as follows:

Exceptions -----

(Signed) -----
Inspector.

compliance with requirements, is acceptable when verified by check analyses of samples taken from one cylinder out of each lot of 200 or less.

(c) Verify compliance of cylinders with all requirements including markings; inspect inside before closing in both ends; verify heat treatment as proper; obtain samples for all tests and check chemical analyses; witness all tests; verify threads by gauge; report volumetric capacity and tare weight (see rework form) and minimum thickness of wall noted.

(d) Render complete report (§ 78.53-20) to purchaser, cylinder maker, and the Bureau of Explosives.

§ 78.53-5 Steel.

(a) Open-hearth or electric steel of uniform and weldable quality. Content percent for the following not over: Carbon, 0.25; phosphorus, 0.045; sulphur, 0.050, except that the following steels commercially known as 4130X, Type 304, 316, 321, and 347 stainless steels may be used with proper welding procedure and complying with the following analyses:

4130X

Table with 2 columns: Element (Carbon, Manganese, Phosphorus, Sulfur, Silicon, Chromium, Molybdenum, Zirconium, Nickel) and Percent (0.26/0.35, 0.40/0.60, 0.04 max, 0.03 max, 0.20/0.30, 0.80/1.10, 0.10/0.15, 0.10/0.25).

Table titled 'Stainless steels' with columns for 304, 316, 321, and 347 (percent). Rows include Carbon, Manganese, Phosphorus, Sulfur, Silicon, Nickel, Chromium, Molybdenum, and Columbium.

1 Titanium shall be not less than 5X0 and not more than 0.60 percent. 2 Columbium shall be not less than 10X0 and not more than 1.0 percent.

The "service pressure" limits the use of the container. It is shown by marks on container, for example ICC-4C800 indicates the service pressure as 300 pounds per square inch.

§ 78.53 Specification 4D; inside containers, welded steel for aircraft use.

§ 78.53-1 Compliance.

(a) Required in all details.

§ 78.53-2 Type, size, and service pressure.

(a) Type and size. Welded steel spheres (two seamless hemispheres) or circumferentially welded cylinders (two seamless drawn shells) not over 1100 cubic inches capacity. Cylinders closed in by spinning process not authorized.

(b) Service pressure. At least 300 to not over 500 pounds per square inch.

§ 78.53-3 Inspection by whom and where.

(a) By competent inspector of the manufacturer, or a disinterested inspection agency; chemical analyses and tests, as specified, to be made within the limits of the United States.

§ 78.53-4 Duties of inspector.

(a) Inspect all material and reject any not complying with requirements; for cylinders made by billet-piercing process, billets to be inspected after nick and cold break.

(b) Verify chemical analysis of each heat of material by analysis or by obtaining certified analysis: Provided, That a certificate from the manufacturer thereof, giving sufficient data to indicate

Record of Chemical Analysis of Material for Cylinders. Includes fields for Numbered Size, Made by, Heat No., and chemical analysis table with columns O, P, S, Si, Mn, Ni, Cr.

Table for chemical analysis with columns O, P, S, Si, Mn, Ni, Cr and rows for Test No., Heat No., Check analysis No., and Cylinders represented (serial Nos.).

Record of Physical Tests of Material for Cylinders. Includes fields for Numbered Size, Made by, and test results for Yield strength, Tensile strength, Elongation, Reduction of area, and Flattening test.

Table for physical tests with columns: Test No., Cylinders represented by test (serial Nos.), Yield strength, Tensile strength, Elongation, Reduction of area, and Flattening test.

Record of Hydrostatic Tests on Cylinders. Includes fields for Numbered Size, Made by, and test results for Actual test pressure, Total expansion, Permanent expansion, Percent ratio of permanent expansion to total expansion, Tare weight, and Volumetric capacity.

Table for hydrostatic tests with columns: Serial Nos. of cylinders tested, Actual test pressure, Total expansion, Permanent expansion, Percent ratio of permanent expansion to total expansion, Tare weight, and Volumetric capacity.

Notes: When specifications require test for only 1 out of each lot of 200 or less cylinders, the check on the others must be indicated by a notation hereon reading, "Each cylinder was subjected to a pressure of ... pounds per square inch and showed no defect." If the tests are made by a method involving the measurement of the amount of liquid forced into the cylinder by the test pressure, then the basic data, on which the calculations are made, such as the pump factors, temperature of liquid, coefficient of compressibility of liquid, etc., must also be given.

§ 78.53-6 Identification of material.

(a) Required; any suitable method except that plates and billets for hot-drawn cylinders shall be marked with heat number.

§ 78.53-7 Defects.

(a) Material with seams, cracks, laminations, or other injurious defects, not authorized.

§ 78.53-8 Manufacture.

(a) By best appliances and methods; dirt and scale to be removed as necessary to afford proper inspection; no defect acceptable that is likely to weaken the finished container appreciably; reasonably smooth and uniform surface finish required.

§ 78.53-9 Wall thickness.

(a) The wall stress at minimum test pressure shall not exceed 24,000 pounds per square inch, except where steels commercially known as 4130X, Type 304, 316, 321, and 347 stainless steels are used, stress at test pressures shall not exceed 37,000 pounds per square inch. Minimum wall 0.040 inch for any diameter container.

(b) Calculation for a sphere must be made by the formula:

$$S = \frac{PD}{4tE}$$

where

S = wall stress in pounds per square inch;
 P = test pressure prescribed for water jacket test, i. e., at least two times service pressure, in pounds per square inch;
 D = outside diameter in inches;
 t = minimum wall thickness in inches;
 E = 0.85 (provides 85 percent weld efficiency factor which must be applied in the girth weld area and heat affected zones which zone shall extend a distance of 6 times wall thickness from center line of weld);
 E = 1.0 (for all other areas).

(c) Calculation for a cylinder must be made by the formula:

$$S = \frac{P(1.3D^2 + 0.4d^2)}{D^2 - d^2}$$

where

S = wall stress in pounds per square inch;
 P = test pressure prescribed for water jacket test, i. e., at least two times service pressure, in pounds per square inch;
 D = outside diameter in inches;
 d = inside diameter in inches.

§ 78.53-10 Heat treatment.

(a) The completed cylinders must be uniformly and properly heat-treated prior to tests.

§ 78.53-11 Openings in container.

(a) Each opening in container, except those for safety devices, must be provided with a fitting, boss, or pad, securely attached to container by brazing or by welding or by threads. If threads are used, they must comply with the following:

(1) Threads must be clean cut, even, without checks, and tapped to gauge.

(2) Taper threads to be of length not less than as specified for American Standard taper pipe threads.

(3) Straight threads, having at least 4 engaged threads, to have tight fit and calculated shear strength at least 10

times the test pressure of the container; gaskets required, adequate to prevent leakage.

(b) Closure of fitting, boss, or pad must be adequate to prevent leakage.

§ 78.53-12 Safety devices and protection for valves, safety devices, and other connections, if applied.

(a) Devices must be as required by the Interstate Commerce Commission's regulations that apply (see §§ 73.34(f) and 73.301(i) of this chapter).

§ 78.53-13 Hydrostatic test.

(a) By water-jacket, or other suitable method, operated so as to obtain accurate data. Pressure gauge must permit reading to accuracy of 1 percent. Expansion gauge must permit reading of total expansion to accuracy either of 1 percent or 0.1 cubic centimeter.

(b) Pressure must be maintained for 30 seconds and sufficiently longer to insure complete expansion. Any internal pressure applied after heat-treatment and previous to the official test must not exceed 90 percent of the test pressure. If, due to failure of the test apparatus, the test pressure cannot be maintained, the test may be repeated at a pressure increased by 10 percent or 100 pounds per square inch, whichever is the lower.

(c) Permanent volumetric expansion must not exceed 10 percent of total volumetric expansion at test pressure.

(d) Containers must be tested as follows:

(1) Each container to at least 2 times service pressure, or

(2) One container out of each lot of 200 or less to at least 3 times service pressure. Others must be examined under pressure of 2 times service pressure and show no defects.

§ 78.53-14 Flattening test for spheres and cylinders.

(a) *Flattening test for spheres.* Between parallel steel plates on a press with welded seam at right angles to the plates; test one sphere taken at random out of each lot of 200 or less after hydrostatic test. Any projecting appurtenances may be cut off (by mechanical means only) prior to crushing.

(b) *Flattening test for cylinders.* Between knife edges, wedge shaped, 60° angle, rounded to ½ inch radius; test one cylinder taken at random out of each lot of 200 or less, after hydrostatic test.

§ 78.53-15 Physical test and specimens for spheres and cylinders.

(a) *Physical test for spheres.* Required on 2 specimens cut from flat representative sample plate of the same heat taken at random from the steel used to produce the sphere. This flat steel from which the 2 specimens are to be cut must receive the same heat-treatment as the spheres themselves. Sample plates to be taken for each lot of 200 or less spheres.

(b) *Specimens for spheres.* Specimens must be gauge length 2 inches with width not over 1½ inches; provided, that gauge length at least 24 times thickness with width not over 6 times thickness

is authorized when wall of sphere is not over ⅜ inch thick.

(c) *Physical test for cylinders.* Required on 2 specimens cut from 1' cylinder taken at random out of each lot of 200 or less.

(d) *Specimens for cylinders.* Specimens must be gauge length 8 inches with width not over 1½ inches; or gauge length 2 inches with width not over 1½ inches; provided, that gauge length at least 24 times thickness with width not over 6 times thickness is authorized when cylinder wall is not over ⅜ inch thick. The specimen, exclusive of grip ends, must not be flattened. Grip ends may be flattened to within 1 inch of each end of the reduced section. Heating of specimen for any purpose is not authorized.

(e) The yield strength in tension shall be the stress corresponding to a permanent strain of 0.2 percent of the gauge length.

(1) The yield strength shall be determined by either the "offset" method or the "extension under load" method as prescribed in ASTM Standard E8-57T.

(2) In using the "extension under load" method, the total strain (or "extension under load") corresponding to the stress at which the 0.2 percent permanent strain occurs may be determined with sufficient accuracy by calculating the elastic extension of the gauge length under appropriate load and adding thereto 0.2 percent of the gauge length. Elastic extension calculations shall be based on an elastic modulus of 30,000,000. In the event of controversy, the entire stress-strain diagram shall be plotted and the yield strength determined from the 0.2 percent offset.

(3) For the purpose of strain measurement, the initial strain shall be set while the specimen is under a stress of 12,000 pounds per square inch, the strain indicator reading being set at the calculated corresponding strain.

(4) Cross-head speed of the testing machine shall not exceed ⅛ inch per minute during yield strength determination.

§ 78.53-16 Acceptable results for physical and flattening tests.

(a) Elongation at least 40 percent for 2 inch gauge length or at least 20 percent in other cases; yield strength not over 73 percent of tensile strength; flattening test not required.

(b) Elongation at least 20 percent for 2 inch gauge length or 10 percent in other cases; flattening required to 50 percent of the original outside diameter without cracking.

§ 78.53-17 Rejected cylinders.

(a) Reheat-treatment authorized; subsequent thereto, acceptable containers must pass all prescribed tests. Repair of welded seams by welding prior to reheat-treatment authorized.

¹ For lots of 30 or less, physical and flattening tests are authorized to be made on a ring at least 8 inches long cut from each cylinder and subjected to the same heat-treatment as the finished cylinder.

§ 78.53-18 Marking.

(a) Marking on each container by stamping plainly and permanently only where the metal is at least 0.09 inch thick, or on a metal nameplate permanently secured to the container by means other than soft solder, or by means that would not reduce the wall thickness, as follows:

- (1) ICC-4D followed by the service pressure (for example, ICC-4D300, etc.).
(2) A serial number and an identifying symbol (letters); location of number to be just below the ICC mark; location of symbol to be just below the number.
(3) Inspector's official mark, near serial number; date of test (such as 8-50 for August 1950), so placed that dates of subsequent tests can be easily added.

§ 78.53-19 Size of marks.

(a) Of sufficient size to be legible.

§ 78.53-20 Inspector's report.

(a) Required to be clear, legible, and in the following form:

(Place)
(Date)
Gas
(spheres-cylinders)
Manufactured for
Location at
Manufactured by
Location at
Consigned to
Location at
Quantity
Size inches outside diameter by inches long.
Marks stamped into the

(Shoulder-metal plate, § 78.53-18)
Specification ICC-
Serial numbers to inclusive.
Inspector's mark
Identifying symbol (registered)
Test date
Tare weights (yes or no)
Other marks (if any)
These containers were made by process of

The material used was identified by the following numbers (heat-purchase order)

The material used was verified as to chemical analysis and record thereof is attached hereto. The heat numbers (were-were not) marked on the material.

All material, such as plates, billets and seamless tubing, was inspected and each container was inspected both before and after closing in the ends; all that was ac-

1 Lot numbers, not over 500 cylinders in each lot, authorized for cylinders not over 2 inches outside diameter and for cylinders over 2 inches outside diameter when the volumetric capacity does not exceed 60 cubic inches.

2 Symbol in front or following the number with ample space between is also authorized. Other variation in location authorized only when necessitated by lack of space.

Example:
ICC-4D300
1234
XY

cepted was found free from seams, cracks, laminations, and other defects which might prove injurious to the strength of the container. The processes of manufacture and heat treatment of containers were supervised and found to be efficient and satisfactory.

The container walls were measured and the minimum thickness noted was inch. The outside diameter was determined by a close approximation to be inches. The wall stress was calculated to be pounds per square inch under an internal pressure of pounds per square inch.

Hydrostatic tests, flattening tests, tensile tests of material, and other tests, as pre-

scribed in specification No. ICC-4D were made in the presence of the inspector and all material and containers accepted were found to be in compliance with the requirements of that specification. Records thereof are attached hereto.

I hereby certify that all of these containers proved satisfactory in every way and comply with the requirements of Interstate Commerce Commission specification No. 4D except as follows:

Exceptions:
(Signed)
Inspector.

(Place)
(Date)

RECORD OF CHEMICAL ANALYSIS OF MATERIAL FOR CONTAINERS

Numbered to inclusive.
Size inches outside diameter by inches long
Made by Company
For Company
NOTE: Any omission of analyses by heats, if authorized, must be accounted for by notation hereon reading, "The prescribed certificate of the manufacturer of material has been secured, found satisfactory, and placed on file," or by attaching a copy of the certificate.

Table with columns: Test No., Heat No., Check analysis No., Containers represented (serial Nos.), Chemical analysis (C, P, S, Si, Mn, Ni, Cr)

The analyses were made by
(Signed)

(Place)
(Date)

RECORD OF PHYSICAL TESTS OF MATERIAL FOR CONTAINERS

Numbered to inclusive.
Size inches outside diameter by inches long
Made by Company
For Company

Table with columns: Test No., Containers represented by test (serial Nos.), Yield strength (pounds per square inch), Tensile strength (pounds per square inch), Elongation (percent in 8 inches), Reduction of area (percent), Flattening test

(Signed)

(Place)
(Date)

RECORD OF HYDROSTATIC TESTS ON CONTAINERS

Numbered to inclusive.
Size inches outside diameter by inches long
Made by Company
For Company

Table with columns: Serial Nos. of containers tested arranged numerically, Actual test pressure (pounds per square inch), Total expansion (cubic centimeters), Permanent expansion (cubic centimeters), Percent ratio of permanent expansion to total expansion, Tare weight (pounds), Volumetric capacity

NOTE: When specifications require test for only 1 out of each lot of 200 or less containers, the check on the others must be indicated by a notation hereon reading, "Each container was subjected to a pressure of pounds per square inch and showed no defect."

1 If the tests are made by a method involving the measurement of the amount of liquid forced into the container by the test pressure, then the basic data, on which the calculations are made, such as the pump factors, temperature of liquid, coefficient of compressibility of liquid, etc., must also be given.

2 Do not include removable cap but state whether with or without valve. These weights must be accurate to a tolerance of 1 percent.

(Signed)

§ 78.54 Specification 4B240-FLW; welded or welded and brazed cylinders with fusion-welded longitudinal seam.

§ 78.54-1 Compliance.

(a) Required in all details.

§ 78.54-2 Type, size, and service pressure.

(a) *Type and size.* Must be welded or brazed type with longitudinal fusion-welded seam. 240 pounds nominal water capacity. Cylinders closed in by spinning process not authorized.

(b) *Service pressure.*¹ 240 pounds per square inch.

§ 78.54-3 Inspection by whom and where.

(a) By competent and disinterested inspector acceptable to the Bureau of Explosives; chemical analyses and tests, as specified, to be made within limits of the United States.

§ 78.54-4 Duties of inspector.

(a) Inspect all material and reject any not complying with requirements.

(b) Verify chemical analysis of each heat of material by analysis or by obtaining certified analysis: *Provided*, That a certificate from the manufacturer thereof, giving sufficient data to indicate compliance with requirements, is acceptable when verified by check analyses of samples taken from one cylinder out of each lot of 200 or less.

(c) Verify compliance of cylinders with all requirements including markings; inspect inside before closing in both ends; verify heat treatment as proper; obtain samples for all tests and check chemical analyses; witness all tests; verify threads by gauge; report volumetric capacity and tare weight (see report form) and minimum thickness of wall noted.

(d) Render complete report (§ 78.54-22) to purchaser, cylinder maker, and the Bureau of Explosives.

§ 78.54-5 Steel.

(a) Steel shall be plain carbon steel of American Society for Testing Materials firebox quality with carbon content not in excess of 0.25 percent.

§ 78.54-6 Identification of material.

(a) Required; any suitable method.

§ 78.54-7 Defects.

(a) Material with seams, cracks, laminations, or other injurious defects, not authorized.

§ 78.54-8 Manufacture.

(a) By best appliances and methods; dirt and scale to be removed as necessary to afford proper inspection; no defect acceptable that is likely to weaken the finished cylinder appreciably; reasonably smooth and uniform surface finish required. Exposed bottom welds on cylinders over 18" long must be protected by footings. Seams must be made as follows:

¹ The "service pressure" limits the use of the cylinder. It is shown by marks on cylinder; for example, ICC 4B240-FLW.

(1) Circumferential seams by welding or by brazing: Heads attached by brazing must have a driving fit with the shell, unless the shell is crimped, swaged, or curled over the skirt or flange of the head, and be thoroughly brazed until complete penetration by the brazing material of the brazed joint is secured. Depth of brazing from end of shell must be at least four times the thickness of shell metal.

(2) Longitudinal fusion-welded seam shall be of the double-welded butt type. Filler metal may be added from one side when and if means are provided for accomplishing complete penetration and reinforcement on both sides of the joint. For welding the cylinder, procedure and operators must be qualified in accordance with the sections that apply in the Compressed Gas Association's "Standards for Welding and Brazing on Thin Walled Containers" (CGA Pamphlet C-3-1954).²

§ 78.54-9 Welding or brazing.

(a) The attachment to the tops and bottoms only of cylinders by welding or brazing of neckrings, footings, handles, bosses, pads, and valve protection rings is authorized provided that such attachments and the portion of the container to which they are attached are made of weldable steel, the carbon content of which must not exceed 0.25 percent.

§ 78.54-10 Wall thickness.

(a) For outside diameters over 5 inches the minimum wall thickness shall be 0.090 inch. In any case the minimum wall thickness shall be such that calculated wall stress at 480 pounds per square inch shall not exceed 18,000 pounds per square inch.

(b) Calculation must be made by the formula:

$$S = \frac{P(1.3D^2 + 0.4d^2)}{D^2 - d^2}$$

where

S = wall stress in pounds per square inch;

P = 480 pounds per square inch;

D = outside diameter in inches;

d = inside diameter in inches.

§ 78.54-11 Heat treatment.

(a) Each cylinder shall be thermally stress-relieved after all initial welding and seam repair welding operations have been completed and prior to the hydrostatic test.

§ 78.54-12 Openings in cylinders.

(a) Each opening in cylinders, except those for safety devices, must be provided with a fitting, boss, or pad, securely attached to cylinder by brazing or by welding or by threads. Fitting, boss, or pad must be of steel suitable for the method of attachment employed, and which need not be identified or verified as to analysis, except that if attachment is by welding, carbon content must not exceed 0.25 percent. If threads are used, they must comply with the following:

(1) Threads must be clean cut, even, without checks, and tapped to gauge.

² Available from the Compressed Gas Association, Inc., 500 Fifth Avenue, New York 36, New York.

(2) Taper threads to be of length not less than as specified for American Standard taper pipe threads.

(3) Straight threads, having at least 4 engaged threads, to have tight fit and calculated shear strength at least 10 times the test pressure of the cylinder; gaskets required, adequate to prevent leakage.

(b) Closure of fitting, boss, or pad must be adequate to prevent leakage.

§ 78.54-13 Safety devices and protection for valves, safety devices, and other connections, if applied.

(a) Devices must be as required by the Interstate Commerce Commission's regulations that apply (see §§ 73.34(f) and 73.301(i) of this chapter).

§ 78.54-14 Hydrostatic test.

(a) By water-jacket, or other suitable method, operated so as to obtain accurate data. Pressure gauge must permit reading to accuracy of 1 percent. Expansion gauge must permit reading of total expansion to accuracy either of 1 percent or 0.1 cubic centimeter.

(b) Pressure must be maintained for 30 seconds and sufficiently longer to insure complete expansion. Any internal pressure applied after heat-treatment and previous to the official test must not exceed 90 percent of the test pressure. If, due to failure of the test apparatus, the test pressure cannot be maintained, the test may be repeated at a pressure increased by 10 percent or 100 pounds per square inch, whichever is the lower.

(c) Permanent volumetric expansion must not exceed 10 percent of total volumetric expansion at test pressure.

(d) Each cylinder shall be subjected to the hydrostatic test and test pressure shall be at least two and two thirds times the service pressure. Following this test, each cylinder shall be subjected to a dry air-pressure test of two times the service pressure. The cylinder shall be thoroughly dry before air test is applied, and during test welded seams shall be examined for leaks, either by submerging the cylinders in liquid, or by painting all welded seams with a solution suitable for the detection of leaks.

(e) One finished cylinder out of each lot, which appears to the inspector to be the least likely to meet the test, shall be selected by the inspector from each lot of 200 or less successively produced and shall be hydrostatically tested to destruction and shall not burst at a pressure less than six times the service pressure.

§ 78.54-15 Physical test.

(a) To determine yield strength, tensile strength, elongation, and reduction of area of material. Required on 2 specimens cut from 1¹ cylinder, or part thereof heat-treated as required, taken at random out of each lot of 200 or less.

(b) Specimens must be: Gauge length 8 inches with width not over 1½

¹ For lots of 30 or less, physical tests are authorized to be made on a ring at least 8 inches long cut from each cylinder and subjected to same heat treatment as the finished cylinder.

inches; or, gauge length 2 inches with width not over 1 1/2 inches; provided, that gauge length at least 24 times thickness with width not over 6 times thickness is authorized when cylinder wall is not over 3/16 inch thick. The specimen, exclusive of grip ends, must not be flattened. Grip ends may be flattened to within one inch of each end of the reduced section. When size of cylinder does not permit securing straight specimens, the specimens may be taken in any location or direction and may be straightened or flattened cold, by pressure only, not by blows; when specimens are so taken and prepared, the inspector's report must show in connection with record of physical tests detailed information in regard to such specimens. Heating of specimen for any purpose is not authorized.

(c) The yield strength in tension shall be the stress corresponding to a permanent strain of 0.2 percent of the gauge length.

(1) The yield strength shall be determined by either the "offset" method or the "extension under load" method as prescribed in ASTM Standard E8-57T.

(2) In using the "extension under load" method, the total strain (or "extension under load") corresponding to the stress at which the 0.2 percent permanent strain occurs may be determined with sufficient accuracy by calculating the elastic extension of the gauge length under appropriate load and adding thereto 0.2 percent of the gauge length. Elastic extension calculations shall be based on an elastic modulus of 30,000,000. In the event of controversy, the entire stress-strain diagram shall be plotted and the yield strength determined from the 0.2 percent offset.

(3) For the purpose of strain measurement, the initial strain shall be set while the specimen is under a stress of 12,000 pounds per square inch, the strain indicator reading being set at the calculated corresponding strain.

(4) Cross-head speed of the testing machine shall not exceed 1/8 inch per minute during yield strength determination.

§ 78.54-16 Acceptable results for physical tests.

(a) Elongation at least 40 percent for 2 inch gauge length or at least 20 percent in other cases; yield strength not over 73 percent of tensile strength; flattening test not required.

§ 78.54-17 Weld tests.

(a) Guided bend test. A "root" bend test specimen shall be cut from the cylinder or welded test plate, used for the tensile test specified in § 78.54-15(a). Specimens shall be taken across the major seam and shall be prepared and tested in accordance with and shall meet the requirements of the Compressed Gas Association's "Standards for Welding

and Brazing on Thin Walled Containers" (CGA Pamphlet C-3-1954).³

(b) In addition to the guided bend test, a reduced section tension test shall be made transverse to the weld. The tensile strength shall be not less than 100 percent of the minimum of the specified tensile range of the base material used. Should this specimen fail to meet the requirements two additional specimens from the same cylinder shall be tested and if either of these fail to meet the requirements, the entire lot represented shall be rejected.

§ 78.54-18 Radiographic examination.

(a) The techniques and acceptability of radiographic inspection shall conform to the standards set forth in the Compressed Gas Association's "Standards for Welding and Brazing on Thin Walled Containers" (CGA Pamphlet C-3-1954).²

(b) Cylinders must be examined as follows:

(1) One finished longitudinal seam shall be selected at random from each lot of 100 or less successively produced and be radiographed throughout its entire length. Should the radiographic examination fail to meet the requirements of paragraph (a) of this section, two additional seams of the same lot shall be examined, and if either of these fail to meet the requirements, each cylinder may be examined as outlined above; only those passing are acceptable.

§ 78.54-19 Rejected cylinders.

(a) Reheat treatment authorized; subsequent thereto, acceptable cylinders must pass all prescribed tests. Repair of brazed seams by brazing and welded seams by welding is authorized.

§ 78.54-20 Marking.

(a) Marking required on each cylinder by stamping plainly and permanently on shoulder, top head, or neck as follows:

(1) ICC-4B240-FLW.
(2) A serial number and an identifying symbol (letters); location¹ of number to be just below the ICC mark; location¹ of symbol to be just below the number. The symbol and numbers must be those of the purchaser, user, or maker. The symbol must be registered with the Bureau of Explosives; duplications unauthorized.

(3) Inspector's official mark near serial number, date of test (such as 12-50

¹ Symbol in front of or following the number with ample space between or symbol and serial number stamped into welded or brazed-on valve spud directly above the ICC specification mark located on head of cylinder are also authorized. Other variations in location authorized only when necessitated by lack of space.

Example:

ICC-4B240-FLW
1234
XY

² Available from the Compressed Gas Association, Inc., 500 Fifth Avenue, New York 36, New York.

for December 1950), so placed that dates of subsequent test can be easily added.
§ 78.54-21 Size of marks.

(a) At least 1/4" high if space permits.

§ 78.54-22 Inspector's report.

(a) Required to be clear, legible, and in following form:

(Place) _____
(Date) _____
Gas cylinders
Manufactured for _____ Company
Location at _____
Manufactured by _____ Company
Location at _____
Consigned to _____ Company
Location at _____
Quantity _____
Size ___ inches outside diameter by ___ inches long.
Marks stamped into the shoulder of the cylinder are:
Specification ICC- _____
Serial numbers ___ to ___ inclusive.
Inspector's mark _____
Identifying symbol (registered) _____
Test date _____
Tare weights (yes or no) _____
Other marks (if any) _____
These cylinders were made by process of _____
_____ permitted
(neckrings, footrings, etc.)
in § 78.54-9 were attached by process of _____
(welding-brazing)
The material used was identified by the following _____ numbers
(heat-purchase order)

The material used was verified as to chemical analysis and record thereof is attached hereto. The heat numbers _____ marked on the material.
(were-were not)

All material, such as plates, billets and seamless tubing, was inspected and each cylinder was inspected both before and after closing in the ends; all that was accepted was found free from seams, cracks, laminations, and other defects which might prove injurious to the strength of the cylinder. The processes of manufacture and heat treatment of cylinders were supervised and found to be efficient and satisfactory.

The cylinder walls were measured and the minimum thickness noted was ___ inch. The outside diameter was determined by a close approximation to be ___ inches. The wall stress was calculated to be ___ pounds per square inch under an internal pressure of ___ pounds per square inch.

Hydrostatic tests, tensile tests of material, and other tests, as prescribed in specification No. ICC-4B240FLW were made in the presence of the inspector and all material and cylinders accepted were found to be in compliance with the requirements of that specification. Records thereof are attached hereto.

I hereby certify that all of these cylinders proved satisfactory in every way and comply with the requirements of Interstate Commerce Commission specification No. 4B240FLW except as follows:
Exceptions: _____

(Signed) _____
Inspector.

RULES AND REGULATIONS

(Place) _____
(Date) _____

RECORD OF CHEMICAL ANALYSIS OF MATERIAL FOR CYLINDERS

Numbered _____ to _____ inclusive.
Size _____ inches outside diameter by _____ inches long
Made by _____ Company
For _____ Company

NOTE: Any omission of analyses by heats, if authorized, must be accounted for by notation hereon reading, "The prescribed certificate of the manufacturer of material has been secured, found satisfactory, and placed on file," or by attaching a copy of the certificate.

Test No.	Heat No.	Check analysis No.	Cylinders represented (serial Nos.)	Chemical analysis						
				O	P	S	Si	Mn	Ni	Cr

The analyses were made by _____ (Signed) _____

(Place) _____
(Date) _____

RECORD OF PHYSICAL TESTS OF MATERIAL FOR CYLINDERS

Numbered _____ to _____ inclusive.
Size _____ inches outside diameter by _____ inches long
Made by _____ Company
For _____ Company

Test No.	Cylinders represented by test (serial Nos.)	Yield strength (pounds per square inch)	Tensile strength (pounds per square inch)	Elongation (percent in 8 inches)	Reduction of area (percent)

(Signed) _____

(Place) _____
(Date) _____

RECORD OF WELD AND BURST TESTS

Numbered _____ to _____ inclusive.
Size _____ inches outside diameter by _____ inches long
Made by _____ Company
For _____ Company

Test No.	Cylinders represented by test (serial Nos.)	Root bend test acceptable (yes or no)	Transverse test acceptable (yes or no)	Radiographic examination acceptable (yes or no)	Burst test (pounds per square inch)

Radiographic technique employed consisted of _____ (Signed) _____

(Place) _____
(Date) _____

RECORD OF HYDROSTATIC TESTS ON CYLINDERS

Numbered _____ to _____ inclusive.
Size _____ inches outside diameter by _____ inches long
Made by _____ Company
For _____ Company

Serial Nos. of cylinders tested arranged numerically	Actual test pressure (pounds per square inch)	Total expansion (cubic centimeters) ¹	Permanent expansion (cubic centimeters) ¹	Percent ratio of permanent expansion to total expansion ¹	Tare weight (pounds) ²	Volumetric capacity ³

¹ If the tests are made by a method involving the measurement of the amount of liquid forced into the cylinder by the test pressure, then the basic data, on which the calculations are made, such as the pump factors, temperature of liquid, coefficient of compressibility of liquid, etc., must also be given.

² Do not include removable cap but state whether with or without valve. These weights must be accurate to a tolerance of 1 percent.

³ Report approximate maximum and minimum volumetric capacity for the lot. (Signed) _____

§ 78.55 Specification 4B240ET; welded and brazed cylinders made from electric resistance welded tubing.

§ 78.55-1 Compliance.

(a) Required in all details.

§ 78.55-2 Type, spinning process, size and service pressure.

(a) Type. Cylinders must be of brazed type made from electric resistance welded tubing which has been certified to have been pressure tested to a fiber stress of 24,000 pounds per square inch, as calculated by the formula:

$$P = \frac{24,000(D^2 - d^2)}{(1.3D^2 + 0.4d^2)}$$

where P is the pressure required for pressure testing of tubing. Pressure shall be maintained for not less than 30 seconds. Lengths of tubing that leak must be rejected. No repairs permitted.

(b) Spinning process. Cylinders closed in by spinning process authorized.

(c) Size. The maximum water capacity of this type shall not exceed 12 pounds or 333 cubic inches. The maximum outside diameter of the shell shall be five inches and maximum length of shell 21 inches.

(d) Service pressure.¹ Must be 240 pounds per square inch.

§ 78.55-3 Inspection by whom and where.

(a) By competent inspector; chemical analyses and tests, as specified, to be made within limits of the United States. Interested inspectors are authorized.

§ 78.55-4 Duties of inspector.

Inspector shall: (a) Inspect all material and reject any not complying with requirements; for cylinders made by billet-piercing process, billets to be inspected after nick and cold break.

(b) Verify chemical analysis of each heat of material by analysis or by obtaining certified analysis: Provided, That a certificate from the manufacturer thereof, giving sufficient data to indicate compliance with requirements, is acceptable when verified by check analyses of samples taken from one cylinder out of each lot of 200 or less.

(c) Verify compliance of cylinders with all requirements including markings; inspect inside before closing in both ends; verify heat treatment as proper; obtain samples for all tests and check chemical analyses; witness all tests; verify threads by gauge; report volumetric capacity and tare weight (see report form) and minimum thickness of wall noted.

(d) Render complete report (§ 78.55-22) to purchaser, cylinder maker, and the Bureau of Explosives.

§ 78.55-5 Steel.

(a) Open hearth or electric steel of uniform quality. Plain carbon steel content percent for the following not over: carbon, 0.25; phosphorus, 0.045; sulfur, 0.050. The addition of other elements for alloying effect is prohibited.

¹ The "service pressure" limits the use of the cylinder. It is shown by marks on cylinder; for example, ICC-4B240ET indicates the service pressure as 240 pounds per square inch.

§ 78.55-6 Identification of material.

(a) Required; any suitable method.

§ 78.55-7 Defects.

(a) Material with seams, cracks, laminations, or other injurious defects, not authorized.

§ 78.55-8 Manufacture.

(a) By best appliances and methods; dirt and scale to be removed as necessary to afford proper inspection; no defect acceptable that is likely to weaken the finished cylinder appreciably; reasonably smooth and uniform surface finish required. Heads may be attached to shells by lap brazing or may be formed integrally. The thickness of the bottom of cylinders welded or formed by spinning is, under no condition, to be less than two times the minimum wall thickness of the cylindrical shell; such bottom thicknesses to be measured within an area bounded by a line representing the points of contact between the cylinder and floor when the cylinder is in a vertical position. Seams must be made as follows:

(b) Circumferential seams: By brazing only. Heads attached to shells by the lap brazing method shall overlap not less than four times wall thickness. Brazing material shall have a melting point of not less than 1000° F. Heads must have a driving fit with the shell unless the shell is crimped, swedged, or curled over the skirt or flange of the head and be thoroughly brazed until complete penetration of the joint by the brazing material is secured. Brazed joints may be repaired by brazing.

(c) Longitudinal seams in shell: Electric resistance welded joints only. No repairs to longitudinal joints permitted.

§ 78.55-9 Welding or brazing.

(a) The attachment to the tops and bottoms only of cylinders by welding or brazing of neckrings, footrings, handles, bosses, pads, and valve protection rings is authorized provided that such attachments and the portion of the container to which they are attached are made of weldable steel, the carbon content of which must not exceed 0.25 percent.

§ 78.55-10 Wall thickness.

(a) The wall stress at two times service pressure shall not exceed 18,000 pounds per square inch. Minimum thickness shall be 0.044 inch.

(b) Calculation must be made by the formula:

$$S = \frac{P(1.3D^2 + 0.4d^2)}{D^2 - d^2}$$

where

S=wall stress in pounds per square inch;
P=2 times service pressure;
D=outside diameter in inches;
d=inside diameter in inches.

§ 78.55-11 Heat treatment.

(a) Heads formed by drawing or pressing must be uniformly and properly heat treated prior to tests.

(b) Cylinders with integral formed heads or bases must be subjected to a normalizing operation. Normalizing and brazing operations may be combined, provided the operation is carried out at

a temperature in excess of the upper critical temperature of the steel.

§ 78.55-12 Openings in cylinders.

(a) Each opening in cylinders, except those for safety devices, must be provided with a fitting, boss, or pad, securely attached to cylinder by brazing or by welding or by threads. Fitting, boss, or pad must be of steel suitable for the method of attachment employed, and which need not be identified or verified as to analysis, except that if attachment is by welding, carbon content must not exceed 0.25 percent. If threads are used, they must comply with the following:

(1) Threads must be clean cut, even, without checks, and tapped to gauge.

(2) Taper threads to be of length not less than as specified for American Standard taper pipe threads.

(3) Straight threads, having at least 4 engaged threads, to have tight fit and calculated shear strength at least 10 times the test pressure of the cylinder; gaskets required, adequate to prevent leakage.

(b) Closure of fitting, boss, or pad must be adequate to prevent leakage.

§ 78.55-13 Safety devices and protection for valves, safety devices, and other connections, if applied.

(a) Devices must be as required by the Interstate Commerce Commission's regulations that apply (see §§ 73.34(f) and 73.301(i) of this chapter).

§ 78.55-14 Hydrostatic test.

(a) By water-jacket, or other suitable method, operated so as to obtain accurate data. Pressure gauge must permit reading to accuracy of 1 percent. Expansion gauge must permit reading of total expansion to accuracy either of 1 percent or 0.1 cubic centimeter.

(b) Pressure must be maintained for 30 seconds and sufficiently longer to insure complete expansion. Any internal pressure applied after heat-treatment and previous to the official test must not exceed 90 percent of the test pressure. If, due to failure of the test apparatus, the test pressure cannot be maintained, the test may be repeated at a pressure increased by 10 percent or 100 pounds per square inch, whichever is the lower.

(c) Permanent volumetric expansion must not exceed 10 percent of total volumetric expansion at test pressure.

(d) Cylinders must be tested as follows:

(1) At least one cylinder selected at random out of each lot of 200 or less shall be tested as outlined in paragraphs (a), (b), and (c) of this section to at least two times service pressure.

(2) All cylinders not tested as outlined in subparagraph (1) of this paragraph must be examined under pressure of at least two times service pressure and show no defect.

(e) Each 1000 cylinders or less successively produced each day shall constitute a lot. One cylinder shall be selected from each lot and hydrostatically tested to destruction. If this cylinder bursts below five times the service pressure, then two additional cylinders must be selected and subjected to this test.

If either of these cylinders fails by bursting below five times the service pressure, then the entire lot must be rejected. All cylinders constituting a lot shall be of identical size, construction, heat-treatment, finish, and quality.

§ 78.55-15 Flattening test.

(a) Between knife edges, wedge shaped, 60° angle, rounded to 1/2" radius; test 1 cylinder taken at random out of each lot of 200 or less, after hydrostatic test.

§ 78.55-16 Physical test.

(a) To determine yield strength, tensile strength, elongation, and reduction of area of material. Required on 2 specimens cut from 1 cylinder, or part thereof heat-treated as required, taken at random out of each lot of 200 or less in the case of cylinders of capacity greater than 86 cubic inches and out of each lot of 500 or less for cylinders having a capacity of 86 cubic inches or less.

(b) Specimens must be: Gauge length 8 inches with width not over 1 1/2 inches; or, gauge length 2 inches with width not over 1 1/2 inches; provided, that gauge length at least 24 times thickness with width not over 6 times thickness is authorized when cylinder wall is not over 3/16 inch thick. The specimen, exclusive of grip ends, must not be flattened. Grip ends may be flattened to within one inch of each end of the reduced section. When size of cylinder does not permit securing straight specimens, the specimens may be taken in any location or direction and may be straightened or flattened cold, by pressure only, not by blows; when specimens are so taken and prepared, the inspector's report must show in connection with record of physical tests detailed information in regard to such specimens. Heating of specimen for any purpose is not authorized.

(c) The yield strength in tension shall be the stress corresponding to a permanent strain of 0.2 percent of the gauge length.

(1) The yield strength shall be determined by either the "offset" method or the "extension under load" method as prescribed in ASTM Standard E8-57T.

(2) In using the "extension under load" method, the total strain (or "extension under load") corresponding to the stress at which the 0.2 percent permanent strain occurs may be determined with sufficient accuracy by calculating the elastic extension of the gauge length under appropriate load and adding thereto 0.2 percent of the gauge length. Elastic extension calculations shall be based on an elastic modulus of 30,000,000. In the event of controversy, the entire stress-strain diagram shall be plotted and the yield strength determined from the 0.2 percent offset.

(3) For the purpose of strain measurement, the initial strain shall be set while the specimen is under a stress of 12,000 pounds per square inch, the strain indicator reading being set at the calculated corresponding strain.

(4) Cross-head speed of the testing machine shall not exceed 1/8 inch per minute during yield strength determination.

§ 78.55-17 Acceptable results for physical and flattening tests.

(a) Elongation at least 40 percent for 2 inch gauge length or at least 20 percent in other cases; yield strength not over 73 percent of tensile strength; flattening test required, without cracking, to six times wall thickness with weld 90° from direction of applied load. Two rings cut from the ends of length of pipe used in production of a lot may be used for flattening test provided the rings accompany the lot which they represent in all thermal processing operations. At least one of the rings must pass the flattening test.

§ 78.55-18 Leakage test.

(a) All spun cylinders and plugged cylinders (see Notes 1 and 2) must be tested for leakage by gas or air pressure after the bottom has been cleaned and is free from all moisture. Pressure, approximately the same as but no less than service pressure, must be applied to one side of the finished bottom over an area of at least 1/16 of the total area of the bottom but not less than 3/4" in diameter, including the closure, for at least 1 minute, during which time the other side of the bottom exposed to pressure must be covered with water and closely examined for indications of leakage. Leakers must be rejected. (See § 78.55-19 (a) (1).)

NOTE 1: A spun cylinder is one in which an end closure in the finished cylinder has been welded by the spinning process.

NOTE 2: A plugged cylinder is one in which a permanent closure in the bottom of a finished cylinder has been effected by a plug.

NOTE 3: As a safety precaution, if the manufacturer elects to make this test before the hydrostatic test, he should design his apparatus so that the pressure is applied to the smallest area practicable, around the point of closure, and so as to use the smallest possible volume of air or gas.

§ 78.55-19 Rejected cylinders.

(a) *Repairs authorized.* Leakers must be rejected, except that:

(1) Spun cylinders rejected under the provisions of § 78.55-18 may be removed from the spun cylinder category by drilling to remove defective material, tapping, and plugging.

(2) Brazed joints may be rebrazed.

(3) Subsequent to the operations noted above in subparagraphs (1) and (2) of this paragraph, acceptable cylinders must pass all prescribed tests.

§ 78.55-20 Marking.

(a) Marking on each cylinder by stamping plainly and permanently on shoulder, top head, neck or valve protection collar which is permanently attached to the cylinders and forming an integral part thereof, provided that cylinders not less than 0.090 inch thick may be stamped on the side wall adjacent to top head, as follows:

(1) ICC-4B240ET.

(2) A serial number and an identifying symbol (letters); location of number to be just below the ICC mark; location of symbol to be just below the serial number. The symbol and numbers must be those of purchaser, user, or maker. The symbol must be registered with the Bureau of Explosives; duplications unauthorized.

(3) Inspector's official mark, near serial number; date of test (such as 5-50 for May 1950), so placed that date of subsequent test can be easily added; and word "SPUN" or "PLUG" near ICC mark when an end closure in the finished cylinder has been welded by the spinning process or effected by plugging.

§ 78.55-21 Size of marks.

(a) At least 1/4" high if space permits.

§ 78.55-22 Inspector's report.

(a) Required to be clear, legible, and in following form:

(Place) _____
(Date) _____

Gas cylinders

Manufactured for _____ Company
Location at _____
Manufactured by _____ Company
Location at _____
Consigned to _____ Company

¹ Lot numbers, not over 500 cylinders in each lot, authorized for cylinders not over 2 inches outside diameter and for cylinders over 2 inches outside diameter when the volumetric capacity does not exceed 170 cubic inches.

² Symbol in front of or following the number with ample space between or symbol and serial number stamped into welded or brazed-on valve spud directly above the ICC specification mark located on head of cylinder are also authorized. Other variations in location authorized only when necessitated by lack of space.

Example:
ICC-4B240ET
1234
XY

Location at _____
Quantity _____
Size _____ inches outside diameter by _____ inches long.
Marks stamped into the shoulder of the cylinder are:
Specification ICC- _____
Serial numbers _____ to _____ inclusive.
Inspector's mark _____
Identifying symbol (registered) _____
Test date _____
Tare weights (yes or no) _____
Other marks (if any) _____
These cylinders were made by process of _____

The _____ permitted in (neckrings, footrings, etc.)
§ 78.55-9 were attached by process of _____

(welding—brazing)
The material used was identified by the following _____ numbers _____ (heat-purchase order)

The material used was verified as to chemical analysis and record thereof is attached hereto. The heat numbers _____ (were—were not)

marked on the material.

All material such as plates, billets and electric resistance welded tubing, was inspected and each cylinder was inspected both before and after closing in the ends; all that was accepted was found free from seams, cracks, laminations, and other defects which might prove injurious to the strength of the cylinder. The processes of manufacture and heat treatment of cylinders were supervised and found to be efficient and satisfactory.

The cylinder walls were measured and the minimum thickness noted was _____ inch. The outside diameter was determined by a close approximation to be _____ inches. The wall stress was calculated to be _____ pounds per square inch under an internal pressure of _____ pounds per square inch.

Hydrostatic tests, flattening tests, tensile tests of material, and other tests, as prescribed in specification No. ICC-4B-ET were made in the presence of the inspector and all material and cylinders accepted were found to be in compliance with the requirements of that specification. Records thereof are attached hereto.

A certificate of test on the electric resistance tubing has been obtained from the tubing manufacturer. Records thereof are attached hereto.

I hereby certify that all of these cylinders proved satisfactory in every way and comply with the requirements of Interstate Commerce Commission specification No. ICC-4B-ET except as follows:

Exceptions _____

(Signed) _____ Inspector.

(Place) _____
(Date) _____

RECORD OF CHEMICAL ANALYSIS OF MATERIAL FOR CYLINDERS

Numbered _____ to _____ inclusive.
Size _____ inches outside diameter by _____ inches long
Made by _____ Company
For _____ Company
Note: Any omission of analyses by heats, if authorized, must be accounted for by notation hereon reading "The prescribed certificate of the manufacturer of material has been secured, found satisfactory, and placed on file," or by attaching a copy of the certificate.

Test No.	Heat No.	Check analysis No.	Cylinders represented (serial Nos.)	Chemical analysis						
				C	P	S	Si	Mn	Ni	Cr

The analyses were made by _____ (Signed) _____
(Place) _____
(Date) _____

RECORD OF PHYSICAL TESTS OF MATERIAL FOR CYLINDERS

Numbered _____ to _____ inclusive.
Size _____ inches outside diameter by _____ inches long
Made by _____ Company
For _____ Company

Test No.	Cylinders represented by test (serial Nos.)	Yield strength (pounds per square inch)	Tensile strength (pounds per square inch)	Elongation (percent in 8 inches)	Reduction of area (percent)	Flattening test	Bursting test (pounds per square inch)

(Place) _____
(Date) _____

RECORD OF HYDROSTATIC TESTS ON CYLINDERS

Numbered _____ to _____ inclusive.
Size _____ inches outside diameter by _____ inches long
Made by _____ Company
For _____ Company

Serial Nos. of cylinders tested arranged numerically	Actual test pressure (pounds per square inch)	Total expansion (cubic centimeters) ¹	Permanent expansion (cubic centimeters) ¹	Percent ratio of permanent expansion to total expansion ¹	Tare weight (pounds) ²	Volumetric capacity ³

Note: When specifications require test for only 1 out of each lot of 200 or less cylinders, the check on the others must be indicated by a notation hereon reading, "Each cylinder was subjected to a pressure of _____ pounds per square inch and showed no defect."

¹ If the tests are made by a method involving the measurement of the amount of liquid forced into the cylinder by the test pressure, then the basic data, on which the calculations are made, such as the pump factors, temperature of liquid, coefficient of compressibility of liquid, etc., must also be given.

² Do not include removable cap but state whether with or without valve. These weights must be accurate to a tolerance of 1 percent.

³ Report approximate maximum and minimum volumetric capacity for the lot.

(Signed) _____

§ 78.56 Specification 4AA480; welded steel cylinders made of definitely prescribed steels.

§ 78.56-1 Compliance.

(a) Required in all details.

§ 78.56-2 Type, size, and service pressure.

(a) Must be welded type, having not over 1,000 pounds water capacity (nominal). Closures welded by spinning process not permitted.

(b) Service pressure 480 pounds per square inch.

§ 78.56-3 Inspection by whom and where.

(a) By competent inspector; chemical analyses and tests, as specified, to be

made within limits of the United States. Interested inspectors are authorized.

§ 78.56-4 Duties of inspector.

(a) Inspect all material and reject any not complying with requirements of this specification. For cylinders made by the billet piercing process, billets to be inspected after nick and cold break.

(b) Verify chemical analysis of each heat of material by analysis or by obtaining certified analysis: *Provided*, That a certificate from the manufacturer thereof, giving sufficient data to indicate compliance with requirements, is acceptable when verified by check analyses of samples taken from one cylinder out of each lot of 200 or less.

(c) Verify compliance of cylinders with specification requirements includ-

ing markings, condition of inside, tests, threads, heat treatment. Obtain samples for all tests; check chemical analyses; witness all tests; report volumetric capacity, tare weight (see report form), and minimum thickness of wall noted.

(d) Render complete report (§ 78.56-21) to purchaser, cylinder maker, and the Bureau of Explosives.

§ 78.56-5 Steel.

(a) The limiting chemical composition of steel authorized by this specification shall be as shown in § 78.56-20, table I.

§ 78.56-6 Identification of material.

(a) Required; any suitable method except that plates and billets for hot-drawn cylinders shall be marked with the heat number.

§ 78.56-7 Defects.

(a) Material with seams, cracks, laminations, or other injurious defects, not authorized.

§ 78.56-8 Manufacture.

(a) By best appliances and methods; dirt and scale to be removed as necessary to afford proper inspection; no defect acceptable that is likely to weaken the finished cylinder appreciably; reasonably smooth and uniform surface finish required. Exposed bottom welds on cylinders over 18 inches long must be protected by footrings. Minimum thickness of heads and bottoms shall be not less than 90 percent of the required thickness of the side wall. Seams must be made as follows:

(b) Circumferential seams: By welding. Brazing is not authorized.

(c) Longitudinal seams: Not permitted.

§ 78.56-9 Welding.

(a) The attachment to the tops and bottoms only of cylinders by welding of neckrings, footrings, bosses, pads, and valve protection rings is authorized provided that such attachments are made of weldable steel, the carbon content of which does not exceed 0.25 percent.

§ 78.56-10 Wall thickness.

(a) For outside diameters over 5 inches the minimum wall thickness shall be 0.078 inch. In any case the minimum wall thickness shall be such that the calculated wall stress at minimum test pressure (§ 78.56-14) shall not exceed the lesser value of either of the following:

(1) One-half of the minimum tensile strength of the material determined as required in § 78.56-15, or,

(2) 35,000 pounds per square inch.

(b) Calculation must be made by the formula:

$$S = \frac{P(1.3D^2 + 0.4d^2)}{D^2 - d^2}$$

where:

S=wall stress in pounds per square inch;
P=minimum test pressure prescribed for water jacket test;
D=outside diameter in inches;
d=inside diameter in inches.

(c) Cylinders with wall thickness less than 0.100 inch, the ratio of tangential length to outside diameter shall not exceed 4.0.

§ 78.56-11 Heat treatment.

(a) Each cylinder must be uniformly and properly heat treated prior to test. Any suitable heat treatment in excess of 1100° F., is authorized, except that liquid quenching is not permitted. Heat treatment must be accomplished after all forming and welding operations.

(b) Heat treatment is not required after welding weldable low carbon parts to attachments of similar material which have been previously welded to the top or bottom of cylinders and properly heat treated, provided such subsequent welding does not produce a temperature in excess of 400° F., in any part of the top or bottom material.

§ 78.56-12 Openings in cylinders.

(a) All openings must be in the heads or bases.

(b) Each opening in cylinders, except those for safety devices, must be provided with a fitting, boss, or pad, securely attached to cylinder by welding or by threads. If threads are used they must comply with the following:

(1) Threads must be clean-cut, even, without checks and cut to gauge.

(2) Taper threads to be of length not less than as specified for American Standard taper pipe threads.

(3) Straight threads having at least 6 engaged threads, to have tight fit and calculated shear strength at least 10 times the test pressure of the cylinder; gaskets required, adequate to prevent leakage.

(c) Closure of fitting, boss or pad must be adequate to prevent leakage.

§ 78.56-13 Safety devices and protection for valves, safety devices, and other connections, if applied.

(a) Must be as required by the Interstate Commerce Commission's Regulations that apply (see §§ 73.34(f), 73.124(a), and 73.301(i) of this chapter).

§ 78.56-14 Hydrostatic test.

(a) By water jacket, or other suitable method, operated so as to obtain accurate data. Pressure gauge must permit reading to accuracy of 1 percent. Expansion gauge must permit reading of total expansion to accuracy of either 1 percent or 0.1 cubic centimeter.

(b) Pressure must be maintained for 30 seconds and sufficiently longer to insure complete expansion. Any internal pressure applied after heat treatment and previous to the official test must not exceed 90 percent of the test pressure.

(c) Permanent volumetric expansion must not exceed 10 percent of the total volumetric expansion at test pressure.

(d) Cylinders must be tested as follows:

(1) Each cylinder, to at least 2 times service pressure.

(2) Or, 1 cylinder out of each lot of 200 or less; to at least 3 times service pressure. Others must be examined under pressure of 2 times service pressure and show no defect.

§ 78.56-15 Physical test.

(a) To determine yield strength, tensile strength, elongation, and reduction

of area of material. Required on 2 specimens cut from one cylinder having passed the hydrostatic test, or part thereof heat-treated as required, taken at random out of each lot of 200 or less.

(b) Specimens must be: Gauge length 8 inches with width not over 1½ inches; or, gauge length 2 inches with width not over 1½ inches, provided, that gauge length at least 24 times thickness with width not over 6 times thickness is authorized when cylinder wall is not over ⅜ inch thick. The specimen, exclusive of grip ends, must not be flattened. Grip ends may be flattened to within one inch of each end of the reduced section. When size of cylinder does not permit securing straight specimens, the specimens may be taken in any location or direction and may be straightened or flattened cold, by pressure only, not by blows; when specimens are so taken and prepared, the inspector's report must show in connection with record of physical tests detailed information in regard to such specimens. Heating of specimen for any purpose is not authorized.

(c) The yield strength in tension shall be the stress corresponding to a permanent strain of 0.2 percent of the gauge length.

(1) The yield strength shall be determined by either the "offset" method or the "extension under load" method as prescribed in ASTM Standard E8-57T.

(2) In using the "extension under load" method, the total strain (or "extension under load"), corresponding to the stress at which the 0.2 percent permanent strain occurs may be determined with sufficient accuracy by calculating the elastic extension of the gauge length under appropriate load and adding thereto 0.2 percent of the gauge length. Elastic extension calculations shall be based on an elastic modulus of 30,000,000. In the event of controversy, the entire stress-strain diagram shall be plotted and the yield strength determined from the 0.2 percent offset.

(3) For the purpose of strain measurement, the initial strain reference shall be set while the specimen is under a stress of 12,000 pounds per square inch, the strain indicator reading being set at the calculated corresponding strain.

(4) Cross-head speed of the testing machine shall not exceed ⅛ inch per minute during yield strength determination.

§ 78.56-16 Elongation.

(a) Physical test specimens must show at least 40 percent for 2-inch gauge length or at least 20 percent in other cases, except that these elongation percentages may be reduced numerically by 2 for 2-inch specimens and by 1 in other cases for each 7,500 pounds per square inch increment of tensile strength above 50,000 pounds per square inch to a maximum of four such increments.

§ 78.56-17 Tests of welds.

(a) *Tensile test.* A specimen shall be cut from one cylinder of each lot of

200 or less, or welded test plate.¹ The specimen shall be taken across the major seam and shall be prepared and tested in accordance with and must meet the requirements of the Compressed Gas Association's "Standards for Welding and Brazing on Thin Walled Containers" (CGA Pamphlet C-3-1954).² Should this specimen fail to meet the requirements, specimens may be taken from two additional cylinders or welded test plates from the same lot and tested. If either of the latter specimens fail to meet the requirements, the entire lot represented shall be rejected.

(b) *Guided bend test.* A "root" bend test specimen shall be cut from the cylinder or welded test plate, used for the tensile test specified in paragraph (a) of this section. Specimens shall be taken across the major seam and shall be prepared and tested in accordance with and shall meet the requirements of the Compressed Gas Association's "Standards for Welding and Brazing on Thin Walled Containers" (CGA Pamphlet C-3-1954).²

(c) *Alternate guided-bend test.* This test may be used and shall be as required by Compressed Gas Association's "Standards for Welding and Brazing on Thin Walled Containers" (CGA Pamphlet C-3-1954).² The specimen shall be bent until the elongation at the outer surface, adjacent to the root of the weld, between the lightly scribed gage lines— a to b, shall be at least 20 percent, except that this percentage may be reduced for steels having a tensile strength in excess of 50,000 pounds per square inch, as provided in § 78.56-16(a).

§ 78.56-18 Rejected cylinders.

(a) Reheat treatment authorized; subsequent thereto, acceptable cylinders must pass all prescribed tests. Repair of welded seams by welding is authorized.

§ 78.56-19 Marking.

(a) Marking on each cylinder stamped as follows:

(1) ICC-4AA480.

(2) A serial number and an identifying symbol, both to be of the purchaser, user, or maker. The symbol must be registered with the Bureau of Explosives. Duplications unauthorized.

(3) Inspector's official mark.

(4) Date of test (such as 1-54 for January 1954).

(5) Additional markings are permitted.

(b) Sequence of marks. Number shall be just below the ICC marking; identifying symbol shall be just below the

¹ The welded test plate shall be of one of the heats in the lot of 200 or less which it represents, in the same condition and approximately the same thickness as the cylinder wall except that in no case shall it be of lesser thickness than that required for a one-quarter size Charpy impact specimen. The weld must be made by the same procedure and subjected to the same heat treatment as the major weld on the cylinder.

² Available from the Compressed Gas Association, Inc., 500 Fifth Avenue, New York 86, New York.

The compliance of cylinders with specification requirements was verified including markings, condition of inside, tests, threads, etc. All cylinders with defects which might prove injurious were rejected. The processes of manufacture and heat treatment were supervised and found to be eminent and satisfactory.

The cylinder walls were measured and the minimum thickness noted was _____ inch. The outside diameter was determined by a close approximation to be _____ inches. The wall stress was calculated to be _____ pounds per square inch under an internal pressure of _____ pounds per square inch.

Hydrostatic tests, tensile tests of material, and other tests as prescribed in specification ICC 4AA480 were made in the presence of the inspector and all cylinders accepted were

found to be in compliance with the requirements of that specification. Records thereof are attached hereto.

Each cylinder _____ has not) _____ been equipped with safety devices as follows: _____

I hereby certify that all of those cylinders proved satisfactory in every way and comply with the requirements of Interstate Commerce Commission specification No. 4AA480 except as follows: _____

Exceptions _____

(Manufacturer's name) _____

Signed _____ (Inspector)

By _____

(Place) _____

(Date) _____

RECORD OF CHEMICAL ANALYSES OF STEEL FOR CYLINDERS

Numbered _____ to _____ inclusive.
 Size _____ inches outside diameter by _____ inches long.
 Made by _____ Company
 For _____ Company

Test No.	Heat No.	Check analysis No.	Cylinders represented (serial Nos.)	Chemical analysis																
				C	P	S	Si	Mn	Ni	Cr	Mo	Cu	Al	Zr						

Steel was manufactured by _____ Company. The originals of the certified mill test reports are in the files of the manufacturer.

Note: Any omission of analyses by heats, if authorized, must be accounted for by notation hereon reading "The prescribed certificate of the manufacturer of material has been secured, found satisfactory, and placed on file," or by attaching a copy of the certificate.

Chemical analyses were made by _____

(Place) _____

(Date) _____

RECORD OF PHYSICAL TESTS OF MATERIAL FOR CYLINDERS

Numbered _____ to _____ inclusive.
 Size _____ inches outside diameter by _____ inches long.
 Made by _____ Company
 For _____ Company

Test No.	Cylinders represented by test (serial Nos.)	Yield strength (pounds per square inch)	Tensile strength (pounds per square inch)	Elongation (percent in inches)	Reduction of area (percent)	Weld tensile test	Weld bend test

(Signed) _____

(3) On a plate attached to the top of the cylinder or permanent part thereof; sufficient space must be left on the plate to provide for stamping at least six retest dates; the plate must be at least 1/8 inch thick and must be attached by welding, or by brazing at a temperature of at least 1,100° F., throughout all edges of the plate.

(4) Variations in location of markings authorized only when necessitated by lack of space.

(d) Size of marks. Space permitting, at least 1/4 inch high.

§ 78.56-20 Authorized steel.

(a) Open hearth or electric steel of uniform quality and of the following chemical analyses is authorized (see footnote 1 of table):

TABLE I—AUTHORIZED MATERIALS

Designation	Chemical analysis—limits in percent		
	1315**	NAX**	SOX**
Carbon.....	0.10/0.20	0.20 max.	0.13/0.20
Manganese.....	1.10/1.65	0.60/1.00	0.75/1.10
Phosphorus.....	0.045 max.	0.045 max.	0.04 max.
Sulfur.....	0.05 max.	0.045 max.	0.04 max.
Silicon.....	0.15/0.35	0.50/0.90	0.15/0.35
Chromium.....	0.45/0.70	0.15/0.50	0.25/0.35
Molybdenum.....	0.05/0.25	0.15/0.35	0.25/0.35
Zirconium.....	0.40 max.	0.20/0.50	
Copper.....			

1 A heat of steel made under any of the above specifications, check chemical analysis of which is slightly out of the specified range, is acceptable, if satisfactory in all other respects, provided the tolerances published by the American Iron and Steel Institute in Table 6-4 of "Supplementary Information July 1953, Alloy Steel: Semifinished; Hot Rolled and Cold Finished Bars, July 1955," are not exceeded; or provided the variation in chemical analysis is approved by the Bureau of Explosives.

* Addition of other elements to obtain alloying effect is not authorized.

** This designation shall not be restrictive and the commercial steel is limited in analysis shown in the table.

§ 78.56-21 Inspector's report.

(a) Required to be clear, legible and in following form:

(Place) _____
 (Date) _____
 Steel gas cylinders
 Manufactured for _____
 Location at _____
 Location at _____
 Consigned to _____

Quantity _____ Size _____ inches outside diameter by _____ inches long.
 Marks stamped into the _____

(Location of marking) _____
 of the cylinder are: _____
 Specification ICC _____ to _____ inclusive.
 Serial numbers _____
 Inspector's mark _____

Identifying symbol (registered) _____
 Test date _____
 Tare weights (yes or no) _____
 Other marks _____

These cylinders were made by process of _____
 The material used was type _____ authorized in table I of Spec. No. 4AA480.
 The material used was identified by the following _____ (Heat-purchase order) numbers _____

The material used was verified as to chemical analysis and record thereof is attached hereto. The heat numbers _____ (Were—were not) marked on the material.
 All material was inspected and all that was accepted was found free from seams, cracks, laminations and other injurious defects.

(Place) _____
(Date) _____

RECORD OF HYDROSTATIC TESTS ON CYLINDERS

Numbered _____ to _____ inclusive.
Size _____ inches outside diameter by _____ inches long.
Made by _____ Company.
For _____ Company.

Serial Nos. of cylinders tested arranged numerically	Actual test pressure (pounds per square inch)	Total expansion (cubic centimeters) ¹	Permanent expansion (cubic centimeters) ¹	Percent ratio of permanent expansion to total expansion ¹	Tare weight (pounds) ²	Volumetric capacity ³

NOTE: When specifications require test for only 1 out of each lot of 200 or less cylinders, the check on the others must be indicated by a notation hereon reading, "Each cylinder was subjected to a pressure of _____ pounds per square inch and showed no defect."

¹ If the tests are made by a method involving the measurement of the amount of liquid forced into the cylinder by the test pressure, then the basic data, on which the calculations are made, such as the pump factors, temperature of liquid, coefficient of compressibility of liquid, etc., must also be given.² Do not include removable cap but state whether with or without valve. These weights must be accurate to a tolerance of 1 percent.³ Report approximate maximum and minimum volumetric capacity for the lot.

(Signed) _____

§ 78.57 Specification 4L; welded cylinders insulated.

§ 78.57-1 Compliance.

(a) Required in all details.

§ 78.57-2 Type, size, service pressure¹ and service temperature.²(a) *Type and size.* Must be fusion welded; not over 1,000 pounds water capacity (nominal).

(b) The service pressure shall be more than 40 and not over 500 pounds per square inch.

(c) The service temperature shall be minus 320° F. or colder.

§ 78.57-3 Inspection by whom and where.

(a) By competent inspector; chemical analyses and tests, as specified, to be made within limits of the United States. Interested inspectors are authorized.

§ 78.57-4 Duties of inspector.

(a) Inspect all material and reject any not complying with requirements of this specification.

(b) Verify chemical analysis of each heat of material by analysis or by obtaining certified analysis: *Provided*, That a certificate from the manufacturer thereof, giving sufficient data to indicate compliance with requirements, is acceptable when verified by check analyses of samples taken from one cylinder out of each lot of 200 or less.

(c) Verify compliance with all specification requirements. Obtain samples for all tests. Obtain samples for check chemical analyses, where required. Witness all tests. Report volumetric capacity, tare weight (see report form), and minimum thickness of wall noted.

(d) Render complete report (§ 78.57-22) to purchaser, cylinder maker, and the Bureau of Explosives.

¹ The service pressure limits the use of the cylinder. It is shown by marks on the cylinder; for example: IC0-4L200 indicates the service pressure as 200 pounds per square inch.² The service temperature is the lowest temperature at which the cylinder may be used.

§ 78.57-5 Material.

(a) Designations and limiting chemical compositions of steel authorized by this specification shall be as shown in § 78.57-21(a), Table I.

§ 78.57-6 Identification of material.

(a) Required; by any suitable method.

§ 78.57-7 Defects.

(a) Material with seams, cracks, laminations, or other injurious defects, not authorized.

§ 78.57-8 Manufacture.

(a) By best appliances and methods; dirt and scale to be removed as necessary to afford proper inspection; no defect acceptable that is likely to weaken the finished cylinder appreciably; reasonably smooth and uniform surface finish required. The shell portion must be a reasonably true cylinder.

(b) The heads must be seamless, concave side to the pressure, hemispherical or ellipsoidal in shape with the major diameter not more than twice the minor diameter. Minimum thickness of heads shall be not less than 90 percent of the required thickness of the sidewall. The heads must be reasonably true to shape, shall have no abrupt shape changes and the skirts must be reasonably true to round.

(c) The surface of the cylinder must be insulated. Any insulating material must be fire resistant. The insulation must be covered with a steel jacket of not less than 0.060 inch thickness so constructed that moisture cannot come in contact with the insulating material. The construction must be such that the total heat transfer from the atmosphere at ambient temperature to the contents of the cylinder shall not exceed 0.0005 B. t. u. per hour per degree F differential in temperature per pound of water capacity of the cylinder.

§ 78.57-9 Welding.

(a) All seams of the cylinder must be fusion welded. Means must be provided for accomplishing complete penetration of the joint. Only butt or joggle butt

joints for the cylinder seams are authorized. All joints in the cylinder must be in reasonably true alignment.

(b) All attachments to the sidewalls and heads of the cylinder must be by fusion welding and must be of a weldable material complying with the impact requirements of § 78.57-17 (d).

(c) For welding the cylinder, each procedure and operator shall be qualified in accordance with the sections that apply in the Compressed Gas Association's "Standards for Welding and Brazing on Thin Walled Containers" (CGA Pamphlet C-3-1954).¹ In addition, impact tests of the weld shall be performed in accordance with § 78.57-17(d) as part of the qualification of each welding procedure and operator.

(d) Brazing, soldering and threading are permitted only for joints not made directly to the cylinder body. Threads must comply with § 78.57-12.

§ 78.57-10 Wall thickness.

(a) The minimum wall thickness of the cylinder shall be such that the calculated wall stress at minimum required test pressure shall not exceed the least value of the following:

(1) 45,000 pounds per square inch.

(2) One-half of the minimum tensile strength across the welded seam determined as required in § 78.57-17 (a).

(3) One-half of the minimum tensile strength of the base metal determined as required in § 78.57-15.

(4) The yield strength of the base metal determined as required in § 78.57-15.

(5) Further provided that wall for cylinders having longitudinal seams must not exceed 85 percent of the above value, whichever applies.

(b) Calculation must be made by the formula:

$$S = \frac{P(1.3D^2 + 0.4d^2)}{D^2 - d^2}$$

where:

S = wall stress in pounds per square inch;
P = minimum test pressure prescribed for hydrostatic test;
D = outside diameter in inches;
d = inside diameter in inches.

§ 78.57-11 Heat treatment.

(a) *Permissible.* If heat treatment is used each cylinder must be uniformly and properly heat treated as required in § 78.57-21(a), Table I, after all forming and prior to test.

§ 78.57-12 Openings in cylinder.

(a) Openings permitted in heads only. They must be circular and shall not exceed 3 inches diameter or 1/3 of the cylinder diameter, whichever is the smaller. Each opening in the cylinder must be provided with a fitting, boss or pad securely attached to the cylinder body by fusion welding. Attachments to a fitting, boss or pad may be made by welding, brazing, soldering or threading. Threads must comply with following:

(1) Threads must be clean cut, even, without checks and cut to gauge.

¹ Available from the Compressed Gas Association, Inc., 500 Fifth Avenue, New York 36, N. Y.

(2) Taper threads to be of length not less than as specified for American Standard taper pipe threads.

(3) Straight threads must have at least 4 engaged threads and have tight fit and calculated shear strength at least 10 times the test pressure of the cylinder; gaskets required, inert to the commodity and adequate to prevent leakage.

§ 78.57-13 Safety devices and pressure control valves.

(a) Must be as required by Interstate Commerce Commission Regulations that apply (§§ 73.34(f), and 73.304(f) of this chapter).

§ 78.57-14 Hydrostatic test.

(a) Each cylinder before insulating and jacketing must be examined under a pressure of at least 2 times the service pressure, maintained for at least 30 seconds without evidence of leakage, visible distortion or other defect. Pressure gauge must permit reading to accuracy of 1 percent.

§ 78.57-15 Physical test.

(a) Determine yield strength, tensile strength, and elongation on 2 specimens selected from material of each heat and in the same condition as that in the completed cylinder.

(b) Specimens must be: Gauge length 8 inches with width not over 1½ inches; or, gauge length 2 inches with width not over 1½ inches; or, gauge length at least 24 times thickness with width not over 6 times thickness (authorized when cylinder wall is not over ⅜ inch thick). The specimen, exclusive of grip ends, must not be flattened. Grip ends may be flattened to within one inch of each end of the reduced section. When size of cylinder does not permit securing straight specimens, the specimens may be taken in any location or direction and may be straightened or flattened cold, by pressure only, not by blows; when specimens are so taken and prepared, the inspector's report must show in connection with record of physical tests detailed information in regard to such specimens. Heating of specimen for any purpose is not authorized.

(c) The yield strength in tension shall be the stress corresponding to a permanent strain of 0.2 percent of the gauge length.

(1) The yield strength shall be determined by either the "offset" method or the "extension under load" method as prescribed in ASTM Standard E8-57T.

(2) In using the "extension under load" method, the total strain (or "extension under load"), corresponding to the stress at which the 0.2 percent permanent strain occurs may be determined with sufficient accuracy by calculating the elastic expansion of the gauge length under appropriate load and adding thereto 0.2 percent of the gauge length. Elastic extension calculations shall be based on the elastic modulus of the material used. In the event of controversy, the entire stress-strain diagram shall be plotted and the yield strength determined from the 0.2 percent offset.

(3) For the purpose of strain measurement, the initial strain reference shall be set while the specimen is under

a stress of 12,000 pounds per square inch, the strain indicator reading being set at the calculated corresponding strain.

(4) Cross-head speed of the testing machine shall not exceed ⅓ inch per minute during yield strength determination.

§ 78.57-16 Acceptable results for physical tests.

(a) Physical properties must meet the limits specified in § 78.57-21(a), Table I, for the particular steel in the annealed condition. If heat treatment is not used, the specimens must show at least 20 percent elongation for 2-inch gauge length except that the percentage may be reduced numerically by 2 for each 75,000 pounds per square inch increment of tensile strength above 100,000 pounds per square inch to a maximum of 5 such increments. Yield strength and tensile strength must meet the requirements of § 78.57-21(a), Table I.

§ 78.57-17 Tests of welds.

(a) *Tensile test.* A specimen shall be cut from one cylinder of each lot of 200 or less, or welded test plate.¹ The specimen shall be taken across the major seam and shall be prepared and tested in accordance with and must meet the requirements of the Compressed Gas Association's "Standards for Welding and Brazing on Thin Walled Containers" (CGA Pamphlet C-3-1954). Should this specimen fail to meet the requirements, specimens may be taken from two additional cylinders or welded test plates from the same lot and tested. If either of the latter specimens fails to meet the requirements, the entire lot represented shall be rejected.

(b) *Guided bend test.* A "root" bend test specimen shall be cut from the cylinder or welded test plate, used for the tensile test specified in § 78.57-17(a) and from any other seam or equivalent welded test plate if the seam is welded by a procedure different from that used for the major seam. Specimens shall be taken across the particular seam being tested and shall be prepared and tested in accordance with and shall meet the requirements of the Compressed Gas Association's "Standards for Welding and Brazing on Thin Walled Containers" (CGA Pamphlet C-3-1954).²

(c) *Alternate guided-bend test.* This test may be used and shall be as required by Compressed Gas Association's "Standards for Welding and Brazing on Thin Walled Containers" (CGA Pamphlet C-3-1954). The specimen shall be bent until the elongation at the outer surface, adjacent to the root of the weld, between the lightly scribed gage lines—

¹The welded test plate shall be in the same condition and approximately the same thickness as the cylinder wall and shall be of material from one of the heats used in the lot of cylinders which it represents, except test plates for impact tests shall comply with § 78.57-17(d)(1). The test plate shall be welded by the same welding procedure as used on the particular cylinder seam being qualified and shall be subjected to the same heat treatment.

² Available from the Compressed Gas Association, Inc., 500 Fifth Avenue, New York 36, New York.

a to b, shall be at least 20 percent, except that this percentage may be reduced for steels having a tensile strength in excess of 100,000 pounds per square inch, as provided in § 78.57-16 (a).

(d) *Impact tests.* One set of three impact test specimens (for each test) shall be prepared and tested for determining the impact properties of the deposited weld metal (1) as part of the qualification of the welding procedure, (2) as part of the qualification of the operators, (3) for each "heat" of welding rod or wire used, and (4) for each 1,000 feet of weld made with the same heat of welding rod or wire.

(1) All impact test specimens shall be of the Charpy type, keyhole or milled U-notch, and shall conform in all respects to Figure 3 of ASTM E-23-60T. Each set of impact specimens shall be taken across the weld and have the notch located in the weld metal. When the cylinder material thickness is 2.5 mm or thicker, impact specimens shall be cut from a cylinder or welded test plate used for the tensile or bend test specimens. The dimension along the axis of the notch shall be reduced to the largest possible of 10 mm, 7.5 mm, 5mm or 2.5 mm, depending upon cylinder thickness. When the material in the cylinder or welded test plate is not of sufficient thickness to prepare 2.5 mm impact test specimens, 2.5 mm specimens shall be prepared from a welded test plate made from ⅓ inch thick material meeting the requirements specified in § 78.57-21(a), Table I, and having a carbon analysis of .05 minimum, but not necessarily from one of the heats used in the lot of cylinders. The test piece shall be welded by the same welding procedure as used on the particular cylinder seam being qualified and shall be subjected to the same heat treatment.

(2) Impact test specimens shall be cooled to the design service temperature. The apparatus for testing the specimens must conform to the requirements of ASTM Standard E-23-60T. The test piece, as well as the handling tongs, shall be cooled for a length of time sufficient to reach the service temperature. The temperature of the cooling device shall be maintained within a range of plus or minus 3° F. The specimen shall be quickly transferred from the cooling device to the anvil of the testing machine and broken within a time lapse of not more than six seconds.

(3) The impact properties of each set of impact specimens shall be not less than the values in the following table:

Size of specimen	Minimum impact value required for average of each set of three specimens (ft-lb)	Minimum impact value permitted on one specimen only of a set of three (ft-lb)
10 mm x 10 mm.....	15	10
10 mm x 7.5 mm.....	12.5	8.5
10 mm x 5 mm.....	10	7.0
10 mm x 2.5 mm.....	5	3.5

(4) When the average value of the three specimens equals or exceeds the minimum value permitted for a single specimen and the value for more than

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one specimen is below the required average value, or when the value for one specimen is below the minimum value permitted for a single specimen, a retest of three additional specimens shall be made. The value of each of these retest specimens shall equal or exceed the required average value. When an erratic result is caused by a defective specimen, or there is uncertainty in test procedure, a retest is authorized.

§ 78.57-18 Radiographic examination.

(a) The techniques and acceptability of radiographic inspection shall conform to the standards set forth in the Compressed Gas Association's "Standards for Welding and Brazing on Thin Walled Containers" (CGA Pamphlet C-3-1954).

(b) Cylinders must be examined as follows:

(1) One finished longitudinal seam shall be selected at random from each lot of 100 or less successively produced and be radiographed throughout its entire length. Should the radiographic examination fail to meet the requirements of paragraph (a) of this section, two additional seams of the same lot shall be examined, and if either of these fail to meet the requirements, each cylinder may be examined as outlined above; only those passing are acceptable.

§ 78.57-19 Rejected cylinders.

(a) Welds may be repaired by suitable methods of fusion welding; reheat treatment authorized; subsequent thereto, acceptable cylinders must pass all prescribed tests.

§ 78.57-20 Marking.

(a) Marking required by stamping plainly and permanently on shoulder or top head of jacket or on a permanently attached plate or head protective ring as follows:

(1) ICC-4L followed by the service pressure (for example, ICC-4L200).

(2) ST followed by service temperature (for example, ST-423 F) on cylinders having a service temperature below minus 320° F. only; location to be just below the ICC mark.

(3) Serial number and identifying symbol; location of number to be just below the service temperature or ICC mark; location of symbol to be just below the number. The symbol and numbers must be those of the purchaser, user, or maker. The symbol must be registered with the Bureau of Explosives; duplications not authorized.

(4) Maximum weight of content (Max. Content 00#) on cylinders having a service temperature below minus 320° F. only; location near symbol.

Examples:

Service temperature minus 320° F. Service temperature below minus 320° F.

ICC-4L200 ICC-4L200
1234 ST-423F
XY 1234
XY

MAX. CONTENT 00#

(5) Inspector's official mark, date of test (such as 10-55 for October 1955), near serial number.

(6) Size of markings at least ¼ inch high if space permits.

(b) Except for serial number, all markings prescribed in paragraph (a) of this section must be duplicated on each cylinder by any suitable means.

§ 78.57-21 Authorized steels.

(a) Electric furnace steel of uniform quality. The following chemical analyses and physical properties are authorized.

TABLE I—AUTHORIZED MATERIALS

Designation	Chemical analysis, limits in percent; stainless steel; type 304 1 1/2	Physical properties (annealed)
Carbon (maximum).....	0.08	
Manganese (maximum).....	2.50	
Phosphorus (maximum).....	0.035	
Sulphur (maximum).....	0.030	
Silicon (maximum).....	0.85	
Nickel (minimum).....	8.00	
Chromium (minimum).....	18.00	
Molybdenum.....		
Titanium.....		
Columbium.....		
Tensile strength, p. s. i. (minimum).....	75,000	
Yield strength, p. s. i. (minimum).....	30,000	
Elongation in 2-inch (minimum) (percent).....	30.0	
Elongation other permissible gage lengths (percent).....	15.0	

1 Identical to ASTM A-240, Grade S, type 304 modified.

2 The carbon analysis shall be reported to the nearest hundredth of 1 percent.

3 Heat treatment is authorized, and if used must be suitable and proper.

§ 78.57-22 Inspector's report.

(a) Required to be clear, legible and in following form:

(Place)
(Date)

Steel gas cylinders.

Manufactured for
Location at
Manufactured by
Location at
Consigned to
Location at
Quantity
Size inches outside diameter by inches long.
Cylinders were hydrostatically tested at pounds per square inch and found to be satisfactory.
Maximum and minimum weight
Maximum and minimum volumetric capacity
Marks stamped into the (Location of marking) of the cylinder are:

Test No.	Heat No.	Check analysis No.	Cylinders represented (serial Nos.)	Chemical analysis																	
				C	P	S	Si	Mn	Ni	Cr	Mo	Cu	Al	Zr							
.....

Steel was manufactured by Company. The originals of the certified mill test reports are in the files of the manufacturer.

NOTE: Any omission of analyses by heats, if authorized, must be accounted for by nota-

Specification ICC-
Service Temperature minus° F.
Maximum Weight of Content (pounds).
Serial numbers to inclusive.
Inspector's mark
Identifying symbol (registered)
Test date
Tare weights (yes or no)
Other marks
These cylinders were made by process of

The material used was authorized by § 78.57-21.

The material used was identified by the following (Heat-purchase order)

numbers
The material used was verified as to chemical analysis and record thereof is attached hereto. The heat numbers (Were—were not)

marked on the material.
All material was inspected and all that was accepted was found free from seams, cracks, laminations and other injurious defects.

The compliance of cylinders with specification requirements was verified including markings, condition of inside, tests, threads, etc. All cylinders with defects which might prove injurious were rejected. The processes of manufacture and heat treatment were supervised and found to be efficient and satisfactory.

The cylinder walls were measured and the minimum thickness noted was inch. The outside diameter was determined by a close approximation to be inches. The wall stress was calculated to be pounds per square inch under an internal pressure of pounds per square inch.

Hydrostatic tests, tensile tests of material, and other tests as prescribed in specification No. ICC-4L were made in the presence of the inspector and all cylinders accepted were found to be in compliance with the requirements of that specification. Records thereof are attached hereto.

Each cylinder been equipped with safety devices as follows: (Has—has not)

I hereby certify that all of these cylinders proved satisfactory in every way and comply with the requirements of Interstate Commerce Commission specification No. 4L except as follows:

Exceptions
(Manufacturer's name)
By (Signed) (Inspector)
(Place)
(Date)

RECORD OF CHEMICAL ANALYSIS OF STEEL FOR CYLINDERS

Numbered to inclusive.
Size inches outside diameter by inches long.
Made by Company.
For Company.

tion hereon reading "The prescribed certificate of the manufacturer of material has been secured, found satisfactory, and placed on file," or by attaching a copy of the certificate.

Chemical analyses were made by

(Place) _____
(Date) _____

RECORD OF PHYSICAL TESTS OF MATERIAL FOR CYLINDERS

Numbered _____ to _____ inclusive.
Size _____ inches outside diameter by _____ inches long.
Made by _____ Company.
For _____ Company.

Test No.	Cylinders represented by test (serial Nos.)	Yield strength (pounds per square inch)	Tensile strength (pounds per square inch)	Elongation (percent in inches)	Impact test results	Weld tensile test	Weld bend test

(Signed) _____

§ 78.58 Specification 4DA; inside containers, welded steel for aircraft use.

§ 78.58-1 Compliance.

(a) Required in all details.

§ 78.58-2 Type, size, and service pressure.

(a) *Type and size.* Welded steel spheres (two seamless hemispheres) or circumferentially welded cylinders (two seamless drawn shells) not over 100 pounds water capacity.

(b) *Service pressure.*¹ At least 500 to not over 900 pounds per square inch.

§ 78.58-3 Inspection by whom and where.

(a) By competent and disinterested inspector acceptable to the Bureau of Explosives; chemical analyses and tests, as specified, to be made within the limits of the United States.

§ 78.58-4 Duties of inspector.

(a) Inspect all material and reject any not complying with requirements.

(b) Verify chemical analysis of each heat of material by analysis or by obtaining certified analysis: *Provided*, That a certificate from the manufacturer thereof, giving sufficient data to indicate compliance with requirements, is acceptable when verified by check analyses of samples taken from one container out of each lot of 200 or less.

(c) Verify compliance of containers with all requirements including markings; inspect inside before closing; verify heat treatment and welding procedure as proper; obtain samples for all tests and check chemical analyses; witness all tests; verify threads by gauge; report volumetric capacity and tare weight and minimum thickness of wall noted.

(d) Render complete report to purchaser, container maker, and the Bureau of Explosives.

§ 78.58-5 Steel.

(a) Open-hearth or electric steel of uniform quality. The following chemical analyses are authorized (see Note 1):

¹ The "service pressure" limits the use of the container. It is shown by marks on container; for example ICC-4DA500 indicates the service pressure as 500 pounds per square inch.

4130

	Percent
Carbon.....	0.28/0.33.
Manganese.....	0.40/0.60.
Phosphorus.....	0.040 max.
Sulfur.....	0.040 max.
Silicon.....	0.20/0.35.
Chromium.....	0.80/1.10.
Molybdenum.....	0.15/0.25.

NOTE 1: A heat of steel made under the above specification, check chemical analysis of which is slightly out of the specified range, is acceptable, if satisfactory in all other respects, provided the tolerances published by the American Iron and Steel Institute in Table 6-4 of "Supplementary Information July 1958, Alloy Steel: Semi-finished; Hot Rolled and Cold Finished Bars, July 1955," are not exceeded; or provided the variation in chemical analysis is approved by the Bureau of Explosives.

§ 78.58-6 Identification of material.

(a) Required; any suitable method except that plates and billets for hot-drawn containers shall be marked with heat number.

§ 78.58-7 Defects.

(a) Material with seams, cracks, laminations, or other injurious defects, not authorized. Defects in welded joints shall not exceed the limits specified in § 78.58-17 covering radiographic inspection.

§ 78.58-8 Manufacture.

(a) By best appliances and methods; dirt and scale to be removed as necessary to afford proper inspection; no defect acceptable that is likely to weaken the finished container appreciably, reasonably smooth and uniform surface finish required. No abrupt change in wall thickness permitted. Certification of welders and/or process required in accordance with the sections that apply of Compressed Gas Association Standards for Welding and Brazing on Thin Walled Containers (CGA Pamphlet C-3-1954).²

(b) All seams of the sphere or cylinders must be fusion welded. Seams shall be of the butt or joggle butt type and means must be provided for accomplishing complete penetration of the joint.

² Available from the Compressed Gas Association, Inc., 500 Fifth Avenue, New York 36, New York.

§ 78.58-9 Welding.

(a) Attachments to the container are authorized by fusion welding provided that such attachments are made of weldable steel, the carbon content of which must not exceed 0.25 percent except in the case of 4130 steel.

§ 78.58-10 Wall thickness.

(a) The minimum wall thickness shall be such that the wall stress at the minimum specified test pressure shall not exceed 67 percent of the minimum tensile strength of the steel as determined from the physical and burst tests required and shall not be over 70,000 psi. Minimum wall 0.060 inch for any diameter container.

(b) Calculation for a sphere must be made by the formula:

$$S = \frac{PD}{4tE}$$

where:

S = wall stress in pounds per square inch;
P = test pressure prescribed for water jacket test, i. e., at least 2 times service pressure, in pounds per square inch;

D = outside diameter in inches;

t = minimum wall thickness in inches;

E = 0.85 (provides 85 percent weld efficiency factor which must be applied in the girth weld area and heat affected zones which zone shall extend a distance of 6 times wall thickness from center line of weld);

E = 1.0 (for all other areas).

(c) Calculation for a cylinder must be made by the formula:

$$S = \frac{P(1.3D^2 + 0.4d^2)}{D^2 - d^2}$$

where:

S = wall stress in pounds per square inch;
P = test pressure prescribed for water jacket test, i. e., at least 2 times service pressure, in pounds per square inch;

D = outside diameter in inches;

d = inside diameter in inches.

§ 78.58-11 Heat treatment.

(a) The completed containers must be uniformly and properly heat-treated prior to tests. Heat-treatment of containers of the authorized analysis shall be as follows:

(1) All containers must be oil quenched except as noted in subparagraph (5) of this paragraph.

(2) The steel temperature on quenching shall be that recommended for the steel analysis, but in no case shall exceed 1,750° F.

(3) The steel shall be tempered at the temperature most suitable for the analysis except that in no case shall the tempering temperature be less than 1,000° F.

(4) The steel may be normalized at a temperature of 1,650° F. instead of being quenched, and containers so normalized need not be tempered.

(5) The steel coming under this specification may be quenched in molten salt bath maintained at a temperature not less than 375° F.

§ 78.58-12 Openings in container.

(a) Each opening in the container must be provided with a fitting, boss, or pad of weldable steel securely attached to the container by fusion welding.

(b) Attachments to a fitting, boss, or pad must be adequate to prevent leakage. Threads must comply with the following:

(1) Threads must be clean cut, even, without checks, and tapped to gauge.

(2) Taper threads to be of length not less than as specified for American Standard taper pipe threads.

(3) Straight threads, having at least 4 engaged threads, to have tight fit and calculated shear strength at least 10 times the test pressure of the container; gaskets required, adequate to prevent leakage.

§ 78.58-13 Safety devices.

(a) Safety relief devices must be as required by the Interstate Commerce Commission's Regulations. (See § 73.34 (f) of this chapter.)

§ 78.58-14 Hydrostatic test.

(a) By water-jacket, or other suitable method, operated so as to obtain accurate data. Pressure gauge must permit reading to accuracy of 1 percent. Expansion gauge must permit reading of total expansion to accuracy either of 1 percent or 0.1 cubic centimeter.

(b) Pressure must be maintained for 30 seconds and sufficiently longer to insure complete expansion. Any internal pressure applied after heat-treatment and previous to the official test must not exceed 90 percent of the test pressure. If, due to failure of the test apparatus, the test pressure cannot be maintained, the test may be repeated at a pressure increased by 10 percent or 100 pounds per square inch, whichever is the lower.

(c) Permanent volumetric expansion must not exceed 10 percent of total volumetric expansion at test pressure.

(d) Each container must be tested to at least 2 times service pressure.

§ 78.58-15 Burst test.

(a) One container taken at random out of 200 or less shall be hydrostatically tested to destruction. Rupture pressure shall be included as part of the inspector's report.

§ 78.58-16 Flattening test.

(a) *Flattening test for spheres.* At the weld between parallel steel plates on a press with welded seam at right angles to the plates, test one sphere taken at random out of each lot of 200 or less after hydrostatic test. Any projecting appurtenances may be cut off (by mechanical means only) prior to crushing.

(b) *Flattening test for cylinders.* Between knife edges, wedge shaped, 60° angle, rounded to ½ inch radius; test one cylinder taken at random out of each lot of 200 or less, after hydrostatic test.

§ 78.58-17 Radiographic inspection.

(a) Required on all welded joints which are subjected to internal pressure, except that at the discretion of the disinterested inspector, openings less than 25 percent of the sphere diameter need not be subjected to radiographic inspection. Evidence of any defects likely to

seriously weaken the container shall be cause for rejection.

§ 78.58-18 Physical test and specimens for spheres and cylinders.

(a) *Physical test for spheres.* Required on 2 specimens cut from flat representative sample plate of the same heat taken at random from the steel used to produce the sphere. This flat steel from which the 2 specimens are to be cut must receive the same heat-treatment as the spheres themselves. Sample plates to be taken for each lot of 200 or less spheres.

(b) *Specimens for spheres.* Specimens must be gauge length 2 inches with width not over 1½ inches: *Provided*, That gauge length at least 24 times thickness with width not over 6 times thickness is authorized when wall of sphere is not over ⅜ inch thick.

(c) *Physical test for cylinders.* Required on 2 specimens cut from 1 cylinder taken at random out of each lot of 200 or less.

(d) *Specimens for cylinders.* Specimens must be gauge length 8 inches with width not over 1½ inches; or gauge length 2 inches with width not over 1½ inches: *Provided*, That gauge length at least 24 times thickness with width not over 6 times thickness is authorized when cylinder wall is not over ⅜ inch thick. The specimen, exclusive of grip ends, must not be flattened. Grip ends may be flattened to within 1 inch of each end of the reduced section. Heating of specimen for any purpose is not authorized.

(e) The yield strength in tension shall be the stress corresponding to a permanent strain of 0.2 percent of the gauge length.

(1) The yield strength shall be determined by either the "offset" method or the "extension under load" method as prescribed in ASTM Standard E8-57T.

(2) In using the "extension under load" method, the total strain (or "extension under load") corresponding to the stress at which the 0.2 percent permanent strain occurs may be determined with sufficient accuracy by calculating the elastic extension of the gauge length under appropriate load and adding thereto 0.2 percent of the gauge length. Elastic extension calculations shall be based on an elastic modulus of 30,000,000. In the event of controversy, the entire stress-strain diagram shall be plotted and the yield strength determined from the 0.2 percent offset.

(3) For the purpose of strain measurement, the initial strain shall be set while the specimen is under a stress of 12,000 pounds per square inch, the strain indicator reading being set at the calculated corresponding strain.

(4) Cross-head speed of the testing machine shall not exceed ½ inch per minute during yield strength determination.

§ 78.58-19 Acceptable results for physical, flattening, and burst tests.

(a) Elongation at least 20 percent for 2-inch gauge length or 10 percent in other cases.

(b) Flattening required to 50 percent of the original outside diameter without cracking.

(c) Burst pressure shall be at least 3 times service pressure.

§ 78.58-20 Rejected containers.

(a) Reheat-treatment authorized; subsequent thereto, acceptable containers must pass all prescribed tests. Repair of welded seams by welding prior to reheat-treatment authorized.

§ 78.58-21 Marking.

(a) Marking on each container by stamping plainly and permanently only on a permanent attachment or on a metal nameplate permanently secured to the container by means other than soft solder, as follows:

(1) ICC-4DA followed by the service pressure (for example, ICC-4DA900).

(2) A serial¹ number and an identifying symbol (letters); location of number to be just below the ICC mark; location² of symbol to be just below the number. The symbols and numbers must be those of purchaser, user, or maker. The symbol must be registered with the Bureau of Explosives; duplications unauthorized.

(3) Inspector's official mark, near serial number, date of test (such as 8-50 for August 1950), so placed that dates of subsequent tests can be easily added.

§ 78.58-22 Size of marks.

(a) Of sufficient size to be legible.

§ 78.58-23 Inspector's report.

(a) Required to be clear, legible, and in the following form:

(Place)

(Date)

Gas

(Spheres-cylinders)

Manufactured for Company.

Location at

Manufactured by Company.

Location at

Consigned to Company.

Location at

Quantity

Size inches outside diameter by inches long.

Marks stamped into the

(Shoulder-metal plate, § 78.58-21.)

Specification ICC

Serial numbers to inclusive.

Inspector's mark

Identifying symbol (registered)

Test date

Tare weights (yes or no)

Other marks (if any)

These containers were made by process of

The material used was identified by the following

(Heat-purchase order)

numbers

The material used was verified as to chemical analysis and record thereof is attached hereto. The heat numbers

(Were—were not)

marked on the material.

All material, such as plates, billets and seamless tubing, was inspected and each con-

¹ Lot numbers not over 500 cylinders in each lot, authorized for cylinders not over 2 inches outside diameter and for cylinders over 2 inches outside diameter when the volumetric capacity does not exceed 60 cubic inches.

² Symbol in front or following the number with ample space between is also authorized. Other variation in location authorized only when necessitated by lack of space.

Example:

ICC-4DA900
1234
XY

tainer was inspected both before and after closing in the ends; all that was accepted was found free from seams, cracks, laminations, and other defects which might prove injurious to the strength of the container. The processes of manufacture and heat treatment of containers were supervised and found to be efficient and satisfactory.

The container walls were measured and the minimum thickness noted was _____ inch. The outside diameter was determined by a close approximation to be _____ inches. The wall stress was calculated to be _____ pounds per square inch under an internal pressure of _____ pounds per square inch.

Hydrostatic tests, flattening tests, tensile tests of material, and other tests, as prescribed in specification No. ICC-4DA were made in the presence of the inspector and all material and containers accepted were found to be in compliance with the requirements of that specification. Records thereof are attached hereto.

I hereby certify that all of these containers proved satisfactory in every way and comply with the requirements of Interstate Commerce Commission specification No. 4DA except as follows:

Exceptions: _____
 (Signed) _____
 (Inspector)

(Place) _____
 (Date) _____

RECORD OF CHEMICAL ANALYSIS OF MATERIAL FOR CONTAINERS

Numbered _____ to _____ inclusive.
 Size _____ inches outside diameter by _____ inches long.
 Made by _____ Company.
 For _____ Company.

Note: Any omission of analyses by heats, if authorized, must be accounted for by notation hereon reading, "The prescribed certificate of the manufacturer of material has been secured, found satisfactory, and placed on file," or by attaching a copy of the certificate.

Test No.	Heat No.	Check analysis No.	Containers represented (Serial Nos.)	Chemical analysis							
				C	P	S	Si	Mn	Ni	Or	

The analyses were made by _____
 (Signed) _____
 (Place) _____
 (Date) _____

RECORD OF PHYSICAL TESTS OF MATERIAL FOR CONTAINERS

Numbered _____ to _____ inclusive.
 Size _____ inches outside diameter by _____ inches long.
 Made by _____ Company.
 For _____ Company.

Test No.	Containers represented by test (Serial Nos.)	Yield strength (pounds per square inch)	Tensile strength (pounds per square inch)	Elongation (percent in 8 inches)	Reduction of area (percent)	Flattening test

(Signed) _____
 (Place) _____
 (Date) _____

RECORD OF HYDROSTATIC TESTS ON CONTAINERS

Numbered _____ to _____ inclusive.
 Size _____ inches outside diameter by _____ inches long.
 Made by _____ Company.
 For _____ Company.

Serial numbers of containers tested arranged numerically	Actual test pressure (pounds per square inch)	Total expansion (cubic centimeters) ^a	Permanent expansion (cubic centimeters) ^b	Percent ratio of permanent expansion to total expansion ^c	Tare weight (pounds) ^d	Volumetric capacity

NOTE: When specifications require test for only 1 out of each lot of 200 or less containers, the check on the others must be indicated by a notation hereon reading "Each container was subjected to a pressure of _____ pounds per square inch and showed no defect."

^a If the tests are made by a method involving the measurement of the amount of liquid forced into the container by the test pressure, then the basic data, on which the calculations are made, such as the pump factors, temperature of liquid, coefficient of compressibility of liquid, etc., must also be given.

^d Do not include removable cap but state whether with or without valve. These weights must be accurate to a tolerance of 1 percent.

(Signed) _____

§ 78.59 Specification 8; steel cylinders with approved porous filling for acetylene.

§ 78.59-1 Compliance.

(a) Required in all details.

§ 78.59-2 Type and service pressure.

(a) Type. Seamless except that the following is authorized: Longitudinal seam if forge lap welded; attachment of heads by welding or by brazing by dipping process; welded circumferential body seam if cylinder has no longitudinal seam.

(b) Service pressure.¹ 250 pounds per square inch.

§ 78.59-3 Inspection by whom and where.

(a) By competent and disinterested inspectors except that for cylinders made in the United States of America interested inspectors are also authorized; chemical analyses and tests, as specified, to be made within limits of the United States.

(b) Duties of shell inspector:

(1) Inspect all material and reject any not complying with requirements; for cylinders made by billet piercing process, billets to be inspected after nick and cold break.

(2) Require certified chemical analyses of steel used, signed by manufacturer thereof; also verify by check analyses of samples taken from each heat or from 1 out of each lot of 200 or less plates, shells, or tubes used.

(3) Verify compliance of cylinder shells with all shell requirements; inspect inside before closing in both ends; verify heat treatment as proper; obtain all samples for all tests and for check analyses; witness all tests; verify threads by gauge; report volumetric capacity and minimum thickness of wall noted.

(4) Prepare report on manufacture of steel shells in form prescribed in § 78.59-20 (a). Furnish one copy to manufacturer and three copies to the company that is to complete the cylinders.

(c) Duties of inspector of completed cylinders: Determine porosity of filling and tare weights; verify compliance of marking with prescribed requirements; obtain necessary copies of steel shell reports prescribed in paragraph (b) of this section; render complete reports, as prescribed in § 78.59-20 to the purchaser to the Bureau of Explosives, and to the company that has completed the manufacture of the cylinders.

§ 78.59-4 Steel.

(a) Open-hearth, electric or basic oxygen process steel of uniform quality. Content percent for the following not over: carbon, 0.25; phosphorus, 0.045; sulphur, 0.050.

§ 78.59-5 Identification of steel.

(a) Required; any suitable method except that plates and billets for hot-drawn cylinders shall be marked with heat number.

¹ Service pressure limits the use of the cylinder to 250 pounds per square inch at 70° F.

§ 78.59-6 Defects.

(a) Material with seams, cracks, laminations, or other injurious defects, not authorized.

§ 78.59-7 Manufacture.

(a) By best appliances and methods; dirt and scale to be removed as necessary to afford proper inspection; no defect acceptable that is likely to weaken the finished cylinder appreciably; reasonably smooth and uniform surface finish required.

§ 78.59-8 Exposed bottom welds.

(a) Exposed bottom welds on cylinders over 18" long must be protected by footrings.

§ 78.59-9 Heat treatment.

(a) Body and heads formed by drawing or pressing must be uniformly and properly heat treated prior to tests.

§ 78.59-10 Openings.

(a) Standard taper pipe threads required; length not less than as specified for American Standard pipe threads; tapped to gauge; clean cut, even, and without checks.

§ 78.59-11 Safety devices and protection for valves, safety devices, and other connections.

(a) If applied must be as required by the Interstate Commerce Commission's regulations that apply. (See §§ 73.34 (f) and 73.301(d) of this chapter.)

§ 78.59-12 Hydrostatic test.

(a) By water jacket, or other suitable method, operated so as to obtain accurate data. Pressure gauge must permit reading to accuracy of 1 percent. Expansion gauge must permit reading of total expansion to accuracy either of 1 percent or 0.1 cubic centimeter.

(b) Pressure must be maintained for 30 seconds and sufficiently longer to insure complete expansion. Any internal pressure applied after heat-treatment and previous to the official test must not exceed 90 percent of the test pressure.

(c) Permanent volumetric expansion must not exceed 10 percent of total volumetric expansion at test pressure.

(d) One cylinder out of each lot of 200 or less must be hydrostatically tested to at least 750 pounds per square inch. Cylinders not so tested must be examined under pressure of between 500 and 600 pounds per square inch and show no defect. If hydrostatically tested cylinder fails, each cylinder in the lot may be hydrostatically tested and those passing are acceptable.

§ 78.59-13 Leakage test.

(a) By interior air or gas pressure not less than the service pressure; leakers must be rejected. Required only for cylinders with bottoms closed in by spinning.

§ 78.59-14 Physical test.

(a) Required on 2 specimens cut longitudinally from 1 cylinder or part thereof taken at random out of each lot of 200 or less, after heat treatment.

(b) Specimens must be: Gauge length 8" with width not over 1½"; or, gauge

length 2" with width not over 1½"; *Provided*, That gauge length at least 24 times thickness with width not over 6 times thickness is authorized when cylinder wall is not over ⅜" thick.

(c) The yield strength in tension shall be the stress corresponding to a permanent strain of 0.2 percent of the gauge length.

(1) The yield strength shall be determined by either the "offset" method or the "extension under load" method as prescribed in ASTM Standard E8-57T.

(2) In using the "extension under load" method, the total strain (or "extension under load") corresponding to the stress at which the 0.2 percent permanent strain occurs may be determined with sufficient accuracy by calculating the elastic extension of the gauge length under appropriate load and adding thereto 0.2 percent of the gauge length. Elastic extension calculations shall be based on an elastic modulus of 30,000,000. In the event of controversy, the entire stress-strain diagram shall be plotted and the yield strength determined from the 0.2 offset.

(3) For the purpose of strain measurement, the initial strain shall be set while the specimen is under a stress of 12,000 pounds per square inch, the strain indicator reading being set at the calculated corresponding strain.

(4) Cross-head speed of the testing machine shall not exceed ⅓ inch per minute during yield strength determination.

(d) Yield strength shall not exceed 73 percent of tensile strength. Elongation must be at least 40 percent in 2 inch or 20 percent in other cases.

§ 78.59-15 Rejected cylinders.

(a) Reheat treatment authorized; subsequent thereto, acceptable cylinders must pass all prescribed tests. Repair by welding is authorized.

§ 78.59-16 Porous filling.

(a) Cylinders must be filled with an approved porous material of such structure that it will not disintegrate or sag when wet with solvent or when subjected to normal service. The porous filling material shall be uniform in quality and free of voids, except that a well drilled into the filling material beneath the valve is authorized: *Provided*, That such a well be filled with a material of such type that the functions of the filling material are not impaired. Overall shrinkage of the filling material is authorized, provided the total clearance between the cylinder shell and filling material, after solvent has been added, does not exceed ½ of 1 percent of the respective diameter or length but in no case to exceed ⅓ inch measured diametrically and longitudinally and that such clearances do not impair the functions of the filling material. In all cases, the filling material as installed in the cylinder must be approved by the Bureau of Explosives.

(b) Porosity of filling to be 80 percent or less except that filling with a porosity in excess of 80 percent but not in excess of 92 percent, may be used when tested with satisfactory results under the supervision of the Bureau of Explosives.

When the porous mass has a porosity in excess of 80 percent but not in excess of 83 percent, the pores shall be uniform and shall not be visible at a magnification of 200 diameters. When the porous mass has a porosity in excess of 83 percent but not in excess of 92 percent, the pores shall be uniform and shall not be visible at a magnification of 500 diameters. A cylinder taken at random from a lot of 200 or less must be tested for porosity providing the porosity of each cylinder is not known. Should test cylinders fail, test of each cylinder of the lot is authorized, cylinders passing the test to be acceptable.

(c) For filling that is molded and dried before insertion in cylinders, porosity test may be made on sample block taken at random from material to be used.

(d) The porosity of the filling material shall be determined; the amount of solvent at 70° F. for a cylinder:

(1) Having shell volumetric capacity above 20 pounds water capacity (nominal) shall not exceed the following:

Percent porosity of filler:	Maximum acetone solvent percent shell capacity by volume	
	Percent porosity of filler:	Maximum acetone solvent percent shell capacity by volume
90 to 92.....	43.4	43.4
87 to 90.....	42.0	42.0
83 to 87.....	40.0	40.0
80 to 83.....	38.6	38.6
75 to 80.....	36.2	36.2
70 to 75.....	33.8	33.8
65 to 70.....	31.4	31.4

(2) Having volumetric capacity of 20 pounds or less water capacity (nominal), shall not exceed the following:

Percent porosity of filler:	Maximum acetone solvent percent shell capacity by volume	
	Percent porosity of filler:	Maximum acetone solvent percent shell capacity by volume
90 to 92.....	41.8	41.8
83 to 90.....	38.5	38.5
80 to 83.....	37.1	37.1
75 to 80.....	34.8	34.8
70 to 75.....	32.5	32.5
65 to 70.....	30.2	30.2

§ 78.59-17 Tare weight.

(a) Tare weight referred to in §§ 78.59-1 to 78.59-21 shall be the combined weight of cylinder proper, porous filling, valve, and solvent, but without removable cap.

§ 78.59-18 Marking.

(a) Marking on each cylinder by stamping plainly and permanently on or near the shoulder, top head, neck or valve protection collar which is permanently attached to the cylinder and forming integral part thereof, as follows:

(1) ICC-8.

(2) A serial number and an identifying symbol (letters) grouped¹ above or below the ICC mark. The symbol and numbers must be those of purchaser, user, or maker. The symbol must be registered with the Bureau of Explosives; duplications unauthorized.

(3) Date of test (such as 5-50 for May 1950), so placed that dates of subsequent tests can be easily added.

¹ Variation in location authorized only when necessitated by lack of space.

Example:
 ICC-8
 1234
 XY

The tare weight of each cylinder was determined and a record thereof is attached hereto.

Each cylinder has been equipped with safety devices -----

A certified report of manufacture and test of the steel shells is attached hereto.

I hereby certify that, subject to the acceptability of the reports covering the steel shells, all of these cylinders proved satisfactory in every way and comply with the requirements of the Interstate Commerce Commission specification No. 8.

Signed -----
(Inspector)

§ 78.59-21 Additional type.

(a) For seamless cylinders, contracted for by the United States Navy or United States Coast Guard, made of steel commercially known as 4130X the prescribed limitations of carbon content, yield point, and elongation of steel are hereby waived provided the cylinders otherwise comply with §§ 78.59-1 to 78.59-20 and the following conditions:

(b) The following chemical analysis is authorized. (See Note 1.)

Designation:	4130X (percent)
Carbon-----	0.25/0.35
Manganese-----	0.40/0.90
Phosphorus-----	0.04 max.
Sulphur-----	0.05 max.
Silicon-----	0.20/0.35
Chromium-----	0.80/1.10
Molybdenum-----	0.15/0.25
Zirconium-----	
Nickel-----	

NOTE 1: A heat of steel made under the above specification, check chemical analysis of which is slightly out of the specified range, is acceptable, if satisfactory in all other respects, provided the tolerances published by the American Iron and Steel Institute in Table 6-4 of "Supplementary Information July 1958, Alloy Steel: Semi-finished, Hot Rolled and Cold Finished Bars, July 1955," are not exceeded; or provided the variation in chemical analysis is approved by the Bureau of Explosives.

(c) Minimum wall thickness must be such that the wall stress under interior pressure of 1,000 pounds per square inch will not exceed 18,000 pounds per square inch when calculated by the formula:

$$S = \frac{P(1.3D^2 + 0.4d^2)}{D^2 - d^2}$$

where

S = wall stress in pounds per square inch;
P = 1,000 pounds per square inch;
D = outside diameter in inches;
d = inside diameter in inches.

(d) The elongation of the steel must be at least 20 percent in 2 inches.

(e) The test pressure under § 78.59-12 must be at least 1,000 pounds per square inch.

(f) Flattening test: Between knife edges, wedge shaped, 60° angle, rounded to ½ inch radius; test 1 cylinder¹ taken at random out of each lot of 200 or less, after hydrostatic test. The cylinders must pass test without cracking to 6 times wall thickness.

(g) Reports of manufacture and tests of the cylinder shells must include the following additional information: Chemical analysis data on manganese, chromium, molybdenum, and other alloy materials present, if any; definite statement as to the heat-treatment used.

§ 78.60 Specification 8AL; steel cylinders with approved porous filling for acetylene.

§ 78.60-1 Compliance.

(a) Required in all details.

§ 78.60-2 Type and service pressure.

(a) *Type.* Seamless except that the following is authorized: Attachment of heads by welding or by brazing by dipping process; welded circumferential body seam. Longitudinal seams not authorized.

(b) *Service pressure.*² 250 pounds per square inch.

¹ For lots of 30 or less, physical and flattening tests are authorized to be made on a ring at least 8 inches long cut from each cylinder and subjected to same heat treatment as the finished cylinder.

² Service pressure limits the use of the cylinder to 250 pounds per square inch at 70° F.

§ 78.60-3 Inspection by whom and where.

(a) By competent and disinterested inspectors except that for cylinders made in the United States of America interested inspectors are also authorized; chemical analyses and tests, as specified, to be made within limits of the United States.

(b) Duties of shell inspector. Inspect all material and reject any not complying with requirements; for cylinders made by billet piercing process, billets to be inspected after nick and cold break.

(1) Require certified chemical analyses of steel used, signed by manufacturer thereof; also verify by check analyses of samples taken from each heat or from 1 out of each lot of 200 or less plates, shells, or tubes used.

(2) Verify compliance of cylinder shells with all shell requirements; inspect inside before closing in both ends; verify heat treatment as proper; obtain all samples for all tests and for check analyses; witness all tests; verify threads by gauge; report volumetric capacity and minimum thickness of wall noted.

(3) Report percentage of each specified alloying element in the steel. Prepare report on manufacture of steel shells in form prescribed in § 78.60-24 (a). Furnish one copy to manufacturer and three copies to the company that is to complete the cylinders.

(c) Duties of inspector of completed cylinders. Determine porosity of filling and tare weights; verify compliance of marking with prescribed requirements; obtain necessary copies of steel shell reports prescribed in paragraph (b) of this section; render complete reports, as prescribed in § 78.60-24, to the purchaser, to the Bureau of Explosives, and to the company that has completed the manufacture of the cylinders.

§ 78.60-4 Authorized steel.

(a) Open hearth or electric steel of uniform quality. The following chemical analyses are authorized. See footnote 1 of table.

TABLE I—AUTHORIZED MATERIALS

Designation	Chemical analysis—limits in percent					
	1315 ^{2,4}	HIS ^{2,4}	MAY ^{2,4}	NAX ^{2,4}	COR ^{2,4}	
Carbon.....	0.10/0.20.....	0.12 maximum..	0.12 maximum..	0.20 maximum..	0.12 maximum..	
Manganese.....	1.10/1.65.....	0.60/0.90.....	0.50/1.00.....	0.45/0.75.....	0.20/0.60.....	
Phosphorus.....	0.045 maximum..	0.05/0.12.....	0.12 maximum..	0.045 maximum..	0.07/0.15.....	
Sulfur.....	0.05 maximum..	0.05 maximum..	0.05 maximum..	0.05 maximum..	0.05 maximum..	
Silicon.....	0.15/0.35.....	0.15 maximum..	0.10/0.50.....	0.50/0.90.....	0.25/0.75.....	
Chromium.....			0.40/1.00.....	0.45/0.70.....	0.50/1.25.....	
Molybdenum.....		0.08/0.18.....		0.05/0.25.....		
Zirconium.....						
Nickel.....		0.45/0.75.....	0.50/1.00.....		0.65 maximum..	
Copper.....	0.40 maximum..	0.95/1.30.....	0.20/0.50.....		0.25/0.55.....	
Aluminum.....		0.12/0.27.....				
Columbium.....						
Heat treatment authorized.....	(¹).....	(¹).....	(¹).....	(¹).....	(¹).....	
Maximum stress.....	35,000.....	35,000.....	35,000.....	35,000.....	35,000.....	
	SOX ^{2,4}	4017 ^{2,4}	OTY ^{2,4}	RDT ^{2,4,6}	YOL ^{2,4,6}	GLX-50-W ^{2,4}
Carbon.....	0.20 maximum..	0.13/0.20.....	0.15 maximum..	0.12 maximum..	0.15 maximum..	0.10/0.20.
Manganese.....	0.60/1.00.....	0.75/1.10.....	0.50/1.40.....	0.50/1.00.....	0.30/0.60.....	0.50/1.00.
Phosphorus.....	0.045 maximum..	0.040 maximum..	0.09/0.135.....	0.040 maximum..	0.04 maximum..	0.04 maximum.
Sulfur.....	0.045 maximum..	0.040 maximum..	0.040 maximum..	0.050 maximum..	0.05 maximum..	0.05 maximum.
Silicon.....	0.15/0.30.....	0.25/0.35.....	0.10 maximum..			0.10 maximum.
Chromium.....	0.15/0.50.....					
Molybdenum.....	0.15/0.35.....	0.25/0.35.....		0.10/0.30.....		
Zirconium.....						
Nickel.....				0.50/1.20.....	1.50/2.00.....	
Copper.....	0.20/0.50.....		0.30/0.70.....	0.50/1.00.....	0.75/1.25.....	
Aluminum.....						
Columbium.....						0.010/0.040.
Heat treatment authorized.....	(¹).....	(¹).....	(¹).....	(¹).....	(¹).....	(3).
Maximum stress.....	35,000.....	35,000.....	35,000.....	35,000.....	35,000.....	35,000.

¹ A heat of steel made under any of the above specifications, check chemical analysis of which is slightly out of the specified range, is acceptable, if satisfactory in all other respects, provided the tolerances published by the American Iron and Steel Institute in Table 6-4 of "Supplementary Information July 1958, Alloy Steel: Semifinished; Hot Rolled and Cold Finished Bars, July 1955," are not exceeded, or provided the variation in chemical analysis is approved by the Bureau of Explosives.

² This designation shall not be restrictive and the commercial steel is limited in analysis shown in the table.
³ Any suitable heat treatment in excess of 1,100° F., except that liquid quenching is not permitted.
⁴ Addition of other elements to obtain alloying effect is not authorized.
⁵ Ferritic grain size 6 or finer, according to ASTM E-112-58T.
⁶ Only fully killed steel authorized.

§ 78.60-5 Identification of steel.

(a) Required; any suitable method except that plates and billets for hot-drawn cylinders shall be marked with heat number.

§ 78.60-6 Defects.

(a) Material with seams, cracks, laminations, or other injurious defects, not authorized.

§ 78.60-7 Manufacture.

(a) By best appliances and methods; dirt and scale to be removed as necessary to afford proper inspection; no defect acceptable that is likely to weaken the finished cylinder appreciably; reasonably smooth and uniform surface finish required.

§ 78.60-8 Footrings.

(a) Exposed bottom welds on cylinders over 18" long must be protected by footrings.

§ 78.60-9 Welding or brazing.

(a) The attachment to the tops or bottoms only of cylinders by welding or brazing of neckrings, footrings, handlers, bosses, pads, and valve protecting rings is authorized provided that such attachments and the portion of the container to which they are attached are made of weldable steel, the carbon content of which must not exceed 0.25 percent.

(b) Heat treatment is not required after welding or brazing weldable low carbon parts to attachments, specified in paragraph (a) of this section, of similar material which have been previously welded or brazed to the top or bottom of cylinders and properly heat treated, provided such subsequent welding or

brazing does not produce a temperature in excess of 400° F. in any part of the top or bottom material.

§ 78.60-10 Wall thickness; wall stress.

(a) The calculated wall stress at 750 pounds per square inch shall not exceed 35,000 pounds per square inch, or one-half of the minimum ultimate strength of the steel as determined in § 78.60-16, whichever value is the smaller. Measured wall thickness shall not include galvanizing or other protective coating.

(1) Calculation of wall stress must be made by the formula:

$$S = \frac{P(1.3D^2 + 0.4d^2)}{D^2 - d^2}$$

where

- S = wall stress in pounds per square inch;
- P = 750 pounds per square inch (minimum test pressure);
- D = outside diameter in inches;
- d = inside diameter in inches.

Either D or d must be calculated from the relation $D = d + 2t$, where t = minimum wall thickness.

(2) Cylinders with wall thickness less than 0.100 inch, the ratio of straight side wall length to outside diameter shall not exceed 3.5.

(3) For cylinders having outside diameter over 5 inches, the minimum wall thickness shall be 0.087 inch.

§ 78.60-11 Heat treatment.

(a) Each cylinder must be uniformly and properly heat treated, prior to tests, by any suitable method in excess of 1100° F. Heat treatment must be accomplished after all forming and welding operations, except that when brazed joints are used, heat treatment must follow any forming and welding operations but may be done

before, during, or after the brazing operations. Liquid quenching not authorized.

§ 78.60-12 Openings.

(a) Standard taper pipe threads required; length not less than as specified for American Standard pipe threads; tapped to gauge; clean cut, even, and without checks.

§ 78.60-13 Safety devices and protection for valves, safety devices, and other connections.

(a) If applied must be as required by the Interstate Commerce Commission's regulations that apply. (See §§ 73.34(f) and 73.301(i) of this chapter.)

§ 78.60-14 Hydrostatic test.

(a) By water jacket, or other suitable method, operated so as to obtain accurate data. Pressure gauge must permit reading to accuracy of 1 percent. Expansion gauge must permit reading of total expansion to accuracy either of 1 percent or 0.1 cubic centimeter.

(b) Pressure must be maintained for 30 seconds and sufficiently longer to insure complete expansion. Any internal pressure applied after heat-treatment and previous to the official test must not exceed 90 percent of the test pressure.

(c) Permanent volumetric expansion must not exceed 10 percent of total volumetric expansion at test pressure.

(d) One cylinder out of each lot of 200 or less must be hydrostatically tested to at least 750 pounds per square inch. Cylinders not so tested must be examined under pressure of between 500 and 600 pounds per square inch and show no defect. If hydrostatically tested cylinder

falls, each cylinder in the lot may be hydrostatically tested and those passing are acceptable.

§ 78.60-15 Leakage test.

(a) By interior air or gas pressure not less than the service pressure; leakers must be rejected. Required only for cylinders with bottoms closed in by spinning.

§ 78.60-16 Physical test.

(a) Required on 2 specimens cut longitudinally from 1 cylinder or part thereof taken at random out of each lot of 200 or less, after heat treatment.

(b) Specimens must be: Gauge length 8" with width not over 1½"; or, gauge length 2" with width not over 1½"; *Provided*, That gauge length at least 24 times thickness with width not over 6 times thickness is authorized when cylinder wall is not over ⅜" thick.

(c) The yield strength in tension shall be the stress corresponding to a permanent strain of 0.2 percent of the gauge length.

(1) The yield strength shall be determined by either the "offset" method or the "extension under load" method as prescribed in ASTM Standard E8-57T.

(2) In using the "extension under load" method, the total strain (or "extension under load") corresponding to the stress at which the 0.2 percent permanent strain occurs may be determined with sufficient accuracy by calculating the elastic extension of the gauge length under appropriate load and adding thereto 0.2 percent of the gauge length. Elastic extension calculations shall be based on an elastic modulus of 30,000,000. In the event of controversy, the entire stress-strain diagram shall be plotted and the yield strength determined from the 0.2 offset.

(3) For the purpose of strain measurement, the initial strain shall be set while the specimen is under a stress of 12,000 pounds per square inch, the strain indicator reading being set at the calculated corresponding strain.

(4) Cross-head speed of the testing machine shall not exceed ⅛ inch per minute during yield strength determination.

§ 78.60-17 Elongation.

(a) Physical test specimens must show at least 40 percent for 2 inch gauge length or at least 20 percent in other cases, except that these elongation percentages may be reduced numerically by 2 for 2 inch specimens and 1 in other cases for each 7,500 pounds per square inch increment of tensile strength above 50,000 pounds per square inch to a maximum of four such increments.

§ 78.60-18 Weld tests.

(a) Specimens taken across the circumferentially welded seam must be cut from one cylinder taken at random from each lot of 200 or less cylinders after heat treatment and must pass satisfactorily the following tests:

(1) *Tensile test.* A specimen shall be cut from one cylinder of each lot of 200 or less, or welded test plate.¹ The specimen shall be taken across the major seam and shall be prepared and tested in accordance with and must meet the requirements of the Compressed Gas Association's "Standards for Welding and Brazing on Thin Walled Containers" (CGA Pamphlet C-3-1954).² Should this specimen fail to meet the requirements, specimens may be taken from two additional cylinders or welded test plates from the same lot and tested. If either of the latter specimens fail to meet the requirements, the entire lot represented shall be rejected.

(2) *Guided bend test.* A "root" bend test specimen shall be cut from the cylinder or welded test plate, used for the tensile test specified in subparagraph (1) of this paragraph. Specimens shall be taken across the major seam and shall be prepared and tested in accordance with and shall meet the requirements of the Compressed Gas Association's "Standards for Welding and Brazing on Thin Walled Containers" (CGA Pamphlet C-3-1954).²

(3) *Alternate guided-bend test.* This test may be used and shall be as required by Compressed Gas Association's "Standards for Welding and Brazing on Thin Walled Containers" (CGA Pamphlet C-3-1954).² The specimen shall be bent until the elongation at the outer surface, adjacent to the root of the weld, between the lightly scribed gage lines— a to b, shall be at least 20 percent, except that this percentage may be reduced for steels having a tensile strength in excess of 50,000 pounds per square inch, as provided in § 78.60-17(a).

§ 78.60-19 Rejected cylinders.

(a) Reheat treatment authorized; subsequent thereto, acceptable cylinders must pass all prescribed tests. Repair by welding is authorized.

§ 78.60-20 Porous filling.

(a) Cylinders must be filled with an approved porous material of such structure that it will not disintegrate or sag when wet with solvent or when subjected to normal service. The porous filling material shall be uniform in quality and free of voids, except that a well drilled into the filling material beneath the valve is authorized: *Provided*, That such a well be filled with a material of such type that the functions of the filling material are not impaired. Overall shrinkage of the filling material is authorized, provided

¹ The welded test plate shall be of one of the heats in the lot of 200 or less which it represents, in the same condition and approximately the same thickness as the cylinder wall except that in no case shall it be of lesser thickness than that required for a one-quarter size Charpy impact specimen. The weld must be made by the same procedure and subjected to the same heat treatment as the major weld on the cylinder.

² Available from the Compressed Gas Association, Inc., 500 Fifth Avenue, New York 36, New York.

the total clearance between the cylinder shell and filling material, after solvent has been added, does not exceed ½ of 1 percent of the respective diameter or length but in no case to exceed ⅛ inch measured diametrically and longitudinally and that such clearances do not impair the functions of the filling material. In all cases, the filling material as installed in the cylinder must be approved by the Bureau of Explosives.

(b) Porosity of filling to be 80 percent or less except that filling with a porosity in excess of 80 percent but not in excess of 92 percent, may be used when tested with satisfactory results under the supervision of the Bureau of Explosives. When the porous mass has a porosity in excess of 80 percent but not in excess of 83 percent, the pores shall be uniform and shall not be visible at a magnification of 200 diameters. When the porous mass has a porosity in excess of 83 percent but not in excess of 92 percent, the pores shall be uniform and shall not be visible at a magnification of 500 diameters. A cylinder taken at random from a lot of 200 or less must be tested for porosity providing the porosity of each cylinder is not known. Should test cylinders fail, test of each cylinder of the lot is authorized, cylinders passing the test to be acceptable.

(c) For filling that is molded and dried before insertion in cylinders, porosity test may be made on sample block taken at random from material to be used.

(d) The porosity of the filling material shall be determined; the amount of solvent at 70° F. for a cylinder:

(1) Having shell volumetric capacity above 20 pounds water capacity (nominal) shall not exceed the following:

Percent porosity of filler:	Maximum acetone solvent percent shell capacity by volume
90 to 92.....	43.4
87 to 90.....	42.0
83 to 87.....	40.0
80 to 83.....	38.6
75 to 80.....	36.2
70 to 75.....	33.8
65 to 70.....	31.4

(2) Having volumetric capacity of 20 pounds or less water capacity (nominal), shall not exceed the following:

Percent porosity of filler:	Maximum acetone solvent percent shell capacity by volume
90 to 92.....	41.8
83 to 90.....	38.5
80 to 83.....	37.1
75 to 80.....	34.8
70 to 75.....	32.5
65 to 70.....	30.2

§ 78.60-21 Tare weight.

(a) Tare weight here referred to shall be the combined weight of cylinder proper, porous filling, valve, and solvent, but without removable cap.

§ 78.60-22 Marking.

(a) Marking on each cylinder as follows:

(1) ICC-3AL.

(2) A serial number and an identifying symbol (letters) grouped above or below the ICC mark. The symbol and numbers must be those of purchaser, user, or maker. The symbol must be registered with the Bureau of Explosives; duplications unauthorized.

(3) Date of test (such as 5-50 for May 1950) so placed that dates of subsequent tests can be easily added.

(4) Tare weight of cylinder in pounds and ounces.

(5) Cylinders, not completed, when delivered must each be marked for identification of each lot of 200 or less.

(b) Markings shall be stamped plainly and permanently in locations in accordance with the following:

(1) On shoulders and top heads not less than 0.087 inch thick, or

(2) On neck, valve boss, valve protection sleeve, or similar part permanently attached to the top end of cylinder, or

(3) On a plate of ferrous material attached to the top of the cylinder or permanent part thereof; the plate must be at least 1/16 inch thick, and must be attached by welding, or by brazing at a temperature of at least 1,100° F. throughout all edges of the plate. Sufficient space must be left on the plate to provide for stamping at least four (4) retest dates.

§ 78.60-23 Size of marks.

(a) At least 1/8" high for cylinders less than 4" inside diameter and at least 1/4" high for larger cylinders.

§ 78.60-24 Inspector's report.

(a) Report to cover manufacture of acetylene shells; required to be clear, legible, and in the following form:

(Place) _____
(Date) _____

Acetylene shells

Manufactured for _____ Company
Location at _____
Manufactured by _____ Company
Location at _____
Consigned to _____ Company
Location at _____
Quantity _____
Size _____ inches outside diameter by _____ inches long.

Marks stamped into the shoulder of the cylinder are:

Lot number _____
Other marks (if any) _____
These cylinders were made by process of _____

The _____ permitted in (neckrings, footrings, etc.)
§ 78.60-9 were attached by process of _____

(welding—brazing)
The material used was identified by the following _____ numbers _____ (heat—purchase order)

The material used was verified as to chemical analysis and record thereof is attached hereto. The heat numbers _____ (were—were not)

marked on the material.

¹ Variation in location authorized only when necessitated by lack of space.
Example:

ICC-SAL
1234
XY

All material, such as plates, billets and seamless tubing, was inspected and each cylinder was inspected both before and after closing in the ends; all that was accepted was found free from seams, cracks, laminations, and other defects which might prove injurious to the strength of the cylinder. The processes of manufacture and heat treatment of cylinders were supervised and found to be efficient and satisfactory.

The cylinder walls were measured and the minimum thickness noted was _____ inch. The outside diameter was determined by a close approximation to be _____ inches. The wall stress was calculated to be _____ pounds per square inch under an internal pressure of _____ pounds per square inch.

Hydrostatic tests, flattening tests, tensile tests of material, and other tests, as prescribed in specification No. ICC-SAL were made in the presence of the inspector and all material and cylinders accepted were found to be in compliance with the requirements of that specification. Records thereof are attached hereto.

I hereby certify that all of these cylinders proved satisfactory in every way and comply with the requirements of Interstate Commerce Commission specification No. SAL except as follows:

Exceptions: _____

(Signed) _____
Inspector.

(Place) _____
(Date) _____

RECORD OF CHEMICAL ANALYSIS OF STEEL FOR CYLINDERS

Numbered _____ to _____ inclusive.
Size _____ inches outside diameter by _____ inches long
Made by _____ Company
For _____ Company

Test No.	Heat No.	Check analysis No.	Cylinders represented (serial Nos.)	Chemical analysis												
				C	P	S	Si	Mn	Ni	Cr	Mo	Cu	Al	Zr		

Steel was manufactured by _____ Company.
The originals of the certified mill test reports are in the files of the manufacturer.
NOTE: Any omission of analysis by heats, if authorized, must be accounted for by notation hereon reading, "The prescribed certificate of the manufacturer of material has been secured, found satisfactory, and placed on file," or by attaching a copy of the certificate.
The analyses were made by _____

(Signed) _____
(Place) _____
(Date) _____

RECORD OF PHYSICAL TESTS OF MATERIAL FOR CYLINDERS

Numbered _____ to _____ inclusive.
Size _____ inches outside diameter by _____ inches long
Made by _____ Company
For _____ Company

Test No.	Cylinders represented by test (serial Nos.)	Yield strength (pounds per square inch)	Tensile strength (pounds per square inch)	Elongation (percent in 8 inches)	Reduction of area (percent)	Weld tensile test	Weld bend test

(Signed) _____
(Place) _____
(Date) _____

RECORD OF HYDROSTATIC TESTS ON CYLINDERS

Numbered _____ to _____ inclusive.
Size _____ inches outside diameter by _____ inches long
Made by _____ Company
For _____ Company

Serial Nos. of cylinders tested arranged numerically	Actual test pressure (pounds per square inch)	Total expansion (cubic centimeters) ¹	Permanent expansion (cubic centimeters) ¹	Percent ratio of permanent expansion to total expansion ¹	Volumetric capacity ²

NOTE: When specification requires test for only 1 out of each lot of 200 or less cylinders, the check on the others must be indicated by a notation hereon reading, "Each cylinder was subjected to a pressure of _____ pounds per square inch and showed no defect."

¹ If the tests are made by a method involving the measurement of the amount of liquid forced into the cylinder by the test pressure, then the basic data, on which the calculations are made, such as the pump factors, temperature of liquid, coefficient of compressibility of liquid, etc., must also be given.

² Report approximate maximum and minimum volumetric capacity for the lot.
(Signed) _____

(b) Inspector's report to cover completed manufacture of acetylene cylinders; required to be clear and legible and in the following form:

(Place)-----
 (Date)-----
 Final Report: For completed steel cylinders with approved porous filling for acetylene.
 Manufactured for-----
 Location at-----
 Steel sheets manufactured by-----
 Location at-----
 Cylinders completed by-----
 Location at-----
 Consigned to-----
 Location at-----
 Quantity-----
 Size-----inches outside diameter by----- inches long.
 Marks are stamped into----- (show location)

as follows:

Specification ICC-8AL
 Serial numbers----- to ----- inclusive.
 Identifying symbol (registered)-----
 Inspector's mark (if applied)-----
 Test date-----
 Other marks (if any)-----

Application of prescribed marks, as reported above, and location thereof were verified.

Each cylinder was filled with porous filling material consisting of----- in the form of-----

The porosity of the filling is between----- and ----- percent as determined by tests made by the----- company whose report has been found satisfactory and is on file.

The tare weight of each cylinder was determined and a record thereof is attached hereto.

Each cylinder has been equipped with safety devices-----

A certified report of manufacture and test of the steel shells is attached hereto.

I hereby certify that, subject to the acceptability of the reports covering the steel shells, all of these cylinders proved satisfactory in every way and comply with the requirements of the Interstate Commerce Commission specification No. 8AL.

Signed----- (Inspector)

§ 78.63 Specification 9; inside containers, seamless or welded or brazed steel cylinders.

§ 78.63-1 Compliance.

(a) Required in all details.

§ 78.63-2 Type, size, and service pressure.

(a) *Type and size.* Must be seamless, welded, or brazed (brazing material must have a melting point of not less than 1,000° F.). The maximum water capacity of containers in this class shall not exceed 86 cubic inches. Longitudinal seams are prohibited, except that containers constructed from longitudinally welded steel tubing are authorized: *Provided*, That certification is made by the tubing manufacturer that the tubing has been pressure tested to a fiber stress of 24,000 pounds per square inch as calculated by the formula

$$P = \frac{24000(D^2 - d^2)}{(1.3D^2 + 0.4d^2)}$$

where

P is the pressure required for pressure testing of tubing by the tubing manufacturer.

(b) *Service pressure.* Service pressure must be 200 pounds per square inch.

§ 78.63-3 Inspection by whom and where.

(a) By competent inspector; chemical analyses and tests, as specified, to be made within limits of the United States. Interested inspectors are authorized.

§ 78.63-4 Duties of inspector.

(a) Inspect all material and reject any not complying with requirements.

(b) Verify compliance with the requirements of § 78.63-5 by submitting copy of certified chemical analysis obtained from the steel manufacturer for each heat of steel (ladle analysis acceptable); or if such evidence is lacking, then a sample from each coil or sheet must be analyzed and results submitted.

(c) Verify compliance of cylinders with all requirements including markings; inspect inside before closing in both ends; verify heat treatment as proper; select samples for all tests and for check chemical analyses; witness all tests; verify threads by gauge; report volumetric capacity (see report form) and minimum thickness of wall noted.

(d) Render complete report (see § 78.63-19) to purchaser, cylinder maker, and the Bureau of Explosives.

§ 78.63-5 Steel.

(a) Open-hearth or electric steel of uniform quality. Content percent for the following not over: Carbon, 0.150; phosphorus, 0.045; sulphur, 0.055.

§ 78.63-6 Identification of material.

(a) Required; any suitable method.

§ 78.63-7 Defects.

(a) Material with seams, cracks, laminations, or other injurious defects, not authorized.

§ 78.63-8 Manufacture.

(a) By proper appliance and methods; dirt and scale to be removed as necessary to afford proper inspection; no defect acceptable that is likely to weaken the finished cylinder appreciably; reasonably smooth and uniform surface finish required. Seams must be made as follows:

(1) Circumferential seams. Except as provided in subparagraph (2) of this paragraph by welding or by brazing. Heads attached by brazing must have a driving fit with the shell, unless the shell is crimped, swedged, or curled over the skirt or flange of the head, and be thoroughly brazed until complete penetration by the brazing material of the brazed joint is secured. Depth of brazing from end of shell must be at least four times the thickness of shell metal.

(2) A container made of two hemispherical heads, each having an integral tangential cylindrical skirt portion assembled so that the two cylindrical skirt portions telescope one within the other is authorized but must meet the following additional requirements for the skirt portions; one be a driving fit within the other; they be of equal length and telescoped for their full length; the length of the overlap be not less than 8 nor more than 10 times the thickness of the thinner of the two skirts; the overlapping joint be brazed (not welded) so as to get complete penetration for the full length of the joint.

§ 78.63-9 Wall thickness.

(a) The wall stress at 600 pounds per square inch shall not exceed 24,000 pounds per square inch, except that for longitudinally welded steel tubing the stress shall not exceed 20,400 pounds per square inch. The minimum wall for any cylinder shall be 0.040 inch. For the container authorized in § 78.63-8(a)(2) the wall thickness of the cylinder shall be taken as the sum of the thickness of the two skirts (without allowance for the brazing material between).

(b) Calculation must be made by the formula:

$$S = \frac{600(1.3D^2 + 0.4d^2)}{D^2 - d^2}$$

where

S = wall stress in pounds per square inch;
 D = outside diameter in inches;
 d = inside diameter in inches.

(c) Calculation for thickness of hemispherical heads of containers authorized in § 78.63-8 (a) (2) must be made by the formula:

$$S = \frac{600D}{4tC}$$

where

t = thickness in inches;
 C = 0.85 (design factor);
 S and D have same significance as in paragraph (b) of this section. The minimum thickness of head or skirt shall be 0.040 inch. The thickness of the skirt shall be not less than the thickness of the head.

§ 78.63-10 Heat treatment.

(a) Body and heads must be uniformly and properly heat treated prior to tests.

§ 78.63-11 Openings in cylinders.

(a) Each opening in cylinders, except those for safety devices, must be provided with a fitting, boss, or pad, securely attached to cylinder by brazing or by welding or by threads. If threads are used, they must comply with the following:

(1) Threads must be clean cut, even, without checks, and tapped to gauge.

(2) Taper threads to be of length not less than as specified for American Standard taper pipe threads.

(3) Straight threads, having at least 4 engaged threads, to have tight fit and calculated shear strength at least 10 times the test pressure of the cylinder; gaskets required, adequate to prevent leakage.

(b) Closure of fitting, boss, or pad must be adequate to prevent leakage.

§ 78.63-12 Safety devices.

(a) Devices must be as required by the Interstate Commerce Commission's regulations that apply. (See §§ 73.34(f) and 73.301(i) of this chapter.)

§ 78.63-13 Pressure tests.

(a) Each cylinder produced shall be tested at an internal pressure¹ of at least 400 pounds per square inch and not exceeding 600 pounds per square inch, held for at least 30 seconds, and shall show no leak or other defects when inspected by suitable means.

¹ Warning: Where air or gas pressure is used for testing, means designed to protect personnel is recommended.

(b) One out of each 1,000 cylinders or less successively produced shall be hydrostatically tested to destruction and must not burst below 1,200 pounds per square inch. Each such 1,000 cylinders or less successively produced shall constitute a lot and if the test cylinder shall fail, then the entire lot must be rejected. All cylinders constituting a lot shall be of identical size, design, construction, heat treatment, finish and quality.

§ 78.63-14 Flattening test.

(a) Between knife edges, wedge shaped, 60° angle, rounded to 1/2 inch radius; test 1 cylinder taken at random out of each lot of 1,000 or less, after pressure test. This flattening test is required and the test cylinder shall not have cracked when the outer surfaces of the walls are apart not more than a distance of 6 times the thickness of such walls.

§ 78.63-15 Rejected cylinders.

(a) Reheat treatment authorized for lots failing to meet the requirements of § 78.63-14; such lots of cylinders after this treatment must pass all prescribed tests.

§ 78.63-16 Repair of brazed and welded seams.

(a) Only repair of brazed seams by brazing and welded seams by welding is authorized, provided such cylinders are retested and pass the tests prescribed in § 78.63-13.

§ 78.63-17 Marking.

(a) Marking on each cylinder, by embossing plainly and permanently on valve end of cylinder before heat-treatment the marks ICC-9 and registered symbol of manufacturer.

(1) Other marks as prescribed in subparagraph (3) of this paragraph must be shown on a permanently attached name plate or by printing or decalcomania, provided that such markings are waterproofed and adherent and not easily impaired when subjected to water immersion and weathering under service conditions, or are coated with a water-insoluble transparent lacquer, except that, cylinders having brazed lapped circumferential seam may, after having been tested in accordance with §§ 78.63-13 and 78.63-14 of this specification, have marks permanently stamped into metal of this seam, provided that such marks do not exceed (0.015'') fifteen thousandths of an inch in depth.

(2) Such marks must be maintained in a legible condition and if at any time the cylinder is returned for refilling and such marks are illegible, then the cylinder must not be returned to service until it has been retested as prescribed in § 78.63-13 (a) and new test date applied.

(3) Inspector's official mark; lot number; date of test (such as 5-50 for May 1950), so placed that dates of subsequent tests can be easily added.

§ 78.63-18 Size of embossed marks.

(a) At least 1/4 inch high.

§ 78.63-19 Inspector's reports.

(a) Required to be clear, legible, and in following form:

(Place) _____
 (Date) _____
Steel gas cylinders
 Manufactured for _____ Company
 Location at _____
 Manufactured by _____ Company
 Location at _____
 Consigned to _____ Company
 Location at _____
 Quantity _____
 Size _____ inches outside diameter by _____ inches long
 Identification marks on cylinder are:
 Specification ICC-9.
 Lot number _____
 Identifying symbols (registered) _____
 Test date _____
 These cylinders were made by process of _____

The steel used was identified by heat or analysis numbers as shown on the "Record of Chemical Analysis of Steel for Cylinders" attached hereto.

The steel used was verified as to chemical analysis and record thereof is attached hereto.

All material was inspected and each cylinder was inspected both before and after closing; all accepted material and cylinders were found free from seams, cracks, laminations, and other defects which might prove injurious to the strength of the cylinder. The processes of manufacture and heat treatment were supervised and found to be efficient and satisfactory.

A test cylinder of each lot was measured and had a minimum wall thickness and volumetric capacity as shown in table below.

Date of test	Lot No.	Number in lot	Minimum wall thickness (Inches)	Volumetric capacity (cubic inches)

Each and every cylinder was properly tapped; the threads were inspected and found to be clean cut, of proper length, and correct as to gauge.

One finished cylinder out of each lot was taken at random and burst by interior hydrostatic pressure with the following results:

Date of test	Lot No.	Pressure at which cylinder ruptured (pounds per square inch)

Each and every cylinder was subjected to an interior pressure of _____ pounds per square inch and showed no leak or other defect.

Hydrostatic tests, pressure tests, flattening tests, and other tests, as prescribed in specification No. ICC-9 were made in the presence of the inspector and all material and cylinders accepted were found to be in compliance with the requirements of that specification.

I hereby certify that all of these cylinders proved satisfactory in every way and comply with requirements of Interstate Commerce Commission's specification No. 9 except as follows:

Exceptions: _____

(Signed) _____
 Inspector.

RECORD OF CHEMICAL ANALYSIS OF STEEL FOR CYLINDERS

Size _____ inches outside diameter by _____ inches long.
 Made by _____ Company
 For _____ Company

Lot No.	Number in lot	Heat No.	Check analysis No.	Chemical analysis		
				C	P	S

The analyses were made by _____
 (Signed) _____
 Inspector.

§ 78.66 Specification 40; inside containers, non-refillable seamless or welded or brazed steel cylinders.

§ 78.66-1 Compliance.

(a) Required in all details.

§ 78.66-2 Type, size, and service pressure.

(a) *Type and size.* Must be seamless, welded, or brazed (brazing material must have a melting point of not less than 1000° F.). The maximum water capacity of cylinders in this class shall not exceed 1.44 pounds or 40 cubic inches. Longitudinal seams are prohibited, except that containers constructed from longitudinally welded steel tubing are authorized provided that certification is made by the tubing manufacturer that the tubing has been pressure tested to a fiber stress of 24,000 pounds per square inch as calculated by the formula:

$$P = \frac{24000(D^2 - d^2)}{(1.3D^2 + 0.4d^2)}$$

where

P is the pressure required for pressure testing of tubing by the tubing manufacturer.

(b) *Service pressure.* Service pressure must be 200 pounds per square inch.

§ 78.66-3 Inspection by whom and where.

(a) By competent inspector of the manufacturer; or a disinterested inspection agency, chemical analysis and tests, as specified, to be made within limits of the United States.

§ 78.66-4 Duties of inspector.

(a) Inspect all material and reject any not complying with requirements.

(b) Verify compliance with the requirements of § 78.66-5 of this specification by submitting copy of certified chemical analysis obtained from the steel manufacturer for each heat of steel (ladle analysis acceptable); or if such evidence is lacking, then a sample from each coil or sheet must be analyzed and results submitted.

(c) Verify compliance of cylinders with all requirements including markings; inspect inside before closing in both ends; verify heat treatment as proper; select samples for all tests and for check chemical analyses; witness all tests; verify threads by gauge; report

volumetric capacity (see report form) and minimum thickness of wall noted.

(d) Render complete report (§ 78.66-19) to purchaser, cylinder maker, and the Bureau of Explosives.

§ 78.66-5 Steel.

(a) Open-hearth or electric steel of uniform quality. Content percent for the following not over: Carbon, 0.150; phosphorus, 0.045; sulphur, 0.055.

§ 78.66-6 Identification of material.

(a) Required; any suitable method.

§ 78.66-7 Defects.

(a) Material with seams, cracks, laminations, or other injurious defects; not authorized.

§ 78.66-8 Manufacture.

(a) By proper appliances and methods; dirt and scale to be removed as necessary to afford proper inspection; no defect acceptable that is likely to weaken the finished cylinder appreciably; reasonably smooth and uniform surface finish required. Seams must be as follows:

(1) Circumferential seams. Except as provided in subparagraph (2) of this paragraph by welding or by brazing. Heads attached by brazing must have a driving fit with the shell, unless the shell is crimped, swedged, or curled over the skirt or flange of the head, and be thoroughly brazed until complete penetration by the brazing material of the brazed joint is secured. Depth of brazing from end of shell must be at least four times the thickness of shell metal.

(2) A container of two hemispherical heads, each having an integral tangential cylindrical skirt portion assembled so that the two cylindrical skirt portions telescope one within the other is authorized but must meet the following additional requirements for the skirt portions; one be a driving fit within the other; they be of equal length and telescoped for their full length; the length of the overlap be not less than 8 nor more than 10 times the thickness of the thinner of the two skirts; the overlapping joint be brazed (not welded) so as to get complete penetration for the full length of the joint.

§ 78.66-9 Wall thickness.

(a) The wall stress at 600 pounds per square inch shall not exceed 24,000 pounds per square inch, except that for longitudinally welded steel tubing the stress shall not exceed 20,400 pounds per square inch. The minimum wall for any cylinder shall be 0.032 inch. For the container authorized in § 78.66-8 (a) (2) the wall thickness of the cylinder shall be taken as the sum of the thicknesses of the two skirts (without allowance for the brazing material between).

(b) Calculation must be made by the formula:

$$S = \frac{600 (1.3D^2 + 0.4d^2)}{D^2 - d^2}$$

where

S = wall stress in pounds per square inch;
D = outside diameter in inches;
d = inside diameter in inches.

(c) Calculation for thickness of hemispherical heads of containers authorized

in § 78.66-8 (a) (2) must be made by the formula:

$$S = \frac{600D}{4tC}$$

where

t = thickness in inches;
C = 0.85 (design factor);
S and D have same significance as in paragraph (b) of this section. The minimum thickness of the head or skirt shall be 0.032 inch. The thickness of the skirt shall not be less than the thickness of the head.

§ 78.66-10 Heat treatment.

(a) Body and heads must be uniformly and properly heat treated prior to tests.

§ 78.66-11 Openings in cylinders.

(a) Each opening in cylinder, except those for safety devices, must be provided with a fitting, boss, or pad, securely attached to cylinder by brazing or by welding or by threads. If threads are used, they must comply with the following:

(1) Threads must be clean cut, even, without checks, and tapped to gauge.

(2) Taper threads to be of length not less than as specified for American Standard taper pipe threads.

(3) Straight threads, having at least 4 engaged threads, to have tight fit and calculated shear strength at least 10 times the test pressure of the cylinder; gaskets required, adequate to prevent leakage.

(b) Closure of fitting, boss, or pad, must be adequate to prevent leakage.

§ 78.66-12 Safety devices.

(a) Devices must be as required by the Interstate Commerce Commission's regulations that apply. (See §§ 73.34(f) and 73.301(i) of this chapter.)

§ 78.66-13 Pressure tests.

(a) Each cylinder produced shall be tested at an internal pressure¹ of at least 200 pounds per square inch and not exceeding 600 pounds per square inch, held for at least 30 seconds, and shall show no leak or other defect when inspected by suitable means.

(b) One out of each 3,000 cylinders or less successively produced per day shall be hydrostatically tested to destruction and must not burst below 1,200 pounds per square inch. Each such 3,000 cylinders or less successively produced per day shall constitute a lot and if the test cylinder shall fail, then the entire lot must be rejected. All cylinders constituting a lot shall be of identical size, design, construction, heat treatment, finish and quality.

§ 78.66-14 Flattening test.

(a) Between knife edges, wedge shaped, 60° angle, rounded to 1/2 inch radius; test 1 cylinder taken at random out of each lot of 3,000 or less successively produced per day, after pressure test. This flattening test is required and the test cylinder shall not have cracked when the outer surfaces of the walls are apart not more than a distance of 6 times the thickness of such walls.

¹Warning: Where air or gas pressure is used for testing, means designed to protect personnel is recommended.

§ 78.66-15 Rejected cylinders.

(a) Reheat treatment authorized for lots failing to meet the requirements of § 78.66-14; such lots of cylinders after this treatment must pass all prescribed tests.

§ 78.66-16 Repair of brazed and welded seams.

(a) Only repair of brazed seams by brazing and welded seams by welding is authorized, provided such cylinders are retested and pass the tests prescribed in § 78.66-13 (a).

§ 78.66-17 Marking.

(a) Marking on each cylinder by embossing plainly and permanently on valve end of cylinder before heat-treatment, the marks ICC-40 and registered symbol of manufacturer.

(1) Other marks as prescribed in subparagraph (2) of this paragraph, must be shown on a permanently attached name plate or by printing or decalcomania, provided that such markings are waterproofed and adherent and not easily impaired when subject to water immersion and weathering under service conditions, or are coated over with a water-insoluble transparent lacquer; except that cylinders having brazed lapped circumferential seam may, after having been tested in accordance with §§ 78.66-13 and 78.66-14 of this specification, have marks permanently stamped into metal of this seam, provided that such marks do not exceed 0.015" in depth.

(2) Inspector's official mark; lot number; date of test (such as 5-50 for May 1950); the words "Illegal to refill and transport".

§ 78.66-18 Size of embossed marks.

(a) At least 1/4 inch high.

§ 78.66-19 Inspector's reports.

(a) Required to be clear, legible, and in following form:

(Place).....
(Date).....
Steel Gas Cylinders
Manufactured for.....Company
Location at.....
Manufactured by.....Company
Location at.....
Consigned to.....Company
Location at.....
Quantity.....
Size.....inches outside diameter by.....inches long.
Identification marks embossed on cylinders are:
Specification ICC-40.
Identifying symbols (registered).....
Other marks on cylinder are:
Inspector's official mark.....
Lot number.....
Test date.....
Illegal to refill and transport.....
These cylinders were made by process of.....

The steel used was identified by heat or analysis numbers as shown on the "Record of Chemical Analysis of Steel for cylinders" attached hereto.

The steel used was verified as to chemical analysis and record thereof is attached hereto.

All material was inspected and each cylinder was inspected both before and after clos-

ing; all accepted material and cylinders were found free from seams, cracks, laminations, and other defects which might prove injurious to the strength of the cylinder. The processes of manufacture and heat treatment were supervised and found to be efficient and satisfactory.

A test cylinder of each lot was measured and had a minimum wall thickness and volumetric capacity as shown in table below:

Date of test	Lot No.	Number in lot	Minimum wall thickness (inches)	Volumetric capacity (cubic inches or pounds of water)

Such threads as were used were inspected and found to be clean cut, of proper length, and correct as to gauge.

One finished cylinder out of each lot was taken at random and burst by interior hydrostatic pressure with the following results:

Date of test	Lot No.	Pressure at which cylinder ruptured (pounds per square inch)

Each and every cylinder was subjected to an interior pressure of 200-pounds per square inch and showed no leak or other defect.

Hydrostatic tests, pressure tests, flattening tests, and other tests, as prescribed in Specification No. ICC-40 were made in the presence of the inspector and all material and cylinders were found to be in compliance with the requirements of that specification.

I hereby certify that all of these cylinders proved satisfactory in every way and comply with the requirements of Interstate Commerce Commission's specification No. 40 except as follows:

Exceptions: _____

(Signed) _____
Inspector.

RECORD OF CHEMICAL ANALYSIS OF STEEL FOR CYLINDERS

Size _____ inches outside diameter by _____ inches long.
Made by _____ Company
For _____ Company

Lot No.	Number in lot	Heat No.	Check analysis No.	Chemical analysis		
				C	P	S

The analyses were made by _____
(Signed) _____
Inspector.

§ 78.67 Specification 41; inside containers, non-refillable seamless or welded or brazed steel cylinders.

§ 78.67-1 Compliance.

(a) Required in all details.

§ 78.67-2 Type, size, and service pressure.

(a) *Type and size.* Must be seamless, welded, or brazed (brazing material must have a melting point of not less

than 1,000° F.). The maximum water capacity of cylinders in this class shall not exceed 2 pounds or 55 cubic inches. Longitudinal seams are prohibited, except that containers constructed from longitudinally welded steel tubing are authorized provided that certification is made by the tubing manufacturer that the tubing has been pressure tested to a fiber stress of 24,000 pounds per square inch as calculated by the formula:

$$P = \frac{24,000(D^2 - d^2)}{(1.3D^2 + 0.4d^2)}$$

where

P is the pressure required for pressure testing of tubing by the tubing manufacturer.

(b) *Service pressure.* Service pressure must be 240 pounds per square inch.

§ 78.67-3 Inspection by whom and where.

(a) By competent inspector of the manufacturer; or a disinterested inspection agency, chemical analysis and tests, as specified, to be made within limits of the United States.

§ 78.67-4 Duties of inspector.

(a) Inspect all material and reject any not complying with requirements.

(b) Verify compliance with the requirements of § 78.67-5 of the specification by submitting copy of certified chemical analysis obtained from the steel manufacturer for each heat of steel (ladle analysis acceptable); or if such evidence is lacking, then a sample from each coil or sheet must be analyzed and results submitted.

(c) Verify compliance of cylinders with all requirements including markings; inspect inside before closing in both ends; verify heat treatment as proper; select samples for all tests and for check chemical analyses; witness all tests; verify threads by gauge; report volumetric capacity (see report form) and minimum thickness of wall noted.

(d) Render complete report (§ 78.67-19) to purchaser, cylinder maker, and the Bureau of Explosives.

§ 78.67-5 Steel.

(a) Open-hearth or electric steel of uniform quality. Content percent for the following not over: Carbon, 0.150; phosphorus, 0.045; sulphur, 0.055.

§ 78.67-6 Identification of material.

(a) Required; any suitable method.

§ 78.67-7 Defects.

(a) Material with seams, cracks, laminations, or other injurious defects, not authorized.

§ 78.67-8 Manufacture.

(a) By proper appliances and methods; dirt and scale to be removed as necessary to afford proper inspection; no defect acceptable that is likely to weaken the finished cylinder appreciably; reasonably smooth and uniform surface finish required. Seams must be as follows:

(1) Circumferential seams: Except as provided in subparagraph (2) of this paragraph by welding or by brazing. Heads attached by brazing must have a driving fit with the shell, unless the shell is crimped, swedged, or curled over the

skirt or flange of the head, and be thoroughly brazed until complete penetration by the brazing material of the brazed joint is secured. Depth of brazing from end of shell must be at least four times the thickness of shell metal.

(2) A container of two hemispherical heads, each having an integral tangential cylindrical skirt portion assembled so that the two cylindrical skirt portions telescope one within the other is authorized but must meet the following additional requirements for the skirt portions; one be a driving fit within the other; they be of equal length and telescoped for their full length; the length of the overlap be not less than 8 nor more than 10 times the thickness of the thinner of the two skirts; the overlapping joint be brazed (not welded) so as to get complete penetration for the full length of the joint.

§ 78.67-9 Wall thickness.

(a) The wall stress at 720 pounds per square inch shall not exceed 24,000 pounds per square inch, except that for longitudinally welded steel tubing the stress shall not exceed 20,400 pounds per square inch. The minimum wall for any cylinder not exceeding 40 cubic inches capacity shall be 0.032 inch and for any cylinder exceeding 40 cubic inches capacity shall be 0.042 inch. For the container authorized in § 78.67-8 (a) (2) the wall thickness of the cylinder shall be taken as the sum of the thicknesses of the two-skirts (without allowance for the brazing material between).

(b) Calculation must be made by the formula:

$$S = \frac{720(1.3D^2 + 0.4d^2)}{D^2 - d^2}$$

where:

S = wall stress in pounds per square inch;
D = outside diameter in inches;
d = inside diameter in inches.

(c) Calculation for thickness of hemispherical heads of containers authorized in § 78.67-8 (a) (2) must be made by the formula:

$$S = \frac{720D}{4tC}$$

where:

t = thickness in inches;
C = 0.85 (design factor).

S and D have same significance as in paragraph (b) of this section. The minimum thickness of the head or skirt shall be 0.032 inch. The thickness of the skirt shall not be less than the thickness of the head.

§ 78.67-10 Heat treatment.

(a) Body and heads must be uniformly and properly heat treated prior to tests.

§ 78.67-11 Openings in cylinders.

(a) Each opening in cylinder, except those for safety devices, must be provided with a fitting, boss, or pad, securely attached to cylinder by brazing or by welding or by threads. If threads are used, they must comply with the following:

(1) Threads must be clean cut, even, without checks, and tapped to gauge.

(2) Taper threads to be of length not less than as specified for American Standard taper pipe threads.

(3) Straight threads, having at least 4 engaged threads, to have tight fit and

calculated shear strength at least 10 times the test pressure of the cylinder; gaskets required, adequate to prevent leakage.

(b) Closure of fitting, boss, or pad, must be adequate to prevent leakage.

§ 78.67-12 Safety devices.

(a) Devices must be as required by the Interstate Commerce Commission's regulations that apply. (See §§ 73.34 (f) and 73.301 (i) of this chapter.)

§ 78.67-13 Pressure tests.

(a) Each cylinder produced shall be tested at an internal pressure¹ of at least 240 pounds per square inch and not exceeding 720 pounds per square inch, held for at least 30 seconds, and shall show no leak or other defect when inspected by suitable means.

(b) Or, each completed container filled for shipment must be heated until content reaches a minimum temperature of 130° F.; without evidence of leakage, distortion or other defect.

(c) One out of each 3,000 cylinders or less successively produced per day shall be hydrostatically tested to destruction and must not burst below 1,440 pounds per square inch. Each such 3,000 cylinders or less successively produced per day shall constitute a lot and if the test cylinder shall fail, then the entire lot must be rejected. All cylinders constituting a lot shall be of identical size, design, construction, heat treatment, finish and quality.

§ 78.67-14 Flattening test.

(a) Between knife edges, wedge shaped, 60° angle, rounded to ½ inch radius; test 1 cylinder taken at random out of each lot of 3,000 or less successively produced per day, after pressure test. This flattening test is required and the test cylinder shall not have cracked when the outer surfaces of the walls are apart not more than a distance of 6 times the thickness of such walls.

§ 78.67-15 Rejected cylinders.

(a) Reheat treatment authorized for lots failing to meet the requirements of § 78.67-14; such lots of cylinders after this treatment must pass all prescribed tests.

§ 78.67-16 Repair of brazed and welded seams.

(a) Only repair of brazed seams by brazing and welded seams by welding is authorized, provided such cylinders are retested and pass the tests prescribed in § 78.67-13 (a).

§ 78.67-17 Marking.

(a) Marking on each cylinder by embossing plainly and permanently on the valve end or footing of cylinder before heat-treatment, the marks ICC-41 and registered symbol of the manufacturer, except that stamping of all prescribed marks on the valve end of all cylinders having wall thickness of 0.042 inch or greater is authorized providing no

stamping shall exceed 0.015 inch in depth.

(1) On cylinders having wall thickness less than 0.042 inch, other marks as prescribed in subparagraph (2) of this paragraph must be shown on a permanently attached name plate or by printing or decalcomania, provided that such markings are waterproofed and adherent and not easily impaired when subject to water immersion and weathering under service conditions, or are coated over with a water-insoluble transparent lacquer; except that cylinders having brazed lapped circumferential seam may, after having been tested in accordance with §§ 78.67-13 and 78.67-14 of this specification, have marks permanently stamped into metal of this seam, provided that such marks do not exceed 0.015 inch in depth.

(2) Inspector's official mark; lot number; date of test (such as 5-50 for May 1950); the words "Illegal to refill and transport".

§ 78.67-18 Size of embossed marks.

(a) At least ¼ inch high.

§ 78.67-19 Inspector's reports.

(a) Required to be clear, legible, and in following form:

(Place) _____
 (Date) _____
Steel gas cylinders
 Manufactured for _____ Company
 Location at _____
 Manufactured by _____ Company
 Location at _____
 Consigned to _____ Company
 Location at _____
 Quantity _____
 Size _____ inches outside diameter by _____ inches long.
 Identification marks embossed on cylinders are:
 Specification ICC-41.
 Identifying symbols (registered) _____
 Other marks on cylinder are:
 Lot number _____
 Test date _____
 Inspector's official mark _____
 Illegal to refill and transport _____
 These cylinders were made by process of _____

The steel used was identified by heat or analysis numbers as shown on the "Record of Chemical Analysis of Steel for Cylinders" attached hereto.

The steel used was verified as to chemical analysis and record thereof is attached hereto.

All material was inspected and each cylinder was inspected both before and after closing; all accepted material and cylinders were found free from seams, cracks, laminations, and other defects which might prove injurious to the strength of the cylinder. The processes of manufacture and heat treatment were supervised and found to be efficient and satisfactory.

A test cylinder of each lot was measured and had a minimum wall thickness and volumetric capacity as shown in table below:

Date of test	Lot No.	Number in lot	Minimum wall thickness (inches)	Volumetric capacity (cubic inches or pounds of water)
-----	-----	-----	-----	-----
-----	-----	-----	-----	-----
-----	-----	-----	-----	-----
-----	-----	-----	-----	-----

¹ Warning: Where air or gas pressure is used for testing, means designed to protect personnel is recommended.

Such threads as were used were inspected and found to be clean cut, of proper length, and correct as to gauge.

One finished cylinder out of each lot was taken at random and burst by interior hydrostatic pressure with the following results:

Date of test	Lot No.	Pressure at which cylinder ruptured (pounds per square inch)
-----	-----	-----
-----	-----	-----
-----	-----	-----

Each and every cylinder was subjected to an interior pressure of 240-pounds per square inch or was heated until contents reached a minimum temperature of 130° F. and showed no leak or other defect.

Hydrostatic tests, pressure tests, flattening tests, and other tests, as prescribed in Specification No. ICC-41 were made in the presence of the inspector and all material and cylinders were found to be in compliance with the requirements of that specification.

I hereby certify that all of these cylinders proved satisfactory in every way and comply with the requirements of Interstate Commerce Commission's Specification No. 41 except as follows:

Exceptions: _____
 (Signed) _____
 Inspector.

RECORD OF CHEMICAL ANALYSIS OF STEEL FOR CYLINDERS

Size _____ inches outside diameter by _____ inches long.
 Made by _____ Company.
 For _____ Company.

Lot No.	Number in lot	Heat No.	Check analysis No.	Chemical analysis		
				C	P	S
-----	-----	-----	-----	-----	-----	-----
-----	-----	-----	-----	-----	-----	-----
-----	-----	-----	-----	-----	-----	-----

The analyses were made by _____
 (Signed) _____
 Inspector.

§ 78.68 Specification 4E; welded aluminum cylinders.

§ 78.68-1 Compliance.

(a) Required in all details.

§ 78.68-2 Type, size and service pressure.

(a) *Type and size.* Must be welded seamless drawn shells, not more than two shells, with center circumferential weld; not over 1,000 pounds water capacity (nominal); longitudinal welded seam not authorized. Cylinders or shells closed in by spinning process not authorized.

(b) *Service pressure.*¹ At least 225 to not over 500 pounds per square inch.

§ 78.68-3 Inspection by whom and where.

(a) By competent inspector; chemical analyses and tests as specified to be made

¹ The "service pressure" limits the use of the cylinder. It is shown by marks on cylinders; for example ICC-4E240 indicates the service pressure as 240 pounds per square inch.

within limits of the United States. Interested inspectors are authorized.

§ 78.68-4 Duties of inspector.

(a) Inspect all material and reject any material not complying with requirements.

(b) Verify chemical analysis of each lot of material by analysis or by obtaining certified analysis: *Provided*, That a certificate from the manufacturer thereof, giving sufficient data to indicate compliance with requirements, is acceptable when verified by check analysis of samples taken from one aluminum cylinder out of each lot of 200 or less.

(c) Verify compliance of cylinders with all requirements including markings; inspect inside before closing in both ends; verify properties as proper; obtain samples for all tests and check chemical analysis; witness all tests; verify threads by gauge; report volumetric capacity, tare weight (see report form) and wall thickness as approved.

(d) Render complete report (§ 78.68-20) to purchaser; cylinder manufacturer; and the Bureau of Explosives.

§ 78.68-5 Aluminum.

(a) Shall be of uniform quality. The following chemical analyses are authorized.

TABLE I—AUTHORIZED MATERIALS

Designation	Chemical analysis—limits in percent 5154 ¹
Iron plus silicon.....	0.45 maximum.
Copper.....	0.10 maximum.
Manganese.....	0.10 maximum.
Magnesium.....	3.1/3.9.
Chromium.....	0.15/0.35.
Zinc.....	0.20 maximum.
Titanium.....	0.20 maximum.
Others, each.....	0.05 maximum.
Others, total.....	0.15 maximum.
Aluminum.....	Remainder.

¹ Analysis shall regularly be made only for the elements specifically mentioned above. If, however, the presence of other elements is indicated in the course of routine analysis, further analysis should be made to determine conformance with the limits specified for other elements.

§ 78.68-6 Identification of material.

(a) Required; any suitable method that will identify the alloy and manufacturer's lot number.

§ 78.68-7 Defects.

(a) Material with seams, cracks, laminations or other injurious defects not authorized.

§ 78.68-8 Manufacture.

(a) By best processes and methods; dirt and foreign particles to be removed as necessary to afford proper inspection; no defect acceptable that is likely to weaken the finished cylinder appreciably; reasonably smooth and uniform surface finish required; all welding must be by the gas shielded arc process.

§ 78.68-9 Welding.

(a) The attachment to the tops and bottoms only of cylinders by welding of neckrings or flanges, footrings, handles, bosses and pads and valve protection rings is authorized: *Provided*, That such attachments and the portion of the cylinder to which it is attached are made of weldable aluminum alloys.

§ 78.68-10 Wall thickness.

(a) The minimum wall thickness of the cylinder shall be 0.140 inch. In any case, the minimum wall thickness shall be such that calculated wall stress at twice service pressure shall not exceed the lesser value of either of the following:

- (1) 20,000 pounds per square inch.
- (2) One-half of the minimum tensile strength of the material as required in § 78.68-15.

(b) Calculation must be made by the formula:

$$S = \frac{P(1.3D^2 + 0.4d^2)}{D^2 - d^2}$$

where

- S=wall stress in pounds per square inch;
- P=minimum test pressure prescribed for water jacket test;
- D=outside diameter in inches;
- d=inside diameter in inches.

(c) Minimum thickness of heads and bottoms shall not be less than the minimum required thickness of the side wall.

§ 78.68-11 Opening in cylinder.

(a) All openings must be in the heads or bases.

(b) Each opening in cylinders, except those for safety devices, must be provided with a fitting, boss, or pad, securely attached to cylinder by welding by inert gas shielded arc process or by threads. If threads are used, they must comply with the following:

- (1) Threads must be clean-cut, even, without checks and cut to gauge.
- (2) Taper threads to be of length not less than as specified for American Standard taper pipe threads.
- (3) Straight threads, having at least 4 engaged threads, to have tight fit and calculated shear strength at least 10 times the test pressure of the cylinder; gaskets required, adequate to prevent leakage.

(c) Closure of fitting, boss, or pad must be adequate to prevent leakage.

§ 78.68-12 Safety devices and protection for valves, safety devices, and other connections if applied.

(a) Must be as required by the Interstate Commerce Commission regulations that apply (see §§ 73.34(f), 73.124(a), and 73.301(i) of this chapter).

§ 78.68-13 Hydrostatic test.

(a) Each cylinder by water-jacket, or other suitable method, operated so as to obtain accurate data. Pressure gauge must permit reading to accuracy of 1 percent. Expansion gauge must permit reading of total expansion to accuracy either of 1 percent or 0.1 cubic centimeter.

(b) Pressure of 2 times service pressure must be maintained for 30 seconds and sufficiently longer to insure complete expansion. Any internal pressure applied previous to the official test must not exceed 90 percent of the test pressure. If, due to failure of the test apparatus, the test pressure cannot be maintained, the test may be repeated at a pressure increased to 10 percent.

(c) Permanent volumetric expansion must not exceed 12 percent of total volumetric expansion at test pressure.

(d) One finished cylinder selected at random out of each lot of 1,000 shall be

hydrostatically tested to destruction. Failure shall occur in the side wall and shall not occur at a pressure less than 4 times the service pressure. Inability to meet these requirements shall result in rejection of the lot.

§ 78.68-14 Flattening test.

(a) Flattening test required between knife edges, wedge shaped, 60° angle, rounded to ½ inch radius; on one section of a cylinder taken at random out of each lot of 200 or less, after hydrostatic test. Sample must show no evidence of cracking when flattened to 6 times wall thickness.

§ 78.68-15 Physical test.

(a) To determine yield strength, tensile strength, elongation, and reduction of area of material. Required on 2 specimens cut from one cylinder or part thereof taken at random out of each lot of 200 or less.

(b) Specimens must be: Gauge length 8 inches with width not over 1½ inches; or gauge length 2 inches with width not over 1½ inches. The specimen, exclusive of grip ends, must not be flattened. Grip ends may be flattened to within 1 inch of each end of the reduced section. When size of cylinder does not permit securing straight specimens, the specimens may be taken in any location or direction and may be straightened or flattened cold, by pressure only, not by blows; when specimens are so taken and prepared, the inspector's report must show in connection with record of physical test detailed information in regard to such specimens. Heating of specimen for any purpose is not authorized.

(c) The yield strength in tension shall be the stress corresponding to a permanent strain of 0.2 percent of the gauge length.

(1) The yield strength shall be determined by the "offset" method as prescribed in ASTM Standard E8-57T.

(2) Cross-head speed of the testing machine shall not exceed ½ inch per minute during yield strength determination.

§ 78.68-16 Acceptable results for physical tests.

(a) Elongation at least 7 percent for 2 inch gauge length; yield strength not over 80 percent of tensile strength.

§ 78.68-17 Weld tests.

(a) Reduced section tensile test. A specimen shall be cut from the cylinder used for the physical tests specified in § 78.68-15. Specimen shall be taken across the seam, edges shall be parallel for a distance of approximately 2 inches on either side of the weld. The specimen must be fractured in tension. The apparent breaking stress calculated on the minimum wall thickness must be at least equal to 2 times the stress calculated under § 78.68-10(b), and in addition must have an actual breaking stress of at least 30,000 pounds per square inch. Should this specimen fail to meet the requirements, specimens may be taken from 2 additional cylinders from the same lot and tested. If either of the latter specimens fails to meet re-

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quirements, the entire lot represented shall be rejected.

(b) *Guided bend test.* A bend test specimen shall be cut from the cylinder used for the physical tests specified in § 78.68-15. Specimen shall be taken across the seam, shall be 1½ inches wide, edges shall be parallel and rounded with a file, and back-up strip, if used, shall be removed by machining. The specimen shall be bent to refusal in the guided bend test jig illustrated in paragraph 6.10 of CGA Pamphlet C-3-1954, "Standards for Welding and Brazing on Thin Walled Containers."¹ The root of the weld (inside surface of the cylinder) shall be located away from the ram of the jig. No specimen shall show a crack or other open defect exceeding ½ inch in any direction upon completion of the test. Should this specimen fail to meet the requirements, specimens may be taken from each of 2 additional cylinders from the same lot and tested. If either of the latter specimens fail to meet requirements, the entire lot represented shall be rejected.

§ 78.68-18 Rejected cylinders.

(a) Repair of welded seams is authorized. Acceptable cylinders must pass all prescribed tests.

§ 78.68-19 Marking.

(a) Marking on each cylinder by stamping plainly and permanently on shoulder, top head, neck or valve protection collar which may be permanently attached to the cylinder and forming an integral part thereof, as follows:

(1) ICC-4E followed by the service pressure (for example, ICC-4E240).

(2) A serial number and an identifying symbol (letters); location of symbol to be just below the serial number. The symbol and numbers must be those of the purchaser, user, or maker. The symbol must be registered with the Bureau of Explosives.

(3) Inspector's official mark, near serial number: date of test (such as 5-50 for May 1950), so placed that date of subsequent test can be easily added.

(4) Size of marks. Shall be at least ¼ inch high.

§ 78.68-20 Inspector's reports.

(a) Required to be clear, legible, and in following form:

(Place) _____
(Date) _____

Gas cylinders

Manufactured for _____ Company
Location at _____
Manufactured by _____ Company
Location at _____
Consigned to _____ Company
Location at _____
Quantity _____
Size _____ inches outside diameter by _____ inches long.

Marks stamped into the shoulder of the cylinder are:

Specification ICC _____
Serial numbers _____ to _____ inclusive.
Inspector's mark _____
Identifying symbol (registered) _____
Test date _____

¹ Available from the Compressed Gas Association, Inc., 500 Fifth Avenue, New York 36, New York.

Tare weights (yes or no) _____
Other marks (if any) _____
These cylinders were made by process of _____

The _____ permitted in (Neckrings, footrings, etc.)
§ 78.68-9 were attached by process of _____

The material used was identified by the following _____ numbers _____

The material used was verified as to chemical analysis and record thereof is attached hereto.

All material, such as aluminum plate, was inspected before manufacture and the drawn cylinder shells were inspected before final fabrication and found free from seams, cracks, laminations and other defects which might prove injurious to the strength of the cylinder; the processes of manufacture were found to be efficient and satisfactory.

The cylinder walls were measured and the minimum thickness noted was _____ inch. The outside diameter was determined by a close approximation to be _____ inches. The wall stress was calculated to be _____ pounds per square inch under an internal pressure of _____ pounds per square inch.

Hydrostatic tests, flattening tests, tensile tests of material and other tests as prescribed

in Specification ICC-4E were made in the presence of the inspector and all material and cylinders accepted were found to be in compliance with the requirements of that specification. Records thereof are attached hereto.

I hereby certify that all of these cylinders proved satisfactory in every way and comply with the requirements of Interstate Commerce Commission specification No. 4E except as follows:

Exceptions: _____
(Signed) _____
Inspector.

(Place) _____
(Date) _____

RECORD OF CHEMICAL ANALYSIS OF MATERIAL FOR CYLINDERS

Numbered _____ to _____ inclusive.
Size _____ inches outside diameter by _____ inches long.

Made by _____ Company
For _____ Company

NOTE: Any omission of analyses by heats, if authorized, must be accounted for by notation hereon reading "The prescribed certificate of the manufacturer of material has been secured, found satisfactory, and placed on file," or by attaching a copy of the certificate.

Test No.	Check analysis No.	Cylinders represented (Serial Nos.)	Chemical analysis							
			Mg	Cr	Cu	Mn	Zn	Ir	Al	Ti
_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____

The analyses were made by _____
(Signed) _____
(Place) _____
(Date) _____

RECORD OF PHYSICAL TESTS OF MATERIAL FOR CYLINDERS

Numbered _____ to _____ inclusive.
Size _____ inches outside diameter by _____ inches long
Made by _____ Company
For _____ Company

Test No.	Cylinders represented by test (Serial Nos.)	Yield strength (pounds per square inch)	Tensile strength (pounds per square inch)	Elongation (percent in 8 inches)	Reduction of area (percent)	Flattening test	Burst test (pounds per square inch)
_____	_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____	_____

(Signed) _____
(Place) _____
(Date) _____

RECORD OF HYDROSTATIC TESTS ON CYLINDERS

Numbered _____ to _____ inclusive.
Size _____ inches outside diameter by _____ inches long
Made by _____ Company
For _____ Company

Serial numbers of cylinders tested arranged numerically	Actual test pressure (pounds per square inch)	Total expansion (cubic centimeters) ¹	Permanent expansion (cubic centimeters) ¹	Percent ratio of permanent expansion to total expansion ¹	Tare weight (pounds) ²	Volumetric capacity ³
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____

NOTE: When specifications require test for only 1 out of each lot of 200 or less cylinders, the check on the others must be indicated by a notation hereon reading, "Each cylinder was subjected to a pressure of _____ pounds per square inch and showed no defect."

¹ If the tests are made by a method involving the measurement of the amount of liquid forced into the cylinder by the test pressure, then the basic data, on which the calculations are made, such as the pump factors, temperature of liquid, coefficient of compressibility of liquid, etc., must also be given.

² Do not include removable cap but state whether with or without valve. These weights must be accurate to a tolerance of 1 percent.

³ Report approximate maximum and minimum volumetric capacity for the lot.

(Signed) _____

APPENDIX A—SPECIAL ORDERS (USE OF EXISTING CONTAINERS AUTHORIZED, BUT NEW CONSTRUCTION NOT AUTHORIZED)

Order approved December 28, 1939, in No. 3666, authorizing trial transportation of commercial butane (liquefied petroleum gas) on freight vessels in portable fusion-welded tanks of special design, between ports of the United States and points located in Puerto Rico and Virgin Islands, amended by order August 16, 1940, also order March 29, 1940, authorizing trial transportation of commercial butane (liquefied petroleum gas) in such tanks to Cristobal and Balboa, Canal Zone, and Colon and Panama City, Republic of Panama. Pertinent sections of regulations amended accordingly. Stowage canceled by regulations of Secretary of Commerce effective April 9, 1941. Authority noted in § 73.32 (d) of this chapter, covers tanks as follows:

Specification for design, construction, and use of portable tank container for trial service in the transportation of butane on deck in the open freight vessels of common carriers by water engaged in interstate or foreign commerce.

1. *Application.* (a) This specification applies to containers for transportation of butane on freight vessels only.

(b) When reference is made to "gas" in this specification it refers to "butane" in either liquid or gaseous state. The terms "tanks" and "containers" are used interchangeably.

2. *Design, working pressure, and classification of containers.* (a) Containers shall be designed and classified as follows:

Container type	For gases with vapor pressure not to exceed lbs. per sq. in., gauge, at 100° F.	Minimum design pressure of containers by—	
		A. S. M. E. Code, safety factor 5	A. P. I.—A. S. M. E. Code, safety factor 4
		Lb. gauge	Lb. gauge
No. 125.....	*125	125	156
No. 150.....	*150	150	187
No. 175.....	*175	175	219
No. 200.....	*200	200	250

*In no event may vapor pressure of butane filled into any tank exceed 80 pounds per square inch at 100° F.

(b) The shell or head thickness of any container shall not be less than 3/16 inch.

3. *Construction and tests of all containers and markings on containers* (a) Containers shall be constructed in accordance with the Unfired Pressure Vessel Code of the American Society of Mechanical Engineers, or in accordance with the API-ASME Code; except that compliance with the following shall not be required; paragraphs U-2 to U-10, inclusive, and U-19 of the aforesaid ASME Code; paragraphs W-601 to W-606 in section (1) of the aforesaid API-ASME Code.

(1) All fusion-welding under this specification shall be equal in quality, strength and continuing efficiency, and the method used in certifying fabricators shall insure equally efficient welding to that prescribed by the Commission in order dated November 13, 1935 (213 ICC 207), and exhibit containing specifications presented in that proceeding, for tank-car tanks to be used in the transportation of liquefied petroleum gas.

(b) All containers shall be tested at the time of manufacture in accordance with the requirements of the rules or code under which the vessels are manufactured.

(c) The water capacity shall be such that the total weight of any container, including contents and accessories, shall not exceed 8,000 pounds.

(d) A name plate shall be securely attached to each container, located adjacent to filling connections and in such manner as

to be readily visible, and bearing the following information:

(1) Name and address of the assembler of the container and container accessories.

(2) The wording "This container shall not contain butane having a vapor pressure in excess of 80 pounds per square inch at 100 degrees F."

(3) Markings in increments of 20° F., indicating the maximum levels beyond which the container shall not be filled with liquid at temperatures between 20° F. and 130° F., except on containers provided with fixed maximum-level indicators, or replaceable containers which are gauged by weighing. This marking may be on the gauging device.

(e) Each container shall be permanently marked in accordance with the requirements of the code under which it was constructed, or with the stamp of the National Board of Boiler and Pressure Vessel Inspectors, and in addition shall have the following markings:

(1) The water capacity of the container in pounds or gallons, U. S. Standard.

(2) The working pressure in pounds per square inch for which the container is designed.

(3) The wall thickness of the shell and heads.

(f) All container inlets and outlets, except safety relief valves and gauging devices, shall be labeled to designate whether they communicate with vapor or liquid space.

(g) Each container must be subjected, at least once every five years, to the original hydrostatic and hammer test required by the code under which it was manufactured. A container must be condemned if it fails to pass such test. Each tank passing the test must be marked with the date (month and year) plainly and permanently stamped on the tank or name plate. For example: 1-29 for January 1929. Dates of previous tests must not be obliterated.

(h) All prescribed markings on tanks must be kept legible.

(i) Containers exposed to action of fire must not again be placed in service until they have been subjected to proper heat treatment, and retest as provided in section 3 (g).

4. *Filling pipe and discharge pipes.* (a) The discharge outlet shall be provided with a suitable automatic excess flow valve.

(b) Filling connections shall be provided with approved automatic valves to prevent back flow in case the filling connection is broken.

(c) All other connections to containers, except safety relief connections, shall be equipped with approved automatic excess flow valves. All excess flow and back pressure check valves shall be located inside of the container, or at a point outside where the line enters the container. In the latter case, installation shall be made in such manner that any undue strain beyond the excess flow or back pressure check valve will cause breakage on the discharge end of the excess flow or back pressure check valve, and not between container and such valve. Gauging devices which do not involve the flow of liquid, or which are so constructed that outward flow of container contents shall not exceed that passed by a No. 54 drill size, need not be equipped with excess flow valves.

NOTE 1: An excess flow valve is a valve so designed that it will automatically close and shut off the gas or liquid flow in case:

(1) The flow through the valve exceeds predetermined flow, which flow must be less than the pipe line capacity to and from such excess flow valve.

(2) The pressure on the inlet side of excess flow valve exceeds by a certain designed number of pounds per square inch the pressure in pounds on the outlet of such valve.

(d) All connections to containers except gauging device connections (see sec. 6 (a) hereof) and safety relief connections shall

be provided with shut-off valves located as close to the container as practicable.

5. *Safety devices.* (a) Every container shall be provided with one or more safety relief valves of spring loaded or equivalent type arranged to afford free vent to the outer air and with discharge area sufficient to prevent the building up of pressure in excess of 120 percent of the maximum permitted setting of the relief valve on the container, and in accordance with the provisions of Appendix "A-1".

(b) Safety relief valves shall be set to start to discharge, with relation to the design working pressure of the container, as follows:

Container	Minimum		Maximum	
	Percent		Percent	
A. S. M. E.....	100	125	100	125
A. P. I.—A. S. M. E.....	80		80	100

(c) Safety relief valves shall be so arranged that tampering will be minimized and, if pressure setting or adjustment is external, the relief valves shall be provided with suitable means for sealing the adjustment mechanism. No shut-off valve shall be installed between the safety relief valve and the container.

(d) Each safety valve shall be plainly and permanently marked as follows:

(1) With the pressure in pounds per square inch, gauge, at which the valve is set to start to discharge and the actual free discharge area in square inches of the valve at its full open position; for example, 200-24.

6. *Gauging devices.* (a) Each container may be loaded by the weighing method, or by accurately determining liquid levels, with compensation for temperature and for vapor above the liquid in which case it shall be equipped with an accurate liquid level gauging device of approved design, for example, a rotary tube, slip tube, automatic outage tank, magnetic, or fixed tube device, the latter consisting of a dip pipe of small size equipped with a valve at the outer end, and so arranged that the maximum liquid level to which the container may be filled is not in excess of the maximum permitted under the filling density table in Sec. 10 (a), but based on an initial liquid temperature of not to exceed 40° F.

(1) Gauging devices of the rotary tube, fixed tube, slip tube, and magnetic type may be used without installation of an excess flow valve, provided the bleed valve opening is not larger than a #54 drill size. If tanks are to be filled according to liquid level, each tank should have a thermometer well so that the internal liquid temperature can be easily determined and the amount of liquid and vapor in the tank corrected to a 60° F. basis.

(b) Gauging devices shall have a design working pressure of at least 250 lbs. per sq. in., gauge.

(c) Gauge glasses of the column type are prohibited.

7. *Fittings and accessories.* (a) All valves and connections shall be of a type approved as herein provided, suitable for use with liquefied petroleum gas and designed for not less than the maximum pressure to which they may be subjected.

(b) Valve seat material, packing gaskets, etc., shall be of such quality as not to be adversely affected by liquefied petroleum gases.

8. *Protection of valves, fittings, and accessories.* (a) Each container shall have all valves, fittings, accessories, safety devices; gauging devices, and the like suitably protected against mechanical damage by rings, covers, boxes, or hoods, rigidly attached to the containers. Such attachments shall comply with the provisions of the Code of rules under which the containers are constructed, and shall be designed (with a mini-

RULES AND REGULATIONS

imum factor of safety of four) to withstand loading in any direction equal to two times the weight of the container and attachments when filled to the maximum permissible loaded weight.

9. *Mountings for containers.* (a) Horizontal containers shall be designed and built with supports attached. The type of support popularly known as "skids" will be deemed to comply with this requirement.

(b) Containers may be permanently attached to the supports or may be removable, provided proper anchorage is assured to prevent jarring loose, slipping, or rotating of containers.

(c) Containers shall be secured in place on the supports by fastenings, designed (with a factor of safety of four) to withstand loadings in any direction equal to four times the filled weight of the container. Brackets, cradles, lifting lugs, or other attachments intended to carry loadings shall be in accordance with the Code under which the containers are constructed and shall be attached by the container manufacturer before testing.

(d) Lifting lugs, designed (with a safety factor of four) to withstand loadings in any direction equal to four times the filled weight of the container, shall be provided on the container or container support in a manner suitable for attaching lifting gear and hold-down devices.

10. *Filling densities.* (a) The "filling density" is defined as the percent ratio of the weight of the gas in a container to the weight of water the container will hold at 60° F. The filling density of containers shall not exceed the ratios following:

Specific gravity at 60° F.:	Maximum permitted percent filling density
0.369-0.398	32
0.399-0.425	33
0.426-0.440	34
0.441-0.452	35
0.453-0.462	36
0.463-0.472	37
0.473-0.480	38
0.481-0.488	39
0.489-0.495	40
0.496-0.503	41
0.504-0.510	42
0.511-0.519	43
0.520-0.527	44
0.528-0.536	45
0.537-0.544	46
0.545-0.552	47
0.553-0.560	48
0.561-0.568	49
0.569-0.576	50
0.577-0.584	51
0.585-0.592	52
0.593-0.600	53
0.601-0.608	54
0.609-0.617	55
0.618-0.620	56
0.627-0.634	57

(b) The liquid portion of the gas in a container shall not completely fill the container at 130° F.

11. *Odorizing the gas.* (a) In order that the danger of escaping combustible gas may be minimized and to facilitate the quick detection of gas leaks, butane transported in these containers shall be effectively odorized by an approved agent of such character as to positively indicate the presence of gas, down to concentrations in air of not over one-fifth the lower limit of combustibility, by a distinctive odor.

NOTE 1: The lower limit of combustibility of butane is 1.55. This figure represents volumetric percentage of a gas-air mixture.

12. *Painting and marking.* (a) Containers shall be painted a light heat-reflecting color and the paint shall be renewed as often as necessary to thoroughly protect all metal surfaces.

(b) Each container shall be plainly and conspicuously marked in red letters not less

than four inches high with the words "FLAMMABLE GAS—KEEP FIRE AND LIGHTS AWAY."

(c) Each container shall be plainly and conspicuously marked "This Side Up" or "This End Up," as required.

APPENDIX A-1—REQUIRED SIZES OF SAFETY VALVES FOR BUTANE GAS TANKS AS CLASSIFIED UNDER SECTION 2

NOTE: D=outside diameter of tank in feet and fractions thereof; U=over-all length of tank in feet and fractions thereof.

	Type 80-lb. min.	Type 100-lb. min.	Minimum required safety valve actual free discharge area (sq. ins.) ^a			
			Type 125-lb. min.	Type 150-lb. min.	Type 175-lb. min.	Type 200-lb. min.
Where (D×U) does not exceed 10.....	0.32	0.27	0.22	0.19	0.18	0.16
Is greater than 10 but not more than 15..	.46	.38	.30	.26	.24	.21
Is greater than 15 but not more than 20..	.60	.50	.42	.36	.33	.29
Is greater than 20 but not more than 40..	1.25	1.03	.84	.71	.64	.57
Is greater than 40 but not more than 60..	1.90	1.57	1.25	1.06	.94	.83
Is greater than 60 but not more than 80..	2.50	2.06	1.68	1.43	1.25	1.10

^aIn no event may vapor pressure of butane filled into any tank exceed 80 pounds per square inch at 100° F.

Order approved March 29, 1940, in No. 3666, authorizing trial transportation of commercial butane (liquefied petroleum gas) on freight vessels in portable fusion-welded tanks of special design to Cristobal and Balboa, Canal Zone, and Colon and Panama City, Republic of Panama, amending order December 28, 1939, for trial transportation of commercial butane between ports of the United States and points located in Puerto Rico and Virgin Islands. Pertinent sections of regulations amended accordingly. Authority noted in § 73.32 (d) of this chapter. Stowage canceled by regulations of Secretary of Commerce effective April 9, 1941.

Order approved December 18, 1941, in No. 3666, authorizing trial transportation of liquefied petroleum gas in 5,000 cylinders of additional-type alloy steel construction. Pertinent sections of regulations amended accordingly. Authority noted in § 73.312 (a) (1) of this chapter covering specification 4B-240X cylinders, as follows:

SPECIFICATION 4B ALLOY STEEL CYLINDERS

22. *Additional type.* Cylinders without longitudinal welded seam when made for service pressure at least 150 pounds to not over 500 pounds per square inch are authorized when complying with this specification with exceptions and additional requirements as follows:

(a) *Exceptions.* (1) Yield point not over 75 percent of tensile strength is acceptable.

(2) Wall thickness is acceptable, subject to the additional requirement specified in par. 22 (b) (1), as follows:

Inside diameter of cylinders (ins.)	Minimum thickness* (in.)	Inside diameter of cylinders (ins.)	Minimum thickness* (in.)
13 or less.....	0.078	Over 14¼ to 15..	0.087
Over 13 to 14.....	.081	Over 15 to 16..	.092
Over 14 to 14¼....	.084	Over 16.....	.100

*Excluding galvanizing or other protective coating.

(3) Elongation percentages as prescribed in § 78.50-17 (a) may be reduced by 2 percent for 2-inch specimens, and 1 percent in other cases, for each 7,500 pounds per square inch increment of tensile strength above 50,000 pounds per square inch up to the maximum of 80,000 pounds per square inch.

(b) *Additional requirements.* (1) Wall stress at test pressure, as calculated under § 78.50-10 (b), must not exceed 50 percent of the minimum tensile strength of the steel.

(2) Ratio of length of cylinder to its diameter must not exceed 3.5 when wall thickness is less than 0.10 inch.

(3) Each cylinder, except when brazed throughout, must be thermally stress relieved

after all welding operations have been completed and prior to the hydrostatic test.

(4) Weld test specimens must be cut from one cylinder taken at random from each lot of 200 or less cylinders after stress relieving as prescribed and must pass satisfactorily the following tests:

(a) *Tensile test.* Without preparation other than finishing the edges parallel for a distance of approximately 2 inches on each side of the weld, the specimen must be fractured in a tensile test; the unit breaking load must be at least equal to the minimum unit breaking load in the tensile tests made under the requirements of § 78.50-16.

(b) *Guided bend test.* A specimen 1½ inches wide, on which the edges have been machined parallel and rounded with a file, but without other preparation, shall be bent to refusal in the guided bend test jig illustrated in paragraph 6.10 of CGA Pamphlet C-3-1954, "Standards for Welding and Brazing on Thin Walled Containers." The root of the weld (inside surface of cylinder) shall be located away from the ram of the jig. Any specimen which shows a crack exceeding ¼ inch in any direction upon completion of the test shall be considered unsatisfactory.

(5) All markings must be applied on a plate of ferrous material attached to the top end of the cylinder or permanent part thereof; sufficient space must be left on the plate to provide for stamping at least six retest dates; the plate must not be attached to the side wall of the cylinders; the plate must be at least ¼ inch thick and it must be attached by welding, or by brazing at a temperature of at least 1400° F., throughout all edges of the plate; provided, that marks may be stamped into the metal of the valve boss or valve protecting sleeve or similar part permanently attached to the top end of the cylinder; provided further, that marks other than those prescribed in par. 19 may be stamped into the foot ring. Stamping of letters, figures or other marks into the metal of the cylinder for any purpose whatever, except as above authorized, is expressly prohibited.

(6) Reports of manufacture shall include percentage of each alloying element in the steel and shall state that the cylinders are made under the provisions of par. 22 of this specification.

(7) Carbon content of steel must not exceed 0.20 percent.

(c) *Marking requirements of § 78.50-19 (a) (2) of specification No. 4 must be compiled with. The marking of cylinders must be as follows:*

I. C. C.—4 B—240 X

¹ Available from the Compressed Gas Association, Inc., 500 Fifth Avenue, New York 36, N.Y.

Subpart D—Specifications for Metal Barrels, Drums, Kegs, Cases, Trunks, and Boxes

§ 78.80 Specification 5; steel barrels or drums.

Removable head containers which will pass all required tests are authorized.

§ 78.80-1 Compliance.

(a) Required in all details.

§ 78.80-2 Rated capacity.

(a) Rated capacity as marked, see § 78.80-11(a)(3). Actual capacity of straight-sided containers shall be not less than rated (marked) capacity plus 2 percent, nor greater than rated capacity plus 2 percent plus 1 quart, except that for containers over 30 gallons marked capacity actual capacity shall be not less than rated capacity plus 2 percent, nor greater than rated capacity plus 2 percent plus 2 quarts; actual capacity of bilge-type containers must

be not less than rated capacity, nor greater than rated capacity plus 2 percent plus 2 quarts.

§ 78.80-3 Composition.

(a) Sheets for body and heads to be low carbon, open hearth or electric steel. Stainless steel, when used, must be, except for rolling hoops and chime reinforcement, an austenitic 18 and 8 chrome nickel alloy with carbon content not over 0.08 percent, or other equivalent grades.

§ 78.80-5 Seams.

(a) Body seams welded.

§ 78.80-6 Chime reinforcement.

(a) Containers over 25 gallons capacity, with flanged head secured to body, to have chime reinforcement adequate for its protection.

§ 78.80-7 Parts and dimensions.

(a) Parts and dimensions as follows:

Marked capacity not over (gallons)	Type of container	Minimum thickness, uncoated sheets (gauge)		Rolling hoops		
		Body sheet	Head sheet	Type ¹	Minimum	
					Size (gauge or inch)	Weight (pounds per foot)
5	Straight side	22	22	None		
10	do	20	20	do		
33	do	14	14	do		
33	do	18	18	U	16	
55	do	16	16	U ²	14	
110	do	14	14	U ³	12	
33	do	18	18	I-bar	3/4 x 1 1/4	1.25
55	do	16	16	I-bar ²	3/4 x 1 1/4	1.25
110	do	14	14	I-bar ³	3/4 x 1 1/4	1.25
33	do	16	16	(?)		
55	do	14	14	(?)		
33	do	14	14	None		
55	Bilge	14	16	do		
33	do	13	14	do		

¹ Rolling hoops of pliable solid rubber or other suitable material are also authorized when approved as to type and construction by the Bureau of Explosives.

² Rolled or swaged in hoops.

³ In addition to the normal rolling hoops, the body of each removable head drum must have a rolled or swaged in hoop the center-line of which shall be not more than 3 inches from the top curl.

(b) Steel sheets of specified gauges shall comply with the following:

Gauge No.	Nominal thickness ¹ (inch)	Minimum thickness ¹ (inch)
13	0.0897	0.0817
14	.0747	.0677
16	.0598	.0533
18	.0478	.0428
20	.0359	.0324
22	.0299	.0269

¹ Thickness shall be measured at any point on the sheet not less than 3/4 inch from an edge.

§ 78.80-8 Rolling hoops.

(a) Separate hoops to have tight fit on shell and be firmly secured in place. Beading under rolling hoops not permitted. Attachment to drum body by spot welding, except for continuous resistance method, not permitted. Welding of I-bar type directly to body of drum in any manner not permitted.

§ 78.80-9 Closures.

(a) Adequate to prevent leakage; gaskets required.

(b) Closing part (plug, cap, plate, etc., see Note 1) must be of metal as thick as prescribed for head of container; this not required for containers of 12 gallons or less when the opening to be closed is not over 2.7 inches in diameter. If unthreaded cap is used it must be provided with outside sealing devices which cannot be removed without destroying the cap or sealing device.

NOTE 1: This does not apply to cap seal over a closure which complies with all requirements.

(c) For closure with threaded plug or cap, the seat (flange, etc.) for plug, or cap, must have 3 or more complete threads; two drainage holes of not over 5/16-inch diameter are allowed. Plug, or cap, must have sufficient length of thread to engage 3 threads when screwed home with gasket in place.

(d) Full removable head drums over 5 gallons capacity must be closed by means of 12 gauge bolted ring with drop forged lugs, one of which is threaded, and having 3/8 inch bolt and nut for drums not over 30 gallons capacity and 1/2 inch bolt and nut for drums over 30

gallons capacity. Five gallon drums must be of lug type closure with cover having at least 16 lugs. Equally efficient types of closures are authorized upon demonstration and proof of satisfactory tests to representative of Bureau of Explosives.

§ 78.80-10 Defective containers.

(a) Leaks and other defects to be repaired by method used in constructing container, not by soldering.

§ 78.80-11 Marking.

(a) Marking on each container by embossing on head, except that such embossment must be on the permanent head for drums having removable heads, with raised marks, or by embossing or die stamping on footing on drums equipped with footings, or on metal plates securely attached to drum by brazing or welding not less than 20 percent of the perimeter, as follows:

(1) ICC-5. In addition, when the container is of stainless steel, the type of steel used in body and head sheets as identified by American Iron and Steel Institute type number, and also the letters HT following steel designation on containers subjected to stress relieving or heat treatment during manufacture (for example, ICC-5-304 or ICC-5-304 HT as applicable), shall be shown. These marks shall be understood to certify that the container complies with all specification requirements.

(2) Name or symbol (letters) of maker or other party assuming responsibility for compliance with specification requirements; this must be recorded with the Bureau of Explosives.

(3) Gauge of metal in thinnest part, rated capacity in gallons, and year of manufacture (for example, 14-55-50). When gauge of metal in body differs from that in head, both must be indicated with slanting line between and with gauge of body indicated first (for example 14/12-55-50 for body 14 gauge and head 12 gauge).

§ 78.80-12 Size of markings.

(a) Size of markings (minimum): 1/2" high for 33-gallon or less, 3/4" for over 33 and not over 55 gallons, and 1" for over 55 gallons.

§ 78.80-13 Type tests.

(a) Samples taken at random and closed as for use, shall withstand prescribed tests without leakage. Tests to be made of each type and size by each company starting production and to be repeated every four months. Samples last tested to be retained until further tests are made. The type tests are as follows:

(1) Test by dropping, filled with water to 98 percent capacity, from height of 4 feet onto solid concrete so as to strike diagonally on chime, or when without chime seam, to strike on other circumferential seam; also additional drop test

on any other parts which might be considered weaker than the chime. Closing devices and other parts projecting beyond chime or rolling hoops must also be capable of withstanding this test.

(2) Hydrostatic pressure test of 40 pounds per square inch sustained for 5 minutes; except that full removable head drums must sustain 20 pounds per square inch.

(3) Periodic drop and hydrostatic tests are not required when containers fabricated of stainless steel have satisfactorily withstood prescribed tests at the original start of production. Satisfactory test results must be obtained on samples of subsequent containers that have been altered in design or construction. In instances where manufacturers have suspended production for an interval of 12 months or more, drop and hydrostatic tests must be again conducted as prescribed in subparagraphs (1) and (2) of this paragraph as for original start of production.

§ 78.80-14 Leakage test.

(a) Each container shall be tested, with seams under water or covered with soapsuds or heavy oil, by interior air pressure of at least 15 pounds per square inch. Equally efficient means of testing are authorized upon demonstration and proof of satisfactory tests to representative of Bureau of Explosives. Leakers shall be rejected or repaired and re-tested. Removable head containers not required to be tested with heads in place except that samples taken at random and closed as for use, of each type and size, must be tested at start of production and repeated every four months. Samples so tested must be retained until further tests are made.

§ 78.81 Specification 5A; steel barrels or drums.

Removable head containers not authorized.

§ 78.81-1 Compliance.

(a) Required in all details.

§ 78.81-2 Rated capacity.

(a) Rated capacity as marked, see § 78.81-11 (a)(3). Actual capacity of straight-sided containers shall be not less than rated (marked) capacity plus 2 percent, nor greater than rated capacity plus 2 percent plus 1 quart, except that for containers over 30 gallons marked capacity actual capacity shall be not less than rated capacity plus 2 percent, nor greater than rated capacity plus 2 percent plus 2 quarts; actual capacity of bilge-type containers must be not less than rated capacity nor greater than rated capacity plus 2 percent plus 2 quarts.

§ 78.81-3 Composition.

(a) Sheets for body and heads to be low carbon, open hearth or electric steel.

§ 78.81-5 Seams.

- (a) Body seams welded.
- (b) Head and chime seams welded or double-seamed.
- (c) Flanges for closures welded in place.

§ 78.81-6 Chime reinforcement.

(a) Containers over 25 gallons capacity, with flanged head secured to body, to have chime reinforcement adequate for its protection.

§ 78.81-7 Parts and dimensions.

(a) Parts and dimensions as follows:

(b) Steel sheets of specified gauges shall comply with the following:

Gauge No.	Nominal thickness ¹ (inch)	Minimum thickness ¹ (inch)
12	0.1046	0.0946
13	.0897	.0817
14	.0747	.0677
16	.0598	.0533

¹ Thickness shall be measured at any point on the sheet not less than 1/8 inch from an edge.

§ 78.81-8 Rolling hoops.

(a) Separate hoops to have tight fit on shell and be firmly secured in place. Beading under rolling hoops or welding of the rolling hoops directly to the body of the drum in any manner is not permitted.

§ 78.81-9 Closures.

(a) Adequate to prevent leakage; gasket required. Closure must be of screw-thread type or fastened by screw-thread device. Unthreaded cap is authorized for containers of 12 gallons or less if cap is provided with outside sealing devices which cannot be removed without destroying the cap or sealing device.

(b) Closing part (plug, cap, plate, etc., see Note 1) must be of metal as thick as prescribed for head of container; this not required for containers of 12 gallons or less when the opening to be closed is not over 2.3 inches in diameter.

NOTE 1: This does not apply to cap seal over a closure which complies with all requirements.

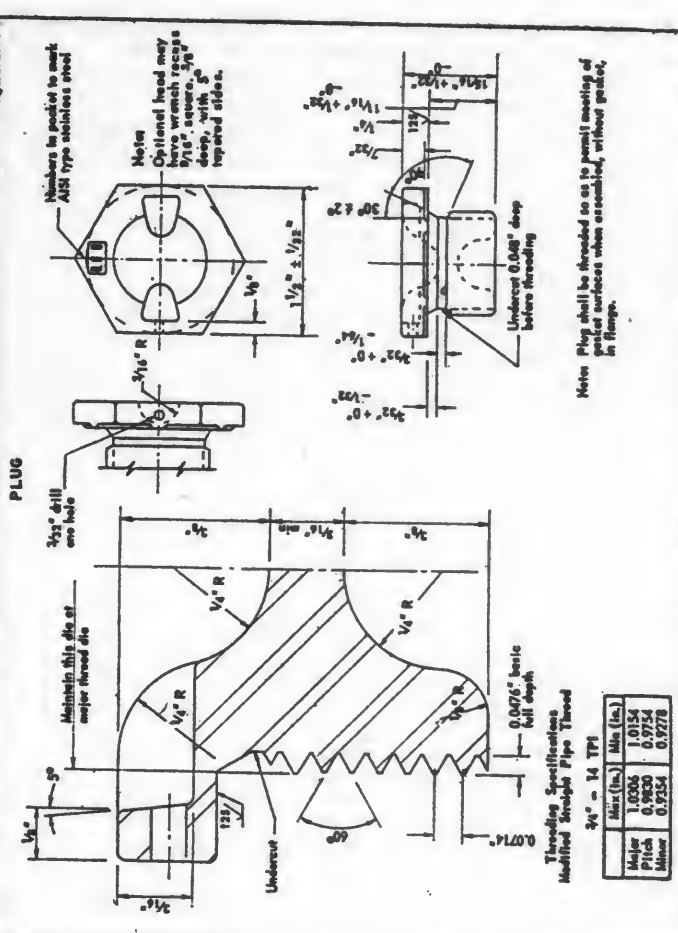
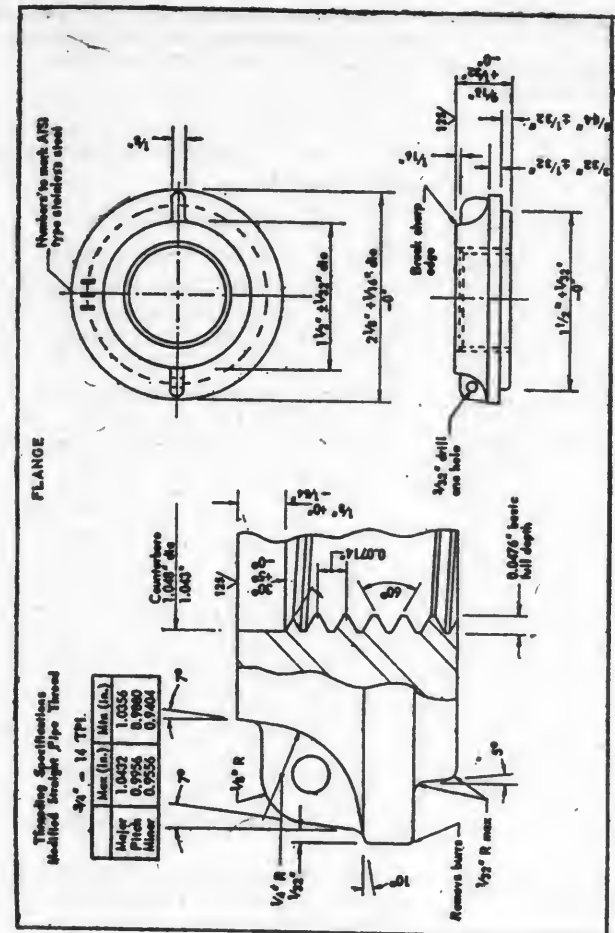
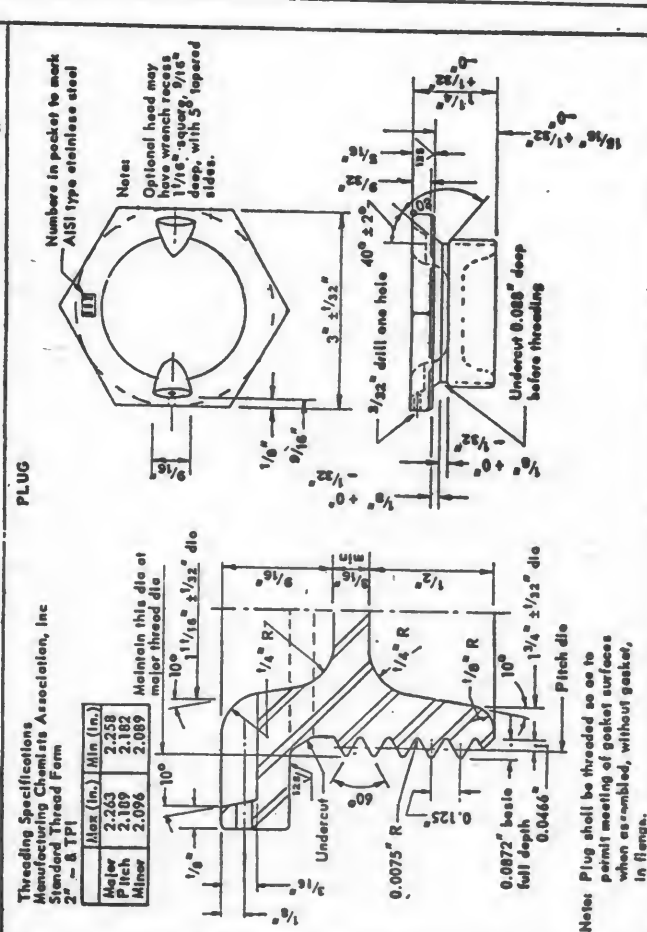
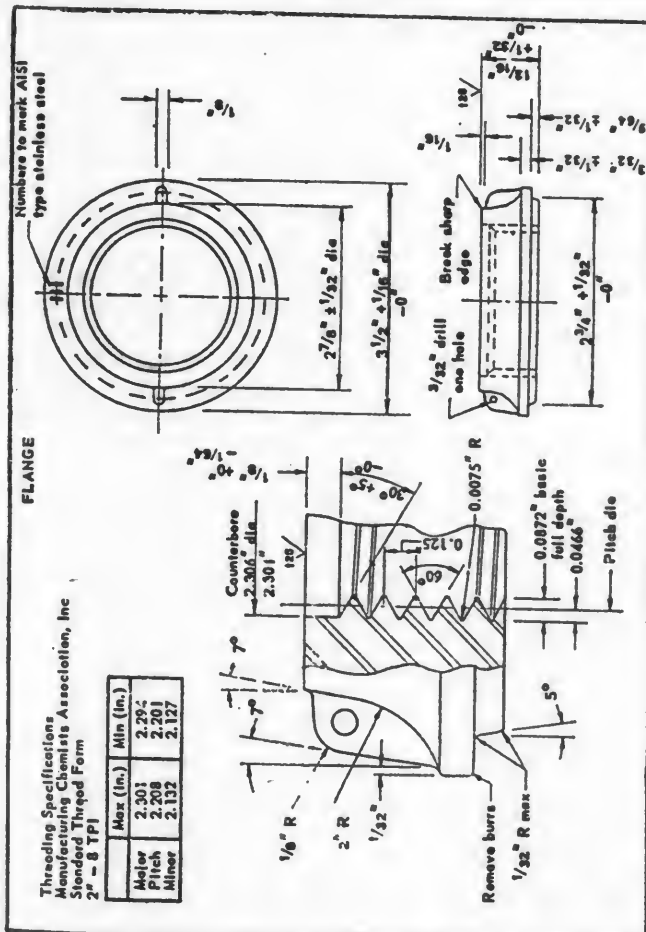
(c) For closure with threaded plug or cap, the seat (flange, etc.) for plug or cap must have 5 or more complete threads; 2 drainage holes of not over 5/16" diameter are allowed in that section of flange which extends inside the drum. Plug or cap must have sufficient length of thread to engage 5 threads when securely tightened with gasket in place.

(d) Openings over 2.3" diameter not permitted. Threads for plug or cap must be 8 or less per inch when over 3/4" standard pipe size. Flanges with inside threads and plugs must conform with the thread diameter and thread form shown in the following drawing; other details shown on the drawing are recommended.

Marked capacity not over (gallons)	Type of container	Minimum thickness, uncoated sheets (gauge)		Rolling hoops		
		Body sheet	Head sheet	Type ¹	Minimum	
					Size (gauge or inch)	Weight (pounds per foot)
10	Straight side	16	16	None		
30	do	16	16	I-bar	3/4 x 1 1/4	1.25
55	do	14	14	do	1 x 1 1/2	1.60
110	do	12	12	do	1 x 1 1/2	1.60
30	Bilge	14	16	None		
55	do	13	14	do		

¹ Rolling hoops of pliable solid rubber or other suitable material are also authorized when approved as to type and construction by the Bureau of Explosives.

(1)



Note: Plug shall be threaded so as to permit meeting of surfaces when assembled, without gasket, in flange.

Note: Plug shall be threaded so as to permit meeting of surfaces when assembled, without gasket, in flange.

(e) Other threaded closures may be authorized by the Bureau of Explosives upon demonstration of equal efficiency.

§ 78.81-10 Defective containers.

(a) Leaks and other defects to be repaired by method used in constructing container, not by soldering.

§ 78.81-11 Marking.

(a) Marking on each container by embossing on head with raised marks, or by embossing or die stamping on footring on drums equipped with footrings, or on metal plates securely attached to drum by brazing or welding not less than 20 percent of the perimeter as follows:

(1) ICC-5A. In addition, when the container is of stainless steel, the type of steel used in body and head sheets as identified by American Iron and Steel Institute type number, and also the letters HT following steel designation on containers subjected to stress relieving or heat treatment during manufacture (for example, ICC-5A-304 or ICC-5A-304 HT as applicable), shall be shown. These marks shall be understood to certify that the container complies with all specification requirements.

(2) Name or symbol (letters) of maker or other party assuming responsibility for compliance with specification requirements; this must be recorded with the Bureau of Explosives.

(3) Gauge of metal in thinnest part, rated capacity in gallons, and year of manufacture (for example, 14-55-50). When gauge of metal in body differs from that in head, both must be indicated with slanting line between and with gauge of body indicated first (for example 14/12-55-50 for body 14 gauge and head 12 gauge).

§ 78.81-12 Size of markings.

(a) Size of markings (minimum): 1/2" high for 33-gallon or less, 3/4" for over 33 and not over 55 gallons, and 1" for over 55 gallons.

§ 78.81-13 Type tests.

(a) Samples taken at random and closed as for use, shall withstand prescribed tests without leakage. Tests to be made of each type and size by each company starting production and to be repeated every four months. Samples last tested to be retained until further tests are made. The type tests are as follows:

(1) Test by dropping, filled with water to 98 percent capacity, from height of 6 feet onto solid concrete so as to strike diagonally on chime, or when without chime seam, to strike on other circumferential seam; also additional drop test on any other parts which might be considered weaker than the chime. Closing devices and other parts projecting beyond chime or rolling hoops must also be capable of withstanding this test.

(2) Hydrostatic pressure test of 80 pounds per square inch sustained for 5 minutes.

§ 78.81-14 Leakage test.

(a) Each container shall be tested, with seams under water or covered with soapsuds or heavy oil, by interior air pressure of at least 15 pounds per square inch. Equally efficient means of testing are authorized upon demonstration and proof of satisfactory tests to representative of Bureau of Explosives. Leakers shall be rejected or repaired and retested.

§ 78.82 Specification 5B; steel barrels or drums.

Removable head containers which will pass all required tests are authorized.

§ 78.82-1 Compliance.

(a) Required in all details.

§ 78.82-2 Rated capacity.

(a) Rated capacity as marked, see § 78.82-11(a)(3). Minimum actual capacity of containers shall be not less than rated (marked) capacity plus 4 percent. Maximum actual capacity shall not be greater than rated (marked) capacity plus 5 percent or rated (marked) capacity plus 4 percent plus 1 quart whichever is the greater. Actual capacity of bilge type containers must be

not less than rated (marked) capacity, nor greater than rated (marked) capacity plus 2 percent plus 2 quarts.

§ 78.82-3 Composition.

(a) Sheets for body and heads to be low carbon, open hearth or electric steel.

§ 78.82-5 Seams.

(a) Body seams welded.

§ 78.82-6 Chime reinforcement.

(a) Containers over 25 gallons capacity, with flanged head secured to body, to have chime reinforcement adequate for its protection.

§ 78.82-7 Parts and dimensions.

(a) Parts and dimensions as follows:

Marked capacity not over (gallons)	Type of container	Minimum thickness, uncoated sheets (gauge)		Rolling hoops		
		Body sheet	Head sheet	Type ¹	Minimum	
					Size (gauge or inch)	Weight (pounds per foot)
5.....	Straight side.....	24	24	None.....		
10.....	do.....	22	22	do.....		
15.....	do.....	20	20	(2).....		
23.....	do.....	18	18	(2).....		
55.....	do.....	16	16	(2).....		
110.....	do.....	13	14	(2).....		
23.....	Bilge.....	16	16	None.....		
55.....	do.....	14	14	do.....		

¹ Rolling hoops of pliable solid rubber or other suitable material are also authorized when approved as to type and construction by the Bureau of Explosives.

² Rolled or swaged in hoops.

³ Each removable head drum body must have three rolled or swaged in hoops with the center-line of one not more than 3 inches from the top curl.

(b) Steel sheets of specified gauges shall comply with the following:

Gauge No.	Nominal thickness ¹ (inch)	Minimum thickness ¹ (inch)
13.....	0.0897	0.0817
14.....	.0747	.0677
16.....	.059	.0533
18.....	.0478	.0428
20.....	.0359	.0324
22.....	.0299	.0269
24.....	.0239	.0209

¹ Thickness shall be measured at any point on the sheet not less than 3/4 inch from an edge.

§ 78.82-3 Rolling hoops.

(a) Separate hoops to have tight fit on shell and be firmly secured in place. Beading under rolling hoops or spot welding not permitted.

§ 78.82-9 Closures.

(a) Adequate to prevent leakage; gaskets required.

(b) Closing part (plug, cap, plate, etc., see Note 1) must be of metal as thick as prescribed for head of container; this not required for containers of 12 gallons or less when the opening to be closed is not over 2.7 inches in diameter. If unthreaded cap is used it must be provided with outside sealing devices which cannot be removed without destroying the cap or sealing device.

NOTE 1: This does not apply to cap seal over a closure which complies with all requirements.

(c) For closure with threaded plug or cap, the seat (flange, etc.) for plug, or cap, must have 3 or more complete threads; two drainage holes of not over 5/16" diameter are allowed. Plug, or cap, must have sufficient length of thread to engage 3 threads when screwed home with gasket in place. Threaded bung

closures consisting of any type other than welded flanges and plugs, must be of a type approved by the Bureau of Explosives for use, after submission of proof as to efficiency.

(d) Full removable head drums over 5 gallons capacity must be closed by means of 12 gauge bolted ring with drop forged lugs, one of which is threaded, and having 3/8 inch bolt and nut for drums not over 30 gallons capacity and 5/8 inch bolt and nut for drums over 30 gallons capacity. Five gallon drums must be of lug type closure with cover having at least 16 lugs. Equally efficient types of closures are authorized upon demonstration and proof of satisfactory tests to representative of Bureau of Explosives.

§ 78.82-10 Defective containers.

(a) Leaks and other defects to be repaired by method used in constructing container, not by soldering.

§ 78.82-11 Marking.

(a) Marking on each container by embossing on head, except that such embossment must be on the permanent head for drums having removable heads, with raised marks, or by embossing or die stamping on footring on drums equipped with footrings, or on metal plates securely attached to drum by brazing or welding not less than 20 percent of the perimeter, as follows:

(1) ICC-5B. In addition, when the container is of stainless steel, the type of steel used in body and head sheets as identified by American Iron and Steel Institute type number, and also the letters HT following steel designation on containers subjected to stress relieving or heat treatment during manufacture, (for example, ICC-5B-304 or ICC-5B-304 HT as applicable), shall be shown. These marks shall be understood to

certify that the container complies with all specification requirements.

(2) Name or symbol (letters) of maker or other party assuming responsibility for compliance with specification requirements; this must be recorded with the Bureau of Explosives.

(3) Gauge of metal in thinnest part, rated capacity in gallons, and year of manufacture (for example, 14-55-50). When gauge of metal in body differs from that in the head, both must be indicated with slanting line between and with gauge of body indicated first (for example 14/12-55-50 for body 14 gauge and head 12 gauge).

§ 78.82-12 Size of markings.

(a) Size of markings (minimum): 1/2" high for 33-gallon or less, 3/4" for over 33 and not over 55 gallons, and 1" for over 55 gallons.

§ 78.82-13 Type tests.

(a) Samples taken at random and closed as for use, shall withstand prescribed tests without leakage. Tests to be made of each type and size by each company starting production and to be repeated every four months. Samples last tested to be retained until further tests are made. The type tests are as follows:

(1) Test by dropping, filled with water to 98 percent capacity, from height of 4 feet onto solid concrete so as to strike diagonally on chime, or when without chime seam, to strike on other circumferential seam; also additional drop test on any other parts which might be considered weaker than the chime. Closing devices and other parts projecting beyond chime or rolling hoops must also be capable of withstanding this test.

(2) Hydrostatic pressure tests of 40 pounds per square inch sustained for 5 minutes; except that full removable head drums must sustain 20 pounds per square inch.

§ 78.82-14 Leakage test.

(a) Each container shall be tested, with seams under water or covered with soapsuds or heavy oil, by interior air pressure of at least 15 pounds per square inch. Equally efficient means of testing are authorized upon demonstration and proof of satisfactory tests to representative of Bureau of Explosives. Leakers shall be rejected or repaired and retested. Removable head containers not required to be tested with heads in place except that samples taken at random and closed as for use, of each type and size, must be tested at start of production and repeated every four months. Samples so tested must be retained until further tests are made.

§ 78.83 Specification 5C; steel barrels or drums.

Removable head containers not authorized.

§ 78.83-1 Compliance.

(a) Required in all details.

§ 78.83-2 Rated capacity.

(a) Rated capacity as marked, see § 78.83-11(a)(3). Actual capacity of straight-sided containers shall be not less than rated (marked) capacity plus 2 percent, nor greater than rated capacity

plus 2 percent plus 1 quart, except that for containers over 30 gallons marked capacity actual capacity shall be not less than rated capacity plus 2 percent, nor greater than rated capacity plus 2 percent plus 2 quarts; actual capacity of bilge-type containers must be not less than rated capacity, nor greater than rated capacity plus 2 percent plus 2 quarts.

§ 78.83-3 Composition.

(a) Steel must be, except for rolling hoops and chime reinforcement, as follows:

(b) All sheet metal, welding rod, closing devices, and samples taken from the welded portion of the finished container must be of Type 304, 18 chrome 8 nickel alloy with 0.08 percent carbon maximum, 18-20 percent chromium, 8-11 percent nickel, or other types of stainless steel of equivalent corrosion resistance and physical properties.

(c) Type 304 or other grades of equivalent corrosion resistant steels in the as-welded condition are permissible for nitric acid concentrations up to and including 78 percent. For all concentrations of nitric acid the following are permissible:

(1) Type 304 heat-treated (quenches from 1900° F.), or

(2) Stabilized Type 347 in the as-welded condition, or

(3) Stabilized Type 347 stress-relieved (1550°-1650° F.), or

(4) Stabilized Type 347 heat-treated (quenches from 1900° F.), or

(5) Other grades of equivalent corrosion resistance.

(d) All parts of any completed container exposed to lading must comply with the standard 65 percent boiling nitric acid test in that the limit of inches per month penetration in accordance with corrosion test as used in American Society of Testing Materials Standard A-262-44-T shall be 0.0015 inch, this figure to be an average of five 48-hour tests.

§ 78.83-5 Seams.

(a) Body seams welded.

(b) Chime seams welded or double-seamed and welded.

(c) Flanges for closures welded in place.

§ 78.83-6 Chime reinforcement.

(a) Containers of 10 gallons capacity or over, with flanged head secured to body, to have chime reinforcement adequate for its protection.

§ 78.83-7 Parts and dimensions.

(a) Parts and dimensions as follows:

Marked capacity not over (gallons)	Type of container	Minimum thickness, uncoated sheets (gauge)		Rolling hoops		
		Body sheet	Head sheet	Type ¹	Minimum	
					Size (gauge or inch)	Weight (pounds per foot)
15.....	Straight side.....	20	20	None.....		
30.....	do.....	18	18	I-bar.....	3/4 x 1 1/4	1.25
55.....	do.....	16	16	do. ²	1 x 1 1/4	1.60
110.....	do.....	14	14	do. ²	1 x 1 1/2	1.60
15.....	Bilge.....	16	16	None.....		
30.....	do.....	14	16	do.....		
55.....	do.....	13	14	do.....		

¹ Rolling hoops of pliable solid rubber or other suitable material are also authorized when approved as to type and construction by the Bureau of Explosives.

² Stainless steel I-bar rolling hoops 3/4 x 1 1/4 inches, weighing not less than 1.27 pounds per foot, are authorized.

(b) Steel sheets of specified gauges shall comply with the following:

Gauge No.	Nominal thickness ¹ (inch)	Minimum thickness ¹ (inch)
13.....	0.0897	0.0817
14.....	.0747	.0677
16.....	.0598	.0533
18.....	.0473	.0428
20.....	.0350	.0324

¹ Thickness shall be measured at any point on the sheet not less than 3/4 inch from an edge.

§ 78.83-8 Rolling hoops.

(a) Separate hoops to have tight fit on shell and be firmly secured in place. Beading under rolling hoops or spot welding not permitted.

§ 78.83-9 Closures.

(a) Adequate to prevent leakage; gaskets required. Closure must be of screw-thread type or fastened by screw-thread device. Unthreaded cap is authorized for containers of 12 gallons or less if cap is provided with outside sealing devices which cannot be removed without destroying the cap or sealing device.

(b) Closing part (plug, cap, plate, etc., see Note 1) must be of metal as thick as prescribed for head of container; this

not required for containers of 12 gallons or less when the opening to be closed is not over 2.3 inches in diameter.

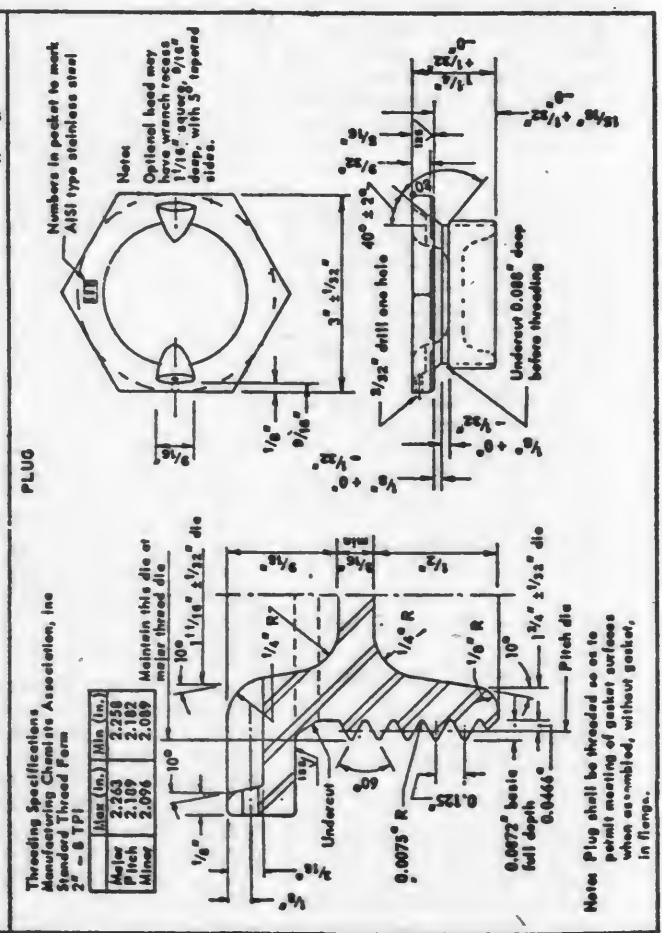
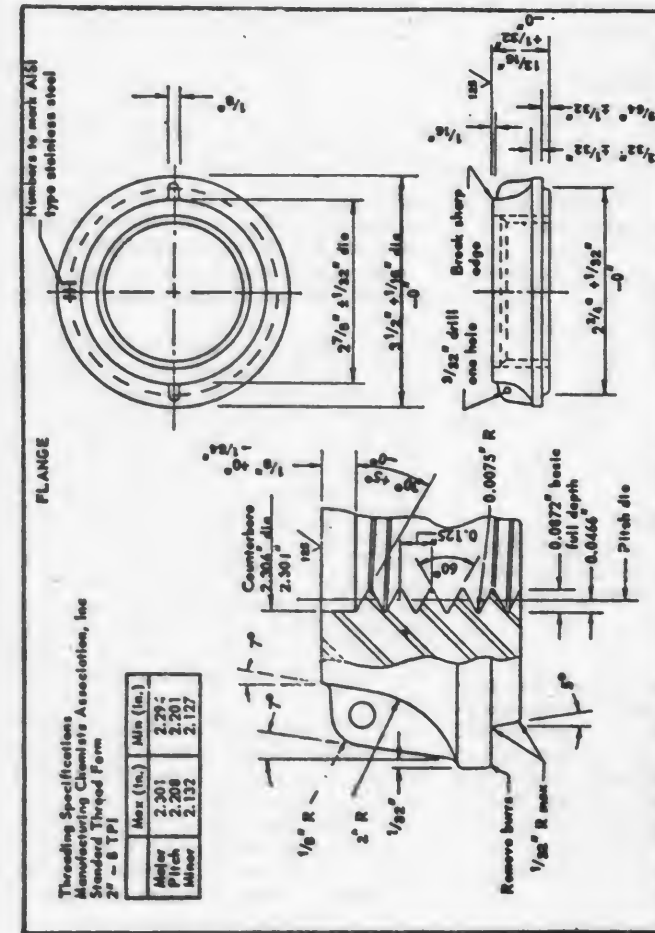
NOTE 1: This does not apply to cap seal over a closure which complies with all requirements.

(c) For closure with threaded plug or cap, the seat (flange, etc.) for plug or cap must have 5 or more complete threads; 2 drainage holes of not over 5/16 inch diameter are allowed in that section of flange which extends inside the drum. Plug or cap must have sufficient length of thread to engage 5 threads when securely tightened with gasket in place. Except that for containers not over 15 gallons marked capacity the seat (flange, etc.) for plug or cap may have at least 3 complete threads and plug or cap sufficient length of thread to engage 3 threads when securely tightened with gasket in place.

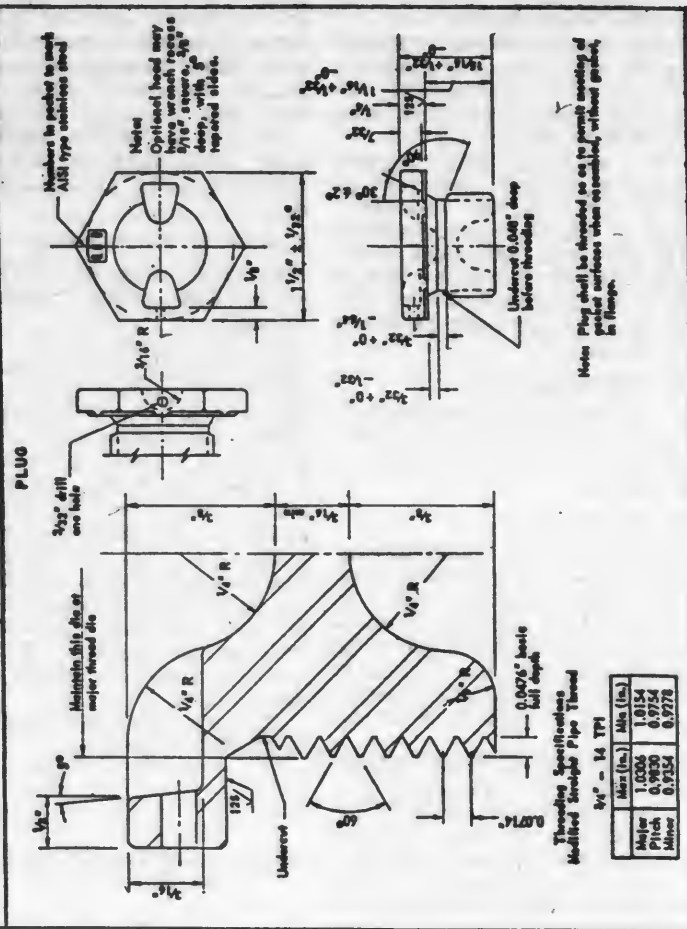
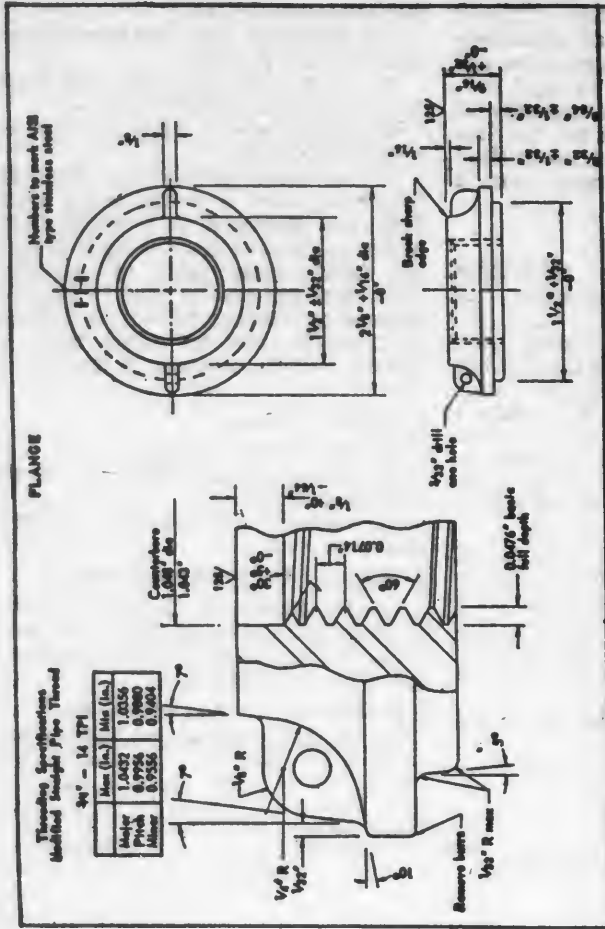
(d) Openings over 2.3 inches are not permitted. Threads for plug or cap must be 8 or less per inch when over 3/4 inch standard pipe size.

(1) Flanges with inside threads and plug must conform with the thread diameter and thread form shown in the following drawing (other details shown on the drawing are recommended):

(1)



OR (2) Eleven and one-half (11 1/2) threads per inch, standard pipe size.



(e) Other threaded closures may be authorized by the Bureau of Explosives upon demonstration of equal efficiency.

§ 78.83-10 Defective containers.

(a) Leaks and other defects to be repaired by method used in constructing container, not by soldering.

§ 78.83-11 Marking.

(a) Marking on each container by embossing on head with raised marks, or by embossing or die stamping on footing on drums equipped with footings, or on metal plates securely attached to drum by brazing or welding not less than 20 percent of the perimeter as follows:

(1) ICC-5C, the type of steel used in body and head sheets as identified by American Iron and Steel Institute type number, and, in addition, the letters HT following steel designation on containers subjected to stress relieving or heat treatment during manufacture (for example, ICC-5C-304 or ICC-5C-304HT as applicable). These marks shall be understood to certify that the container complies with all specification requirements.

(2) Name or symbol (letters) of maker or other party assuming responsibility for compliance with specification requirements; this must be recorded with the Bureau of Explosives. Also, by embossing or stamping, tare weight in pounds (for example, TW121).

(3) Gauge of metal in thinnest part, rated capacity in gallons, and year of manufacture (for example, 14-55-50). When gauge of metal in body differs from that in head, both must be indicated with slanting line between and with gauge of body indicated first (for example 14/12-55-50 for body 14 gauge and head 12 gauge).

§ 78.83-12 Size of marking.

(a) Size of markings (minimum): 1/2" high for 33-gallon or less, 3/4" for over 33 and not over 55 gallons, and 1" for over 55 gallons.

§ 78.83-13 Type tests.

(a) Samples, taken at random and closed as for use, must be capable of withstanding prescribed tests without leakage. Tests to be made of each type and size by each company starting production and to be repeated every 4 months, except as provided in subparagraph (3) of this paragraph. Samples last tested to be retained until further tests are made. The type tests are as follows:

(1) Test by dropping, filled with water to 98 percent capacity, from height of 6 feet onto solid concrete so as to strike diagonally on chime, or when without chime seam, to strike on other circumferential seam; also additional drop test on any other parts which might be considered weaker than the chime. Closing devices and other parts projecting beyond chime or rolling hoops must also be capable of withstanding this test.

(2) Hydrostatic pressure test of 80 pounds per square inch sustained for 5 minutes.

(3) Periodic drop and hydrostatic tests are not required where container has satisfactorily met prescribed tests at the original start of production. Satisfactory test results must be obtained on samples of subsequent containers that have been altered in design or construction.

Samples so tested must be retained.

§ 78.83-14 Leakage test.

(a) Each container shall be tested, with seams under water or covered with soapsuds or heavy oil, by interior air pressure of at least 15 pounds per square inch. Equally efficient means of testing are authorized upon demonstration and proof of satisfactory tests to representative of Bureau of Explosives. Leakers shall be rejected or repaired and re-tested.

§ 78.84 Specification 5D; steel barrels or drums, lined.

Removable head containers which will pass all required tests are authorized.

§ 78.84-1 Compliance.

(a) Required in all details.

§ 78.84-2 Rated capacity.

(a) Rated capacity as marked, see § 78.84-1f (a) (3). Actual capacity of straight-sided containers shall be not less than rated (marked) capacity plus 2 percent, nor greater than rated capacity plus 2 percent plus 1 quart, except that for containers over 30 gallons marked capacity actual capacity shall be not less than rated capacity plus 2 percent, nor greater than rated capacity plus 2 percent plus 2 quarts; actual capacity of bilge-type containers must be not less than rated capacity, nor greater than rated capacity plus 2 percent plus 2 quarts.

ity plus 2 percent plus 1 quart, except that for containers over 30 gallons marked capacity actual capacity shall be not less than rated capacity plus 2 percent, nor greater than rated capacity plus 2 percent plus 2 quarts; actual capacity of bilge-type containers must be not less than rated capacity, nor greater than rated capacity plus 2 percent plus 2 quarts.

§ 78.84-3 Composition.

(a) Sheets for body and heads to be low carbon, open hearth or electric steel.

§ 78.84-5 Lining.

(a) To be applied so as to adhere securely to metal throughout; to be tough and pliable. Hard rubber authorized to line closing devices.

§ 78.84-6 Chime reinforcement.

(a) Containers over 25 gallons capacity, with flanged head secured to body, to have chime reinforcement adequate for its protection.

§ 78.84-7 Parts and dimensions.

(a) Parts and dimensions as follows:

Marked capacity not over (gallons)	Type of container	Minimum thickness, uncoated sheets (gauge)		Rolling hoops		
		Body sheet	Head sheet	Type ¹	Minimum	
					Size (gauge or inch)	Weight (pounds per foot)
10.....	Straight side.....	16	16	None.....		
30.....	.....do.....	16	16	I-bar.....	3/4 x 1 1/4	1.25
55.....	.....do.....	14	14	.....do.....	1 x 1 1/2	1.60
110.....	.....do.....	12	12	.....do.....	1 x 1 1/2	1.60
30.....	Bilge.....	14	16	None.....		
55.....	.....do.....	13	14	.....do.....		

¹ Rolling hoops of pliable solid rubber or other suitable material are also authorized when approved as to type and construction by the Bureau of Explosives.

(b) Steel sheets of specified gauges shall comply with the following:

Gauge No.	Nominal thickness ¹ (inch)	Minimum thickness ¹ (inch)
12.....	0.1046	0.0946
13.....	.0897	.0817
14.....	.0748	.0677
16.....	.0598	.0533

¹ Thickness shall be measured at any point on the sheet not less than 3/8 inch from an edge.

§ 78.84-8 Rolling hoops.

(a) Separate hoops to have tight fit on shell and be firmly secured in place. Beading under rolling hoops or spot welding not permitted.

§ 78.84-9 Closures.

(a) Adequate to prevent leakage; gaskets required.

(b) Closing part (plug, cap, plate, etc., see Note 1) must be of metal as thick as prescribed for head of container; this not required for containers of 12 gallons or less when the opening to be closed is not over 2.3 inches in diameter. If unthreaded cap is used it must be provided with outside sealing devices which cannot be removed without destroying the cap or sealing device.

NOTE 1: This does not apply to cap seal over a closure which complies with all requirements.

(c) For closure with threaded plug or cap, the seat (flange, etc.) for plug, or cap, must have 5 or more complete threads; two drainage holes of not over 5/16" diameter are allowed. Plug, or cap, must have sufficient length of thread to engage 5 threads when screwed home with gasket in place.

(d) Closure must be of screw-thread type or fastened by screw-thread device.

§ 78.84-10 Defective containers.

(a) Leaks and other defects to be repaired by method used in constructing container, not by soldering.

§ 78.84-11 Marking.

(a) Marking on each container by embossing on head, except that such embossment must be on the permanent head for drums having removable heads, with raised marks, or by embossing or die stamping on footing on drums equipped with footings, or on metal plates securely attached to drum by brazing or welding not less than 20 percent of the perimeter, as follows:

(1) ICC-5D. In addition, when the container is of stainless steel, the type of steel used in body and head sheets as identified by American Iron and Steel Institute type number, and also the letters HT following steel designation on containers subjected to stress relieving or heat treatment during manufacture

(for example, ICC-5D-304 or ICC-5D-304 HT as applicable), shall be shown. These marks shall be understood to certify that the container complies with all specification requirements.

(2) Name or symbol (letters) of maker or other party assuming responsibility for compliance with specification requirements; this must be recorded with the Bureau of Explosives.

(3) Gauge of metal in thinnest part, rated capacity in gallons, and year of manufacture (for example, 14-55-50). When gauge of metal in body differs from that in head, both must be indicated with slanting line between and with gauge of body indicated first (for example 14/22-55-50 for body 14 gauge and head 12 gauge).

§ 78.84-12 Size of markings.

(a) Size of markings (minimum): $\frac{1}{2}$ " high for 33-gallon or less, $\frac{3}{4}$ " for over 33 and not over 55 gallons, and 1" for over 55 gallons.

§ 78.84-13 Type tests.

(a) Sample containers, before lining is applied, taken at random and closed as for use, must be capable of withstanding prescribed tests without leakage. Tests to be made of each type and size by each company starting production and to be repeated every 4 months, except as provided in subparagraph (3) of this paragraph. Samples last tested to be retained until further tests are made. The type tests are as follows:

(1) Test by dropping, filled with water to 98 percent capacity, from height of 6 feet onto solid concrete so as to strike diagonally on chime, or when without chime seam, to strike on other circumferential seam; also additional drop test on any other parts which might be considered weaker than the chime. Closing devices and other parts projecting beyond chime or rolling hoops must also be capable of withstanding this test.

(2) Hydrostatic pressure test of 80 pounds per square inch sustained for 5 minutes.

(3) Periodic drop and hydrostatic tests are not required where container has satisfactorily met prescribed tests at the original start of production. Satisfactory test results must be obtained on samples of subsequent containers that have been altered in design or construction. Samples so tested must be retained.

§ 78.84-14 Leakage test.

(a) Each container, with lining material applied, shall be tested, with seams under water or covered with soapsuds or heavy oil, by interior air pressure of at least 15 pounds per square inch. Equally efficient means of testing are authorized upon demonstration and proof of satisfactory tests to representative of Bureau of Explosives. Leakers shall be rejected or repaired and retested. Removable head containers not required to be tested with heads in place except that samples taken at random and closed as for use, of each type and size, must be tested at start of production and repeated every 4 months. Samples so tested must be retained until further tests are made.

§ 78.84-15 Additional test.

(a) On each container by 110-volt electrical circuit between inside and outside of container filled with suitable electrolyte; a milliammeter must show zero reading. The milliammeter test is required when retesting containers which show evidence of damage. A spark coil test is permitted on each container during manufacture in lieu of the milliammeter test described above.

§ 78.85 Specification 5F; steel drums.

Removable head containers not authorized.

§ 78.85-1 Compliance.

(a) Required in all details.

§ 78.85-2 Rated capacity.

(a) Rated capacity as marked, see § 78.85-10 (a) (3): Not over 11 gallons.

§ 78.85-3 Composition.

(a) Sheets for body and heads to be low carbon, open hearth or electric steel.

§ 78.85-5 Seams.

(a) Body seams welded or brazed.

(b) Head and chime seams welded or brazed.

(c) Flanges for closures welded or brazed in place.

§ 78.85-6 Chime reinforcement.

(a) Container to have chime reinforcement adequate for its protection.

§ 78.85-7 Gauge and thickness of sheets.

(a) Body and heads shall be of uncoated steel sheets having nominal thickness of 0.0747 inch and minimum thickness of 0.0677 inch, which sheets shall be designated 14 gauge.

§ 78.85-8 Closures required.

(a) Of screw-thread type and adequate to prevent leakage in transit. Openings over 2.3" diameter not permitted. Threads for connections (valve, bung, etc.) to be American Standard taper pipe threads, tapped to gauge, and clean cut to insure tight joints.

§ 78.85-9 Defective containers.

(a) Leaks and other defects to be repaired by method used in constructing container, not by soldering.

§ 78.85-10 Marking.

(a) Marking on each container by embossing on head with raised marks, or by embossing or die stamping on footing on drums equipped with footings, or on metal plates securely attached to drum by brazing or welding not less than 20 percent of the perimeter as follows:

(1) ICC-5F. This mark shall be understood to certify that the container complies with all specification requirements. Serial number and name or symbol (letters) of company or person for whose use the containers are made are also required.

(2) Name or symbol (letters) of maker or other party assuming responsibility for compliance with specification requirements; this must be recorded with the Bureau of Explosives.

(3) Gauge of metal in thinnest part, rated capacity in gallons, and year of manufacture (for example 14-11-50). When gauge of metal in body differs from that in head, both must be indicated with slanting line between and with gauge of body indicated first (for example 14/12-11-50 for body 14 gauge and head 12 gauge).

§ 78.85-11 Size of markings.

(a) Size of markings (minimum): $\frac{1}{2}$ " high.

§ 78.85-12 Type tests.

(a) Samples, taken at random and closed as for use, shall withstand prescribed tests without leakage. Tests to be made of each type and size by each company starting production and to be repeated every four months. Samples last tested to be retained until further tests are made. The type tests are as follows:

(1) Test by dropping, filled with water to 98 percent capacity, from height of 6 feet onto solid concrete so as to strike diagonally on chime, or when without chime seam, to strike on other circumferential seam; also additional drop test on any other parts which might be considered weaker than the chime. Closing devices and other parts projecting beyond chime or rolling hoops must also be capable of withstanding this test.

(2) Hydrostatic pressure test of 125 pounds per square inch sustained for 5 minutes.

§ 78.85-13 Leakage test.

(a) Each container shall be tested, with seams under water or covered with soapsuds or heavy oil, by interior air pressure of at least 100 pounds per square inch. Equally efficient means of testing are authorized upon demonstration and proof of satisfactory tests to representative of Bureau of Explosives. Leakers shall be rejected or repaired and retested.

§ 78.87 Specification 5H; steel barrels or drums, lead lined.

Removable head containers not authorized.

§ 78.87-1 Compliance.

(a) Required in all details.

§ 78.87-2 Rated capacity.

(a) Rated capacity as marked, see § 78.87-11(a) (3). Actual capacity of straight-sided containers shall be not less than rated (marked) capacity plus 2 percent, nor greater than rated capacity plus 2 percent plus 1 quart, except that for containers over 30 gallons marked capacity actual capacity shall be not less than rated capacity plus 2 percent, nor greater than rated capacity plus 2 percent plus 2 quarts; actual capacity of bilge-type containers must be not less than rated capacity, nor greater than rated capacity plus 2 percent plus 2 quarts.

§ 78.87-3 Composition.

(a) Sheets for body and heads to be low carbon, open hearth or electric steel.

§ 78.87-5 Seams.

- (a) Body seams welded.
- (b) Head and chime seams welded or double-seamed.
- (c) Flanges for closures welded in place.

§ 78.87-6 Chime reinforcement.

- (a) Containers with flanged head secured to body to have chime reinforcement adequate for its protection.

§ 78.87-7 Parts and dimensions.

- (a) Parts and dimensions as follows:

Marked capacity not over (gallons)	Type of container	Minimum thickness, uncoated sheets (gauge)		Rolling hoops		
		Body sheet	Head sheet	Type ¹	Minimum	
					Size (gauge or inch)	Weight (pounds per foot)
10	Straight side	16	16	None		
30	do	16	16	I-bar	3/4 x 1 1/4	1.25
55	do	14	14	do	1 x 1 1/2	1.60
110	do	12	12	do	1 x 1 1/2	1.60
30	Bilge	14	16	None		
55	do	13	14	do		

¹ Rolling hoops of pliable solid rubber or other suitable material are also authorized when approved as to type and construction by the Bureau of Explosives.

- (b) Steel sheets of specified gauges shall comply with the following:

Gauge No.	Nominal thickness ¹ (inch)	Minimum thickness ¹ (inch)
12	0.1046	0.0946
13	.0897	.0817
14	.0747	.0677
16	.0598	.0533

¹ Thickness shall be measured at any point on the sheet not less than 3/8 inch from an edge.

- (c) Lining required: Of lead, at least 3/32" thick, completely bonded to the steel.

§ 78.87-8 Rolling hoops.

- (a) Separate hoops to have tight fit on shell and be firmly secured in place. Beading under rolling hoops or spot welding not permitted.

§ 78.87-9 Closures.

- (a) Adequate to prevent leakage; gaskets required. Closure must be of screw-thread type or fastened by screw-thread device. Unthreaded cap is authorized for containers of 12 gallons or less if cap is provided with outside sealing devices which cannot be removed without destroying the cap or sealing device.

- (b) Closing part (plug, cap, plate, etc., see Note 1) must be of metal as thick as prescribed for head of container; this not required for containers of 12 gallons or less when the opening to be closed is not over 2.3 inches in diameter.

NOTE 1: This does not apply to cap seal over a closure which complies with all requirements.

- (c) For closure with threaded plug or cap, the seat (flange, etc.) for plug, or

cap, must have 5 or more complete threads; two drainage holes of not over 5/16" diameter are allowed. Plug, or cap, must have sufficient length of thread to engage 5 threads when screwed home with gasket in place.

- (d) Openings over 2.3" diameter not permitted. Threads for plug or cap must be 8 or less per inch when over 3/4" standard pipe size.

§ 78.87-10 Defective containers.

- (a) Leaks and other defects to be repaired by method used in constructing container, not by soldering.

§ 78.87-11 Marking.

- (a) Marking on each container by embossing on head with raised marks, or by embossing or die stamping on footing on drums equipped with footings, or on metal plates securely attached to drum by brazing or welding not less than 20 percent of the perimeter as follows:

- (1) ICC-5H. In addition, when the container is of stainless steel, the type of steel used in body and head sheets as identified by American Iron and Steel Institute type number, and also the letters HT following steel designation on containers subjected to stress relieving or heat treatment during manufacture, (for example, ICC-5H-304 or ICC-5H-304 HT as applicable), shall be shown. These marks shall be understood to certify that the container complies with all specification requirements.

- (2) Name or symbol (letters) of maker or other party assuming responsibility for compliance with specification requirements; this must be recorded with the Bureau of Explosives.

- (3) Gauge of metal in thinnest part, rated capacity in gallons, and year of manufacture (for example, 14-55-50): When gauge of metal in body differs from that in head, both must be indicated with slanting line between and with gauge of body indicated first (for example 14/12-55-50 for body 14 gauge and head 12 gauge).

§ 78.87-12 Size of marking.

- (a) Size of marking (minimum): 1/2" high for 33-gallon or less, 3/4" for over 33 and not over 55 gallons, and 1" for over 55 gallons.

§ 78.87-13 Type tests.

- (a) Samples taken at random and closed as for use, shall withstand prescribed tests without leakage. Tests to be made of each type and size by each company starting production and to be repeated every four months. Samples last tested to be retained until further tests are made. The type tests are as follows:

- (1) Test by dropping, filled with water to 98 percent capacity, from height of 6 feet onto solid concrete so as to strike diagonally on chime, or when without chime seam, to strike on other circumferential seam; also additional drop test on any other parts which might be considered weaker than the chime. Closing devices and other parts projecting beyond chime or rolling hoops must also be capable of withstanding this test.

- (2) Hydrostatic pressure test of 80 pounds per square inch sustained for 5 minutes.

- (3) Periodic drop tests will not be required after initial drop tests at start of manufacture, on containers of a construction in excess of minimum specification requirements approved by the Bureau of Explosives. Changes in construction (drum, lining, or closures) must also be approved by the Bureau of Explosives for use, after submission of proof as to efficiency, to continue this exemption.

§ 78.87-14 Leakage test.

- (a) Each container shall be tested, with seams under water or covered with soap-suds or heavy oil, by interior air pressure of at least 15 pounds per square inch. Equally efficient means of testing are authorized upon demonstration and proof of satisfactory tests to representative of Bureau of Explosives. Leakers shall be rejected or repaired and retested.

§ 78.88 Specification 5K; nickel barrels or drums.

- Removable head containers not authorized.

§ 78.88-1 Compliance.

(a) Required in all details.

§ 78.88-2 Rated capacity.

(a) Rated capacity as marked, see § 78.88-10(a)(3). Actual capacity of straight-sided containers shall be not less than rated (marked) capacity plus 2 percent, nor greater than rated capacity plus 2 percent for containers over 30 gallons marked capacity actual capacity shall be not less than rated capacity plus 2 percent, nor greater than rated capacity plus 2 percent; actual capacity of blige-type containers must be not less than rated capacity, nor greater than rated capacity plus 2 percent plus 2 quarts.

§ 78.88-3 Composition.

(a) Material must be, except for rolling hoops and chime reinforcements, nickel at least 99.0 percent pure.
 (b) Head and chime seams welded or double-seamed.
 (c) Flanges for closures welded in place.

§ 78.88-4 Seams.

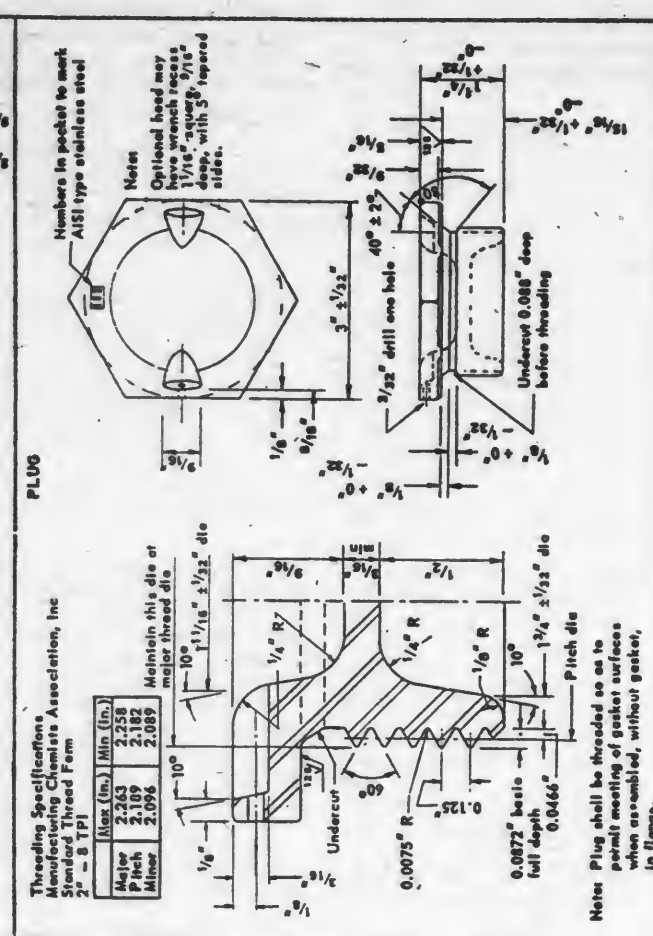
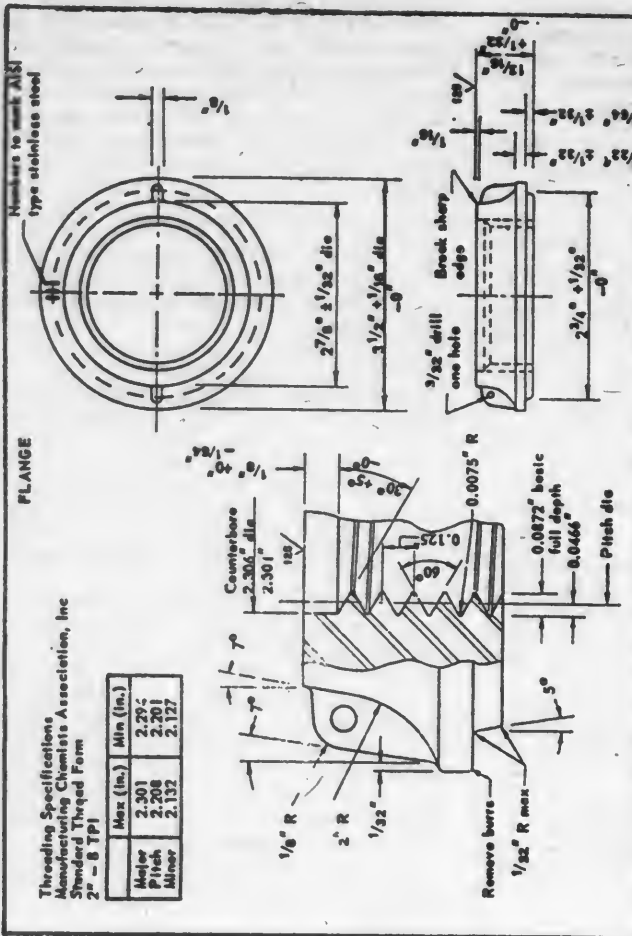
(a) Body seams welded.
 (b) Head and chime seams welded or double-seamed.
 (c) Flanges for closures welded in place.

§ 78.88-5 Chime reinforcement.

(a) Containers over 25 gallons capacity, with flanged head secured to body, to have chime reinforcement adequate for its protection.

§ 78.88-6 Parts and dimensions.

(a) Parts and dimensions as follows:



or (2) Eleven and one-half (11½) threads per inch, standard pipe size.

§ 78.88-7 Rolling hoops.

(a) Separate hoops to have tight fit on shell and be firmly secured in place. Beading under rolling hoops or spot welding not permitted.

§ 78.88-8 Closures.

(a) Adequate to prevent leakage; gas-kets required. Closure must be of screw-thread type or fastened by screw-thread device. Unthreaded cap is authorized for containers of 12 gallons or less if cap is provided with outside sealing devices which cannot be removed without destroying the cap or sealing device.
 (b) Closing part (plug, cap, plate, etc. see Note 1) must be of metal as thick as prescribed for head of container; this not required for containers of 12 gallons or less when the opening to be closed is not over 2.3 inches in diameter.

NOTE 1: This does not apply to cap seal over a closure which complies with all requirements.

(c) For closure with threaded plug or cap, the seat (flange, etc.) for plug or cap must have 5 or more complete threads; 2 drainage holes of not over ¼-inch diameter are allowed in that section of flange which extends inside the drum. Plug or cap must have sufficient length of thread to engage 5 threads when securely tightened with gasket in place.
 (d) Openings over .23 inches in diameter are not permitted. Threads for plug or cap must be 8 or less per inch when over ¾ inch standard pipe size.

(1) Flanges with inside threads and plug must conform with the thread diameter and thread form shown in the following drawing (other details shown on the drawing are recommended):

Marked capacity not over (gallons)	Type of container	Minimum thickness in the back (gauge, United States stand. ard)		Rolling hoops		Weight (pounds per foot)
		Body sheet	Head sheet	Type	Minimum Size (gauge or inch)	
10	Straight side	16	16	None	¾ x 1¼	1.25
20	do.	16	16	I-bar	1 x 1¼	1.60
55	do.	14	14	do.	1 x 1¼	1.60
110	do.	12	12	do.	1 x 1¼	1.60
20	Blige	14	16	None	do.	do.
55	do.	13	14	do.	do.	do.

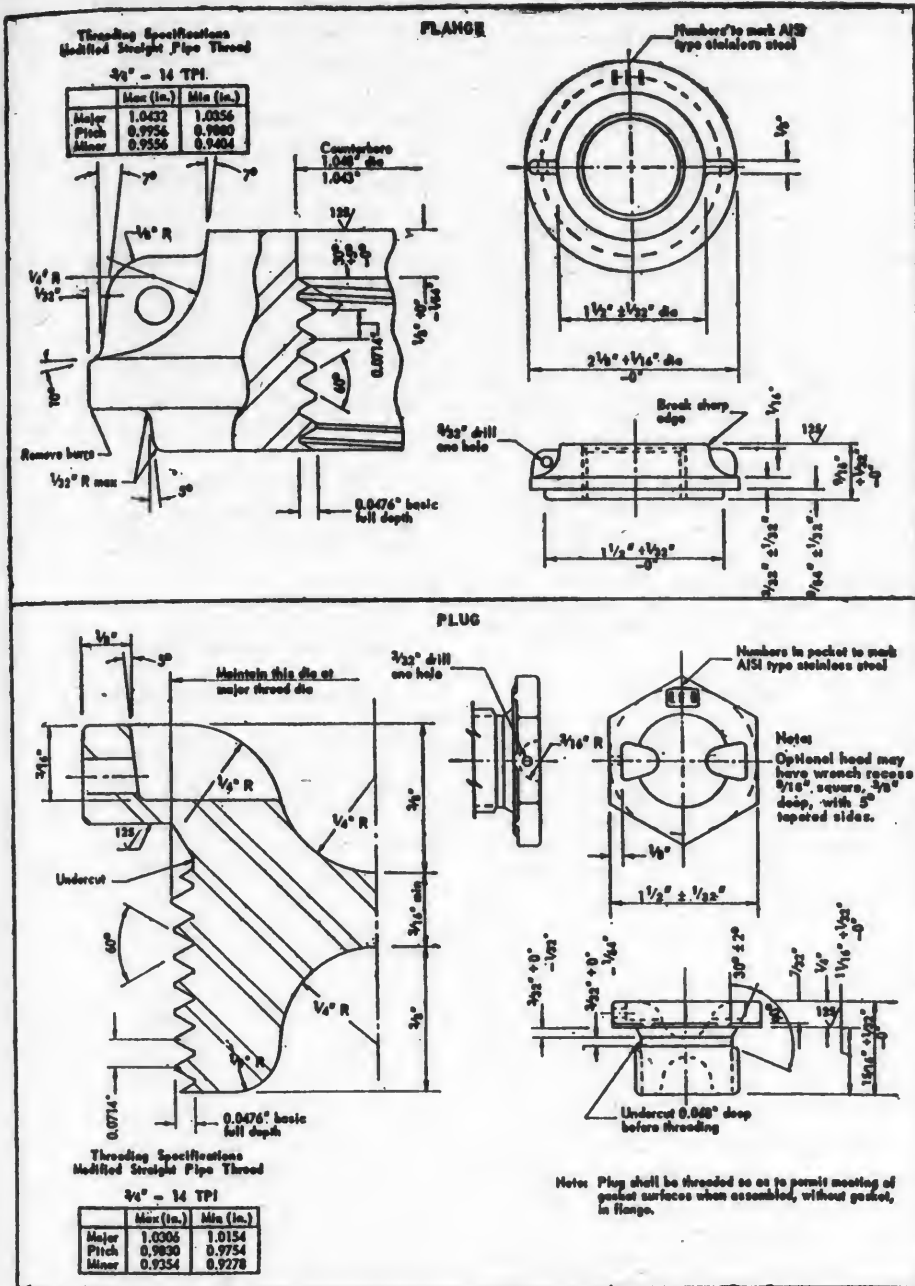
Rolling hoops of pliable solid rubber or other suitable material are also authorized when approved as to type and construction by the Bureau of Explosives.

NOTE 1: This does not apply to cap seal over a closure which complies with all requirements.

(c) For closure with threaded plug or cap, the seat (flange, etc.) for plug or cap must have 5 or more complete threads; 2 drainage holes of not over ¼-inch diameter are allowed in that section of flange which extends inside the drum. Plug or cap must have sufficient length of thread to engage 5 threads when securely tightened with gasket in place.
 (d) Openings over .23 inches in diameter are not permitted. Threads for plug or cap must be 8 or less per inch when over ¾ inch standard pipe size.

(1) Flanges with inside threads and plug must conform with the thread diameter and thread form shown in the following drawing (other details shown on the drawing are recommended):

(1)



§ 78.88-12 Type tests.

(a) Samples, taken at random and closed as for use, must be capable of withstanding prescribed tests without leakage. Tests to be made of each type and size by each company starting production and to be repeated every 12 months, except as provided in subparagraph (3) of this paragraph. Samples last tested to be retained until further tests are made. The types tests are as follows:

(1) Test by dropping, filled with water to 98 percent capacity, from height of 6 feet onto solid concrete so as to strike diagonally on chime, or when without chime seam, to strike on other circumferential seam; also additional drop test on any other parts which might be considered weaker than the chime. Closing devices and other parts projecting beyond chime or rolling hoops must also be capable of withstanding this test.

(2) Hydrostatic pressure test of 80 pounds per square inch sustained for 5 minutes.

(3) Periodic drop and hydrostatic tests are not required where container has satisfactorily met prescribed tests at the original start of production. Satisfactory test results must be obtained on samples of subsequent containers that have been altered in design or construction. Samples so tested must be retained.

§ 78.88-13 Leakage test.

(a) Each container shall be tested, with seams under water or covered with soapsuds or heavy oil, by interior air pressure of at least 15 pounds per square inch. Equally efficient means of testing are authorized upon demonstration and proof of satisfactory tests to representative of Bureau of Explosives. Leakers shall be rejected or repaired and retested.

§ 78.89 Specification 5L; steel barrels or drums.

Removable head containers not authorized.

§ 78.89-1 Compliance.

(a) Required in all details.

§ 78.89-2 Rated capacity.

(a) Rated capacity as marked, see § 78.89-9(a)(3). Actual capacity shall be not less than rated (marked) capacity plus 2 percent, nor greater than rated capacity plus 2 percent plus 1 quart.

§ 78.89-3 Composition.

(a) Sheets for body and heads to be low carbon, open hearth or electric steel.

§ 78.89-5 Seams.

(a) Body seams welded.
(b) Head and chime seams welded or double-seamed.

(c) Flanged spout for filling and emptying container welded in place or attached in a manner approved by Bureau of Explosives.

§ 78.89-6 Parts and dimensions.

(a) Parts and dimensions as follows:

(e) Other threaded closures may be authorized by the Bureau of Explosives upon demonstration of equal efficiency.

§ 78.88-9 Defective containers.

(a) Leaks and other defects to be repaired by method used in constructing container, not by soldering.

§ 78.88-10 Marking.

(a) Marking on each container by embossing on head with raised marks, or by embossing or die stamping on footing on drums equipped with footrings, or on metal plates securely attached to drum by brazing or welding not less than 20 percent of the perimeter as follows:

(1) ICC-5K. This mark shall be understood to certify that the container complies with all specification requirements.

(2) Name or symbol (letters) of maker or other party assuming responsibility for compliance with specification requirements; this must be recorded with the Bureau of Explosives.

(3) Gauge of metal in thinnest part, rated capacity in gallons, and year of manufacture (for example, 14-55-50). When gauge of metal in body differs from that in head, both must be indicated with slanting line between and with gauge of body indicated first (for example 14/12-55-50 for body 14 gauge and head 12 gauge).

§ 78.88-11 Size of markings.

(a) Size of markings (minimum): 1/2" high for 33-gallon or less, 3/4" for over 33 and not over 55 gallons, and 1" for over 55 gallons.

Marked capacity not over (gallons)	Type of container	Minimum thickness, uncoated sheets (gauge)		Rolling hoops		
		Body sheet	Head sheet	Type	Minimum	
					Size (gauge or inch)	Weight (pounds per foot)
5	Rectangular	20	20	None		

(b) Steel sheets of specified gauges shall comply with the following:

Gauge No.	Nominal thickness ¹ (inch)	Minimum thickness ¹ (inch)
20	0.0359	0.0324

¹ Thickness shall be measured at any point on the sheet not less than 3/4 inch from an edge.

§ 78.89-7 Closures.

- (a) Adequate to prevent leakage; gaskets required.
- (b) Closing part must be of sufficient strength to withstand the drop test prescribed in § 78.89-11 (a) (1).
- (c) Closure must be of screw-thread type or fastened by screw-thread device.
- (d) Openings over 2.5 inches diameter not permitted.

§ 78.89-8 Defective containers.

- (a) Leaks and other defects to be repaired by method used in constructing container, not by soldering.

§ 78.89-9 Marking.

(a) Marking on each container by embossing on head with raised marks, or by embossing or die stamping on footing on drums equipped with footings, or on metal plates securely attached to drum by brazing or welding not less than 20 percent of the perimeter as follows:

(1) ICC-5L. This mark shall be understood to certify that the container complies with all specification requirements.

(2) Name or symbol (letters) of maker or other party assuming responsibility for compliance with specification requirements; this must be recorded with the Bureau of Explosives.

(3) Gauge of metal in thinnest part, rated capacity in gallons, and year of manufacturer (for example, 20-5-50). When gauge of metal in body differs from that in head, both must be indicated with slanting line between and with gauge of body indicated first (for example 20/18-5-50 for body 20 gauge and head 18 gauge).

§ 78.89-10 Size of markings.

- (a) Size of markings (minimum): 1/2" high.

§ 78.89-11 Type tests.

(a) Samples taken at random and closed as for use, shall withstand prescribed tests without leakage. Tests to be made of each type and size by each

company starting production and to be repeated every four months. Samples last tested to be retained until further tests are made. The type tests are as follows:

- (1) Test by dropping, filled with water to 98 percent capacity, from height of 6 feet onto solid concrete so as to strike diagonally on chime, or when without chime seam, to strike on other circumferential seam; also additional drop test on any other parts which might be considered weaker than the chime. Closing devices and other parts projecting beyond chime or rolling hoops must also be capable of withstanding this test.
- (2) Hydrostatic pressure test of 15 pounds per square inch sustained for 5 minutes.

§ 78.89-12 Leakage test.

- (a) Each container shall be tested, with seams under water or covered with soapsuds or heavy oil, by interior air pressure of at least 5 pounds per square inch. Equally efficient means of testing are authorized upon demonstration and proof of satisfactory tests to representa-

tive of Bureau of Explosives. Leakers shall be rejected or repaired and retested.

§ 78.90 Specification 5M; monel drums.

Removable head containers not authorized.

§ 78.90-1 Compliance.

- (a) Required in all details.

§ 78.90-2 Rated capacity.

(a) Rated capacity as marked, see § 78.90-10(a) (3). Actual capacity of containers shall be not less than rated (marked) capacity plus 2 percent, nor greater than rated capacity plus 2 percent plus 1 quart, except that for containers over 30 gallons marked capacity actual capacity shall be not less than rated capacity plus 2 percent, nor greater than rated capacity plus 2 percent plus 2 quarts.

§ 78.90-3 Composition.

- (a) Material must be, except for rolling hoops and chime reinforcements, monel.

§ 78.90-4 Seams.

- (a) Body seams welded.
- (b) Head and chime seams welded or double-seamed.
- (c) Flanges for closures welded in place.

§ 78.90-5 Chime reinforcement.

- (a) Containers to have chime reinforcement adequate for its protection.

§ 78.90-6 Parts and dimensions.

- (a) Parts and dimensions as follows:

Marked capacity not over (gallons)	Type of container	Minimum thickness in the blank (gauge, United States standard)		Rolling hoops		
		Body sheet	Head sheet	Type ¹	Minimum	
					Size (gauge or inch)	Weight (pounds per foot)
10	Straight side	14	14	None		
55	do	14	14	1-bar	1 x 1 1/2	1.60

¹ Rolling hoops of pliable solid rubber or other suitable material are also authorized when approved as to type and construction by the Bureau of Explosives.

§ 78.90-7 Rolling hoops.

- (a) Separate hoops if used, to have tight fit on shell and be firmly secured in place. Beading under rolling hoops or spot welding not permitted.

§ 78.90-8 Closures.

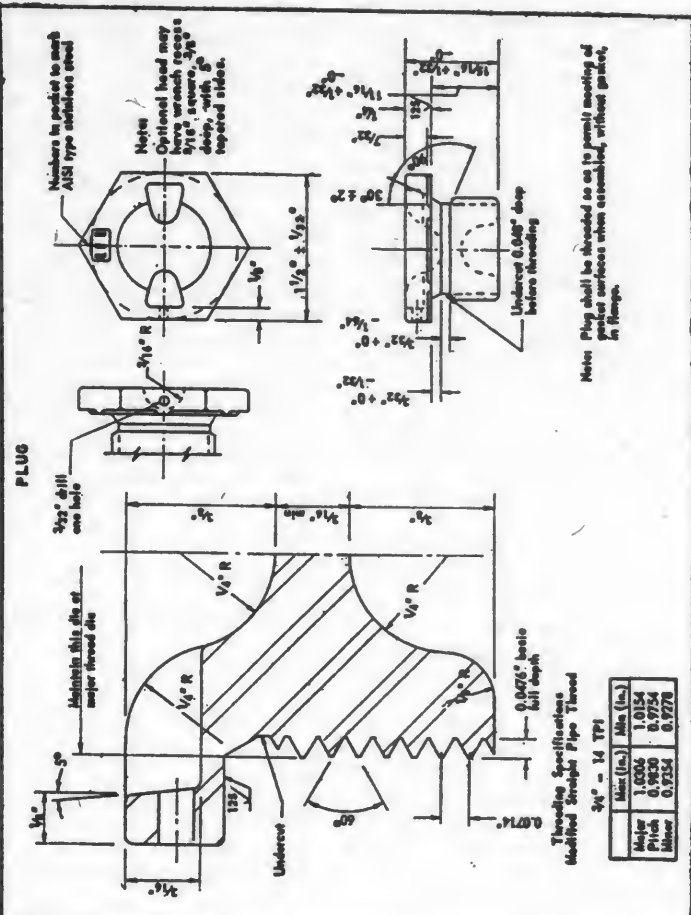
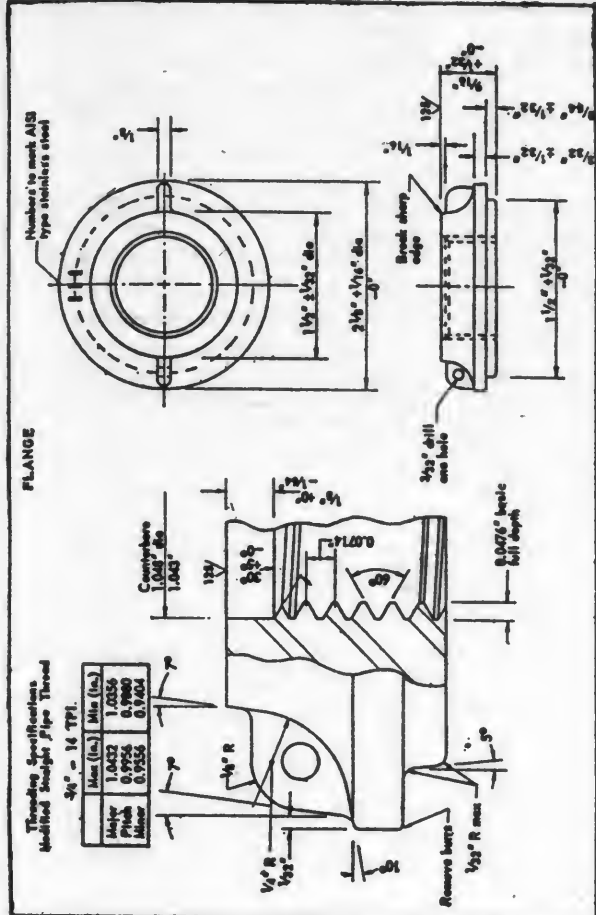
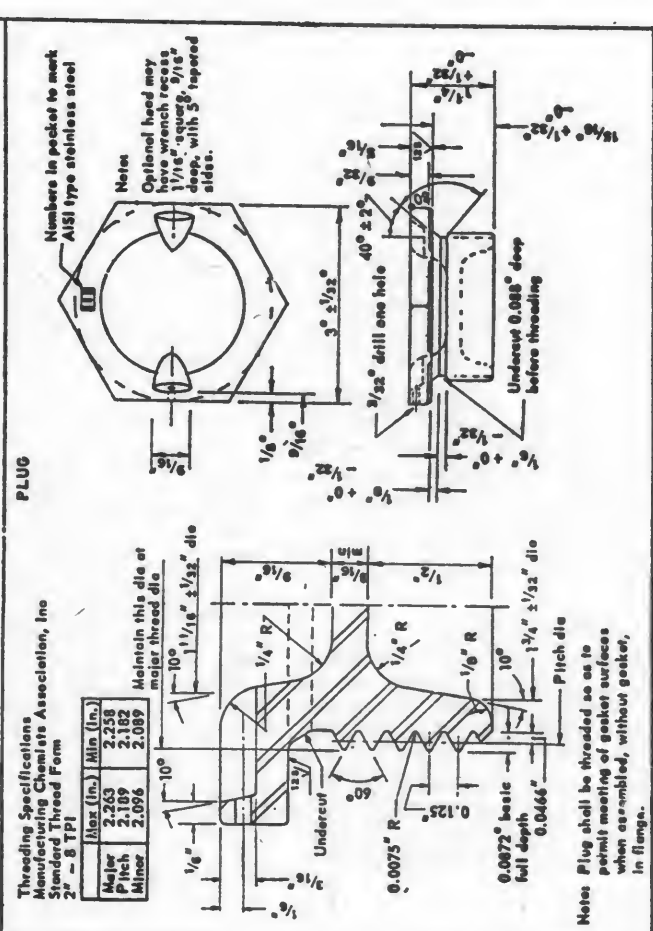
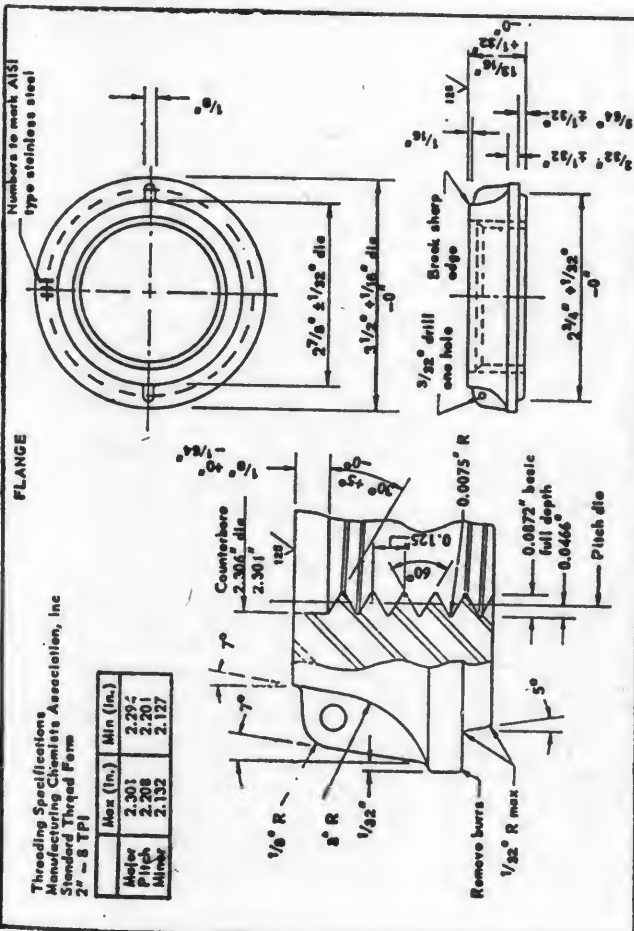
- (a) Adequate to prevent leakage. Closure must be of screw-thread type or fastened by screw-thread device. Unthreaded cap is authorized for containers of 12 gallons or less if cap is provided with outside sealing devices which cannot be removed without destroying the cap or sealing device.
- (b) Closing part (plug, cap, plate, etc., see Note 1) must be of metal as thick as prescribed for head of container; this not required for containers of 12 gallons or less when the opening to be closed is not over 2.3 inches in diameter.

NOTE 1: This does not apply to cap seal over a closure which complies with all requirements.

- (c) For closure with threaded plug or cap, the seat (flange, etc.) for plug or cap must have 5 or more complete threads; 2 drainage holes of not over 1/16-inch diameter are allowed in that section of flange which extends inside the drum. Plug or cap must have sufficient length of thread to engage 5 threads when securely tightened with gasket in place.
- (d) Openings over 2.3 inches diameter are not permitted. Threads for plug or cap must be 8 or less per inch when over 3/4 inch standard pipe size.

(1) Flanges with inside threads and plug must conform with the thread diameter and thread form shown in the following drawing (other details shown on the drawing are recommended):

(1)



or (2) Eleven and one-half (11 1/2) threads per inch, standard pipe size.

(e) Other threaded closures may be authorized by the Bureau of Explosives upon demonstration of equal efficiency.

Note: Plug shall be threaded so as to permit meeting of gasket surfaces when assembled, without gasket, in flange.

Note: Plug shall be threaded so as to permit meeting of gasket surfaces when assembled, without gasket, in flange.

§ 78.90-9 Defective containers.

(a) Leaks and other defects to be repaired by method used in constructing container, not by soldering.

§ 78.90-10 Marking.

(a) Marking on each container by embossing on head with raised marks, or by embossing or die stamping on footing on drums equipped with footings, or on metal plates securely attached to drum by brazing or welding not less than 20 percent of the perimeter as follows:

(1) ICC-5M. This mark shall be understood to certify that the container complies with all specification requirements.

(2) Name or symbol (letters) of maker or other party assuming responsibility for compliance with specification requirements; this must be recorded with the Bureau of Explosives.

(3) Gauge of metal in thinnest part, rated capacity in gallons, and year of manufacture (for example, 14-55-50).

§ 78.90-11 Size of markings.

(a) Size of marking (minimum): 1/2" high for 33-gallon or less, 3/4" for over 33 and not over 55 gallons.

§ 78.90-12 Type tests.

(a) Samples, taken at random and closed as for use, must be capable of withstanding prescribed tests without leakage. Tests to be made of each type and size by each company starting production and to be repeated every 12 months, except as provided in subparagraph (3) of this paragraph. Samples last tested to be retained until further tests are made. The type tests are as follows:

(1) Test by dropping, filled with water to 98 percent capacity, from height of 6 feet onto solid concrete so as to strike diagonally on chime, or when without chime seam, to strike on other circumferential seam; also additional drop test on any other parts which might be considered weaker than the chime. Closing devices and other parts projecting beyond chime or rolling hoops must also be capable of withstanding this test.

(2) Hydrostatic pressure test of 80 pounds per square inch sustained for 5 minutes.

(3) Periodic drop and hydrostatic tests are not required where container has satisfactorily met prescribed tests at the original start of production. Satisfactory test results must be obtained on samples of subsequent containers that have been altered in design or construction. Samples so tested must be retained.

§ 78.90-13 Leakage test.

(a) Each container shall be tested, with seams under water or covered with soapsuds or heavy oil, by interior air pressure of at least 15 pounds per square inch. Equally efficient means of testing are authorized upon demonstration and proof of satisfactory tests to representative of Bureau of Explosives. Leakers shall be rejected or repaired and retested.

§ 78.91 Specification 5X; steel drums, aluminum lined.

Removable head containers not authorized.

§ 78.91-1 Compliance.

(a) Required in all details.

§ 78.91-2 Rated capacity.

(a) Rated capacity as marked, see § 78.91-11(a)(3). Actual capacity of straight-sided containers shall be not less than rated (marked) capacity plus 2 percent, nor greater than rated capacity plus 2 percent plus 1 quart, except that for containers over 30 gallons marked capacity actual capacity shall be not less than rated capacity plus 2 percent, nor greater than rated capacity plus 2 percent plus 2 quarts; actual capacity of bilge-type containers must be not less than rated capacity, nor greater

than rated capacity plus 2 percent plus 2 quarts.

§ 78.91-3 Composition.

(a) Sheets for body and heads to be low carbon, open hearth or electric steel.

§ 78.91-5 Seams.

(a) Body seams welded.
(b) Head and chime seams welded or double-seamed.

(c) Flanges for closures welded in place.

§ 78.91-6 Chime reinforcement.

(a) Containers over 25 gallons capacity, with flanged head secured to body, to have chime reinforcement adequate for its protection.

§ 78.91-7 Parts and dimensions.

(a) Parts and dimensions as follows:

Marked capacity not over (gallons)	Type of container	Minimum thickness, uncoated sheets (gauge)		Rolling hoops		
		Body sheet	Head sheet	Type ¹	Minimum	
					Size (gauge or inch)	Weight (pounds per foot)
10	Straight side	16	16	None		
30	do.	16	16	I-bar	3/4 x 1 1/4	1.25
55	do.	14	14	do.	1 x 1 1/2	1.60
110	do.	12	12	do.	1 x 1 1/2	1.60
30	Bilge	14	16	None		
55	do.	13	14	do.		

¹ Rolling hoops of pliable solid rubber or other suitable material are also authorized when approved as to type and construction by the Bureau of Explosives.

(b) Steel sheets of specified gauges shall comply with the following:

Gauge No.	Nominal thickness ¹ (inch)	Minimum thickness ¹ (inch)
12	0.1046	0.0946
13	.0897	.0817
14	.0747	.0677
16	.0598	.0533

¹ Thickness shall be measured at any point on the sheet not less than 3/8 inch from an edge.

(c) Lining. Required; of aluminum 99 percent pure; thickness 0.12"; all seams welded. It shall have reasonably good fit in outside drum and be arranged so that extensive movement therein will be prevented.

§ 78.91-8 Rolling hoops.

(a) Separate hoops to have tight fit on shell and be firmly secured in place. Beading under rolling hoops or spot welding not permitted.

§ 78.91-9 Closures.

(a) Adequate to prevent leakage; shall be located between rolling hoops; aluminum plate gasket, at least 0.10 inch thick, is required. Closure must be of screw-thread type or fastened by screw-thread device. Unthreaded cap is authorized for containers of 12 gallons or less if cap is provided with outside sealing devices which cannot be removed without destroying the cap or sealing device.

(b) Closing part (plug, cap, plate, etc., see Note 1) must be of metal as thick

as prescribed for head of container; this not required for containers of 12 gallons or less when the opening to be closed is not over 2.3 inches in diameter.

NOTE 1: This does not apply to cap seal over a closure which complies with all requirements.

(c) For closure with threaded plug or cap, the seat (flange, etc.) for plug, or or cap, must have 5 or more complete threads; two 5/16" drainage holes are allowed. Plug, or cap, must have sufficient length of thread to engage 5 threads when screwed home without gasket. Threaded cap closures, 3 full threads engaged are also authorized.

(d) Openings over 2.3" diameter not permitted. Threads for plug or cap must be 8 or less per inch when over 3/4" standard pipe size.

§ 78.91-10 Defective containers.

(a) Leaks and other defects to be repaired by method used in constructing container, not by soldering.

§ 78.91-11 Marking.

(a) Marking on each container by embossing on head with raised marks, or by embossing or die stamping on footing on drums equipped with footings, or on metal plates securely attached to drum by brazing or welding not less than 20 percent of the perimeter as follows:

(1) ICC-5X. In addition, when the container is of stainless steel, the type of steel used in body and head sheets, as identified by American Iron and Steel Institute type number, and also the let-

ters HT following steel designation on containers subjected to stress relieving or heat treatment during manufacture (for example, ICC-5X-304 or ICC 5X-304 HT as applicable) shall be shown. These marks shall be understood to certify that the container complies with all specification requirements.

(2) Name or symbol (letters) of maker or other party assuming responsibility for compliance with specification requirements; this must be recorded with the Bureau of Explosives.

(3) Gauge of metal in thinnest part, rated capacity in gallons, and year of manufacture (for example, 14-55-50). When gauge of metal in body differs from that in head, both must be indicated with slanting line between and with gauge of body indicated first (for example 14/12-55-50 for body 14 gauge and head 12 gauge).

§ 78.91-12 Size of markings.

(a) Size of marking (minimum): $\frac{1}{2}$ " high for 33-gallon or less, $\frac{3}{4}$ " for over 33 and not over 55 gallons, and 1" for over 55 gallons.

§ 78.91-13 Type tests.

(a) Samples taken at random and closed as for use, shall withstand prescribed tests without leakage. Tests to be made of each type and size by each company starting production and to be repeated every four months. Samples last tested to be retained until further tests are made. The type tests are as follows:

(1) Test by dropping, filled with water to 98 percent capacity, from height of 6 feet onto solid concrete so as to strike diagonally on chime, or when without chime seam, to strike on other circumferential seam; also additional drop test on any other parts which might be considered weaker than the chime. Closing devices and other parts projecting beyond chime or rolling hoops must also be capable of withstanding this test.

(2) Hydrostatic pressure test of 80 pounds per square inch sustained for 5 minutes.

§ 78.91-14 Leakage test.

(a) Each container shall be tested, with seams under water or covered with soapsuds or heavy oil, by interior air pressure of at least 15 pounds per square inch. Equally efficient means of testing are authorized upon demonstration and proof of satisfactory tests to representative of Bureau of Explosives. Leakers shall be rejected or repaired and retested.

§ 78.92 Specification 5P; lagged steel drums.

Removable head containers not authorized.

§ 78.92-1 Compliance.

(a) Required in all details.

§ 78.92-2 Rated capacity.

(a) Rated capacity not over 61 gallons, see § 78.92-12 (a) (3). Actual capacity shall be not less than rated capacity plus two percent nor greater than rated capacity plus two percent plus one and one-half gallons.

§ 78.92-3 Composition.

(a) Sheets for body and heads of inside container to be low carbon or austenitic stainless, open hearth or electric steel. Sheets for body and heads of outside shell may be of any weldable steel suitable for the purpose.

§ 78.92-5 Construction.

(a) Container shall consist of a straight sided inside steel drum which must be lagged with a suitable fire-resistant lagging material of such insulating properties and thickness that the drum charged with the commodity to be shipped will not rupture in a fire when it is equipped with safety devices as required by § 78.92-9. The entire insulation must be covered with a metal shell so constructed that moisture cannot come in contact with lagging.

(b) Brazing is not permitted.

(c) All seams of drum and shell must be fusion welded.

(d) Flanges or bosses for closures in the inner container must be fusion welded in place to the inside drum and the metal shell.

(e) Means for testing inside drum for leaks must be provided in outside shell.

§ 78.92-6 Parts and dimensions.

(a) Parts and dimensions as follows:

(1) Steel sheets used for body and head sheets for inside drum must have nominal thickness of at least 0.0747 inch and minimum thickness of 0.0677 inch, uncoated sheets, which shall be designated 14 gauge.

(2) Steel sheets used for body sheets for outside shell must have nominal thickness of at least 0.1046 inch and minimum thickness of 0.0946 inch, uncoated sheets, which shall be designated 12 gauge.

(3) Steel sheets used for head sheets for outside shell must have nominal thickness of at least 0.0747 inch and minimum thickness of 0.0677 inch, uncoated sheets, which shall be designated 12 gauge.

§ 78.92-7 Rolling hoops.

(a) Rolling hoops are required and these may be rolled or swaged in the outside shell or consist of separate hoops having a tight fit on shell and securely held in place.

§ 78.92-8 Closures.

(a) All closures must be of screw-thread type adequate to prevent leakage and be of a material which will not react dangerously in contact with the commodity.

(b) All openings in inside drums must be located in the top head.

(c) Openings over 2.3 inches screw thread size not permitted.

(d) Plugs, caps, or other fittings must have sufficient length of thread to engage 5 threads when screwed home with gasket in place.

(e) Gaskets which are not affected by lading are required for closures having straight threads.

§ 78.92-9 Safety devices.

(a) Each container must be provided with safety devices approved as to type and location by the Bureau of Explosives

and found to prevent the bursting of the normally charged container when it is placed in a fire. See § 73.124(a)(4) of this chapter.

§ 78.92-10 Closure protection.

(a) Construction must be such as to afford adequate protection to valves and safety devices.

§ 78.92-11 Defective containers.

(a) Leaks and other defects to be repaired only by processes used in constructing container.

§ 78.92-12 Marking.

(a) Marking on each container by embossing with raised marks or by steel stamping on top head of outside shell or on a permanently attached head protective ring, as follows:

(1) ICC-5P. This mark shall be understood to certify that the container complies with all specification requirements.

(2) Name or symbol (letters) of maker; this must be recorded with and its use approved by the Bureau of Explosives.

(3) Minimum gauge of metal of inner container, rated capacity in gallons and year of manufacture must be indicated in the order named (for example, 14-61-50).

(4) Size of markings (minimum): $\frac{1}{2}$ inch high for stamping, 1 inch high for embossing.

§ 78.92-13 Tests.

(a) Sample drums, taken at random and closed as for use, shall withstand prescribed tests without leakage, one test to be made of each design and size of drum by each company before starting production as follows:

(1) Test by dropping, filled with water to 98 percent capacity, from height of 4 feet on to solid concrete so as to strike diagonally on chime (foot ring), or when without chime seam, to strike on other circumferential seam; also additional drop test on any other parts which might be considered weaker.

(2) Hydrostatic pressure test of 100 pounds per square inch sustained for five minutes. This test shall be applied to the finished inner container before lagging material and outer shell are assembled.

(3) Samples last tested to be retained until further tests are made.

§ 78.92-14 Leakage test.

(a) Each container shall be subjected to a pressure test of at least 125 pounds per square inch sustained for at least 30 seconds. Test shall be applied to inner container before lagging material or outer shell is assembled. Failures shall be rejected or repaired and retested.

NOTE 1: If air or other gas is the pressurizing medium, the test should be conducted in a pit or equivalent means of safeguarding personnel.

(b) Subsequent to the test specified in paragraph (a) of this section each container shall be tested with seams under water or covered with soapsuds or other suitable material by interior air pressure of at least 75 pounds per square inch.

Leakage test shall be applied to finished inner container before lagging or outer shell is assembled. Leakers shall be rejected or repaired and retested.

§ 78.97 Specification 6A; steel barrels or drums.

Removable head containers which will pass all required tests are authorized.

§ 78.97-1 Compliance.

(a) Required in all details.

§ 78.97-2 Rated capacity.

(a) Rated capacity as marked, see § 78.97-9(a) (3). Actual capacity of straight-sided containers shall be not less than rated (marked) capacity plus 2

percent, nor greater than rated capacity plus 2 percent plus 1 quart, except that for containers over 30 gallons marked capacity actual capacity shall be not less than rated capacity plus 2 percent, nor greater than rated capacity plus 2 percent plus 2 quarts; actual capacity of bilge-type containers must be not less than rated capacity, nor greater than rated capacity plus 2 percent plus 2 quarts.

§ 78.97-3 Composition.

(a) Sheets for body and heads to be low carbon, open hearth or electric steel.

§ 78.97-5 Parts and dimensions.

(a) Parts and dimensions as follows:

Marked capacity (gallons)	Authorized gross weight (pounds)	Type of container	Minimum thickness, uncoated sheets (gauge)		Rolling hoops		
			Body sheet	Head sheet	Type	Minimum	
						Size (gauge or inch)	Weight (pounds per foot)
5 to 10.....	160	Straight side.	16	16	None.....		
5 to 30.....	490	do.	14	14	I-bar.....	¾ x 1¼	1.25
5 to 55.....	890	do.	12	12	do.	1 x 1¼	1.60
5 to 33.....	490	Bilge.	13	14	None.....		
5 to 55.....	890	do.	12	12	do.		

(b) Steel sheets of specified gauges shall comply with the following:

Gauge No.	Nominal thickness ¹ (inch)	Minimum thickness ¹ (inch)
12.....	0.1046	0.0946
13.....	.0897	.0817
14.....	.0747	.0677
16.....	.0598	.0533

¹ Thickness shall be measured at any point on the sheet not less than ¾ inch from an edge.

§ 78.97-6 Rolling hoops.

(a) Separate hoops to have tight fit on shell and be firmly secured in place. Beading under rolling hoops or spot welding not permitted.

§ 78.97-7 Closures.

(a) Adequate to prevent leakage; gaskets required. Closures must be of screw-thread type or secured by positive fastening.

(b) Closing part (plug, cap, plate, etc., see note 1) must be of metal as thick as prescribed for head of container; this not required for containers of 12 gallons or less when the opening to be closed is not over 2.3 inches in diameter. If unthreaded cap is used it must be provided with outside sealing devices which cannot be removed without destroying the cap or sealing device.

NOTE 1: This does not apply to cap seal over a closure which complies with all requirements.

§ 78.97-8 Defective containers.

(a) Leaks and other defects to be repaired by method used in constructing container, not by soldering.

§ 78.97-9 Marking.

(a) Marking on each container by embossing on head, except that such embossment must be on the permanent head for drums having removable heads, with raised marks, or by embossing or die stamping on footing on drums equipped with footings, or on metal plates securely attached to drum by brazing or welding not less than 20 percent of the perimeter, as follows:

(1) ICC-6A***; stars to be replaced by the authorized gross weight (for example, ICC-6A880, etc.). In addition, when the container is of stainless steel, the type of steel used in body and head sheets, as identified by American Iron and Steel Institute type number, and also the letters HT following steel designation on containers subjected to stress relieving or heat treatment during manufacture (for example, ICC-6A880-304 or ICC-6A880-304 HT as applicable), shall be shown. These marks shall be understood to certify that the container complies with all specification requirements.

(2) Name or symbol (letters) of maker or other party assuming responsibility for compliance with specification requirements; this must be recorded with the Bureau of Explosives.

(3) Gauge of metal in thinnest part, rated capacity in gallons, and year of manufacture (for example, 14-55-50). When gauge of metal in body differs from that in head, both must be indicated with slanting line between and with gauge of body indicated first (for example 14/12-55-50 for body 14 gauge and head 12 gauge).

§ 78.97-10 Size of markings.

(a) Size of markings (minimum): ½'' high for 33-gallon or less, ¾'' for over 33 and not over 55 gallons.

§ 78.97-11 Type tests.

(a) Samples taken at random and closed as for use, shall withstand prescribed tests without leakage. Tests to be made of each type and size by each company starting production and to be repeated every four months. Samples last tested to be retained until further tests are made. The type tests are as follows:

(1) Test by dropping, filled with dry, finely powdered material to the authorized gross weight, from height of 4 feet onto solid concrete so as to strike diagonally on top chime, or when without chime seam, to strike on other circumferential seam; also additional drop test on any other parts which might be considered weaker than the chime. Closing devices and other parts projecting beyond chime or rolling hoops must also be capable of withstanding this test.

(2) Hydrostatic pressure test of 30 pounds per square inch sustained for 5 minutes. Leakage through closure shall not constitute failure.

§ 78.97-12 Leakage test.

(a) Each container shall be tested, with seams under water or covered with soapsuds or heavy oil, by interior air pressure of at least 15 pounds per square inch. Equally efficient means of testing are authorized upon demonstration and proof of satisfactory tests to representative of Bureau of Explosives. Leakers shall be rejected or repaired and retested. Removable head containers not required to be tested with heads in place except that samples taken at random and closed as for use, of each type and size, must be tested at start of production and repeated every four months. Samples so tested must be retained until further tests are made.

§ 78.98 Specification 6B; steel barrels or drums.

Removable head containers which will pass all required tests are authorized.

§ 78.98-1 Compliance.

(a) Required in all details.

§ 78.98-2 Rated capacity.

(a) Rated capacity as marked, see § 78.98-9(a) (3). Actual capacity of straight-sided containers shall be not less than rated (marked) capacity plus 2 percent, nor greater than rated capacity plus 2 percent, plus 1 quart, except that for containers over 30 gallons marked capacity actual capacity shall be not less than rated capacity plus 2 percent, nor greater than rated capacity plus 2 percent plus 2 quarts; actual capacity of bilge-type containers must be not less than rated capacity, nor greater than rated capacity plus 2 percent plus 2 quarts.

§ 78.98-3 Composition.

(a) Sheets for body and heads to be low carbon, open hearth or electric steel.

§ 78.98-5 Parts and dimensions.

(a) Parts and dimensions as follows:

Marked capacity (gallons)	Authorized gross weight (pounds)	Type of Container	Minimum thickness, uncoated sheets (gauge)		Rolling hoops		
			Body Sheet	Head Sheet	Type	Minimum	
						Size (gauge or inch)	Weight (pounds per foot)
5 to 10.....	160	Straight side.....	18	18	None.....		
5 to 30.....	480	.....do.....	16	16	U ¹	14	
5 to 55.....	880	.....do.....	14	14	U.....	12	
5 to 30.....	480	.....do.....	16	16	I-bar ¹	3/4 x 1 1/4	1.25
5 to 55.....	880	.....do.....	14	14	.....do.....	3/4 x 1 1/4	1.25
5 to 110.....	1,760	.....do.....	12	12	.....do.....	1 x 1 1/4	1.60
5 to 33.....	480	Bilge.....	15	16	None.....		
5 to 55.....	880	.....do.....	13	14	.....do.....		

¹ Rolled or swaged in hoops permitted.

(b) Steel sheets of specified gauges shall comply with the following:

Gauge No.	Nominal thickness ¹ (inch)	Minimum thickness ¹ (inch)
12.....	0.1046	0.0946
13.....	.0897	.0817
14.....	.0747	.0677
15.....	.0673	.0603
16.....	.0598	.0533
18.....	.0478	.0428

¹ Thickness shall be measured at any point on the sheet not less than 1/8 inch from an edge.

§ 78.98-6 Rolling hoops.

(a) Separate hoops to have tight fit on shell and be firmly secured in place. Beading under rolling hoops not permitted. Attachment to drum body by spot welding, except for continuous resistance method, not permitted. Welding of I-bar type directly to body of drum in any manner not permitted.

§ 78.98-7 Closures.

(a) Adequate to prevent leakage; gaskets required. Closures must be of screw-thread type or secured by positive fastening.

(b) Closing part (plug, cap, plate, etc., see Note 1) must be of metal as thick as prescribed for head of container; this not required for containers of 12 gallons or less when the opening to be closed is not over 2.3 inches in diameter. If unthreaded cap is used it must be provided with outside sealing devices which cannot be removed without destroying the cap or sealing device.

Note 1: This does not apply to cap seal over a closure which complies with all requirements.

§ 78.98-8 Defective containers.

(a) Leaks and other defects to be repaired by method used in constructing container, not by soldering.

§ 78.98-9 Marking.

(a) Marking on each container by embossing on head, except that such embossment must be on the permanent head for drums having removable heads, with raised marks, or by embossing or die stamping on footing on drums equipped with footings, or on metal plates securely attached to drum by brazing or welding not less than 20 percent of the perimeter, as follows:

(1) ICC-6B***; stars to be replaced by the authorized gross weight (for example, ICC-6B880, etc.). In addition, when the container is of stainless

steel, the type of steel used in body and head sheets, as identified by American Iron and Steel Institute type number, and also the letters HT following steel designation on containers subjected to stress relieving or heat treatment during manufacture (for example, ICC-6B880-304 or ICC-6B880-304 HT as applicable), shall be shown. These marks shall be understood to certify that the container complies with all specification requirements.

(2) Name or symbol (letters) of maker or other party assuming responsibility for compliance with specification requirements; this must be recorded with the Bureau of Explosives.

(3) Gauge of metal in thinnest part, rated capacity in gallons, and year of manufacture (for example, 14-55-50). When gauge of metal in body differs from that in head, both must be indicated with slanting line between and with gauge of body indicated first (for example, 14/12-55-50 for body 14 gauge and head 12 gauge).

§ 78.98-10 Size of markings.

(a) Size of markings (minimum): 1/2" high for 33-gallon or less, 3/4" for over 33 and not over 55 gallons, and 1" for over 55 gallons.

§ 78.98-11 Type tests.

(a) Samples taken at random and closed as for use, shall withstand prescribed tests without leakage. Tests to be made of each type and size by each company starting production and to be repeated every four months. Samples last tested to be retained until further tests are made. The type tests are as follows:

(1) Test by dropping, filled with dry, finely powdered material to the authorized gross weight, from height of 4 feet onto solid concrete so as to strike diag-

onally on top chime, or when without chime seam, to strike on other circumferential seam; also additional drop test on any other parts which might be considered weaker than the chime. Closing devices and other parts projecting beyond chime or rolling hoops must also be capable of withstanding this test.

(2) Hydrostatic pressure test of 30 pounds per square inch sustained for 5 minutes. Leakage through closure shall not constitute failure.

§ 78.98-12 Leakage test.

(a) Each container shall be tested, with seams under water or covered with soapsuds or heavy oil, by interior air pressure of at least 15 pounds per square inch. Equally efficient means of testing are authorized upon demonstration and proof of satisfactory tests to representatives of Bureau of Explosives. Leakers shall be rejected or repaired and retested. Removable head containers not required to be tested with heads in place except that samples taken at random and closed as for use, of each type and size, must be tested at start of production and repeated every four months. Samples so tested must be retained until further tests are made.

§ 78.99 Specification 6C; steel barrels or drums.

Removable head containers which will pass all required tests are authorized.

§ 78.99-1 Compliance.

(a) Required in all details.

§ 78.99-2 Rated capacity.

(a) Rated capacity as marked, see § 78.99-9 (a) (3). Actual capacity of straight-sided containers shall be not less than rated (marked) capacity plus 2 percent, nor greater than rated capacity plus 2 percent plus 1 quart, except that for containers over 30 gallons marked capacity actual capacity shall be not less than rated capacity plus 2 percent, nor greater than rated capacity plus 2 percent plus 2 quarts; actual capacity of bilge-type containers must be not less than rated capacity, nor greater than rated capacity plus 2 percent plus 2 quarts.

§ 78.99-3 Composition.

(a) Sheets for body and heads to be low carbon, open hearth or electric steel.

§ 78.99-5 Parts and dimensions.

(a) Parts and dimensions as follows:

Marked capacity (gallons)	Authorized gross weight (pounds)	Type of container	Minimum thickness, uncoated sheets (gauge)		Rolling hoops		
			Body sheet	Head sheet	Type	Minimum	
						Size (gauge or inch)	Weight (pounds per foot)
5.....	80	Straight side.....	22	22	None.....		
5 to 10.....	160	.....do.....	20	20	.....do.....		
5 to 30.....	480	.....do.....	18	18	U.....	16	
5 to 55.....	880	.....do.....	16	16	U.....	14	
5 to 110.....	1,760	.....do.....	14	14	U.....	12	
5 to 30.....	480	.....do.....	18	18	I-bar.....	3/4 x 1 1/4	1.25
5 to 55.....	880	.....do.....	16	16	.....do.....	3/4 x 1 1/4	1.25
5 to 110.....	1,760	.....do.....	14	14	.....do.....	1 x 1 1/4	1.60
5 to 33.....	480	Bilge.....	16	18	None.....		
5 to 55.....	880	.....do.....	15	16	.....do.....		

(b) Steel sheets of specified gauges shall comply with the following:

Gauge No.	Nominal thickness ¹ (inch)	Minimum thickness ¹ (inch)
14	0.0747	0.0677
15	.0673	.0603
16	.0598	.0533
18	.0478	.0428
20	.0359	.0324
22	.0299	.0269

¹ Thickness shall be measured at any point on the sheet not less than 3/4 inch from an edge.

§ 78.99-6 Rolling hoops.

(a) Separate hoops to have tight fit on shell and be firmly secured in place. Beading under rolling hoops not permitted. Attachment to drum body by spot welding except for continuous resistance method, not permitted. Welding of I-bar type directly to body of drum in any manner not permitted.

§ 78.99-7 Closures.

(a) Adequate to prevent leakage; gaskets required. Closures must be of screw-thread type or secured by positive fastening.

(b) Closing part (plug, cap, plate, etc., see Note 1) must be of metal as thick as prescribed for head of container; this not required for containers of 12 gallons or less when the opening to be closed is not over 2.3 inches in diameter. If unthreaded cap is used it must be provided with outside sealing device which cannot be removed without destroying the cap or sealing device.

NOTE 1: This does not apply to cap seal over a closure which complies with all requirements.

§ 78.99-8 Defective containers.

(a) Leaks and other defects to be repaired by method used in constructing container, not by soldering.

§ 78.99-9 Marking.

(a) Marking on each container by embossing on head, except that such embossment must be on the permanent head for drums having removable heads, with raised marks, or by embossing or die stamping on footing on drums equipped with footings, or on metal plates securely attached to drum by brazing or welding not less than 20 percent of the perimeter, as follows:

(1) ICC-6C***; stars to be replaced by the authorized gross weight (for example, ICC-6C880, etc.). In addition, when the container is of stainless steel, the type of steel used in body and head sheets, as identified by American Iron and Steel Institute type number, and also the letters HT following steel designation on containers subjected to stress relieving or heat treatment during manufacture (for example, ICC-6C880-304 or ICC-6C880-304 HT as applicable) shall be shown. These marks shall be understood to certify that the container complies with all specification requirements.

(2) Name or symbol (letters) of maker or other party assuming responsibility for compliance with specification requirements; this must be recorded with the Bureau of Explosives.

(3) Gauge of metal in thinnest part, rated capacity in gallons, and year of manufacture (for example, 14-55-50). When gauge of metal in body differs from that in head, both must be indicated with slanting line between and with gauge of body indicated first (for example 14/12-55-50 for body 14 gauge and head 12 gauge).

§ 78.99-10 Size of markings.

(a) Size of markings (minimum): 1/2" high for 33-gallon or less, 3/4" for over 33 and not over 55 gallons, and 1" for over 55 gallons.

§ 78.99-11 Type tests.

(a) Samples taken at random and closed as for use, shall withstand prescribed tests without leakage. Tests to be made of each type and size by each company starting production and to be repeated every four months. Samples last tested to be retained until further tests are made. The type tests as follows:

(1) Test by dropping, filled with dry, finely powdered material to the authorized gross weight, from height of 4 feet onto solid concrete so as to strike diagonally on top chime, or when without chime seam, to strike on other circumferential seam; also additional drop test on any other parts which might be considered weaker than the chime. Closing devices and other parts projecting beyond chime or rolling hoops must also be capable of withstanding this test.

(2) Hydrostatic pressure test of 30 pounds per square inch sustained for 5 minutes. Leakage through closure shall not constitute failure.

§ 78.99-12 Leakage test.

(a) Each container shall be tested, with seams under water or covered with

soapsuds or heavy oil, by interior air pressure of at least 15 pounds per square inch. Equally efficient means of testing are authorized upon demonstration and proof of satisfactory tests to representative of Bureau of Explosives. Leakers shall be rejected or repaired and retested. Removable head containers not required to be tested with heads in place except that samples taken at random and closed as for use of each type and size, must be tested at start of production and repeated every four months. Samples so tested must be retained until further tests are made.

§ 78.100 Specification 6J; steel barrels and drums.

Removable head containers which will pass all required tests are authorized.

§ 78.100-1 Compliance.

(a) Required in all details.

§ 78.100-2 Rated capacity.

(a) Rated capacity as marked, see § 78.100-9(a)(3). Actual capacity of straight-sided containers shall be not less than rated (marked) capacity plus 2 percent, nor greater than rated capacity plus 2 percent plus 1 quart, except that for containers over 30 gallons marked capacity actual capacity shall be not less than rated capacity plus 2 percent, nor greater than rated capacity plus 2 percent plus 2 quarts; actual capacity of bilge-type containers must be not less than rated capacity, nor greater than rated capacity plus 2 percent plus 2 quarts.

§ 78.100-3 Composition.

(a) Sheets for body and heads to be low carbon, open hearth or electric steel.

§ 78.100-5 Parts and dimensions.

(a) Parts and dimensions as follows:

Marked capacity (gallons)	Authorized gross weight (pounds)	Type of container	Minimum thickness, uncoated sheets (gauge)		Rolling hoops		
			Body sheet	Head sheet	Type	Minimum	
						Size (gauge or inch)	Weight (pounds per foot)
5 to 30	260	Straight side	19	19	(1)		
5 to 55	450	do	18	18	(1)		
5 to 65	830	do	16	16	U	14	
5 to 55	880	do	16	16	I-bar	3/4 x 1 1/4	1.25
5 to 33	490	Bilge	16	18	None		
5 to 55	890	do	16	16	do		

¹ Rolled or swaged in hoops.

(b) Steel sheets of specified gauges shall comply with the following:

Gauge No.	Nominal thickness ¹ (inch)	Minimum thickness ¹ (inch)
15	0.0673	0.0603
16	.0598	.0533
18	.0478	.0428
19	.0418	.0378

¹ Thickness shall be measured at any point on the sheet not less than 3/4 inch from an edge.

§ 78.100-6 Rolling hoops.

(a) Separate hoops to have tight fit on shell and be firmly secured in place. Beading under rolling hoops not permitted. Attachment to drum body by spot welding, except for continuous re-

sistance method, not permitted. Welding of I-bar type directly to body of drum in any manner not permitted.

§ 78.100-7 Closures.

(a) Adequate to prevent leakage; gaskets, required. Closures must be of screw-thread type or secured by positive fastening.

(b) Closing part (plug, cap, plate, etc., see Note 1) must be of metal as thick as prescribed for head of container; this not required for containers of 12 gallons or less when the opening to be closed is not over 2.3 inches in diameter. If unthreaded cap is used, it must be provided with outside sealing devices which can-

not be removed without destroying the cap or sealing device.

NOTE 1: This does not apply to cap seal over a closure which complies with all requirements.

§ 78.100-8 Defective containers.

(a) Leaks and other defects to be repaired by method used in constructing container, not by soldering.

§ 78.100-9 Marking.

(a) Marking on each container by embossing on head, except that such embossment must be on the permanent head for drums having removable heads, with raised marks, or by embossing or die stamping on footing on drums equipped with footings, or on metal plates securely attached to drum by brazing or welding not less than 20 percent of the perimeter, as follows:

(1) ICC-6J***; stars to be replaced by the authorized gross weight (for example, ICC-6J880, etc.). In addition, when the container is of stainless steel, the type of steel used in body and head sheets, as identified by American Iron and Steel Institute type number, and also the letters HT following steel designation on containers subjected to stress relieving or heat treatment during manufacture (for example, ICC-6J880-304 or ICC-6J880-304 HT as applicable), shall be shown. These marks shall be understood to certify that the container complies with all specification requirements.

(2) Name or symbol (letters) of maker or other party assuming responsibility for compliance with specification requirements; this must be recorded with the Bureau of Explosives.

(3) Gauge of metal in thinnest part, rated capacity in gallons, and year of manufacture (for example, 14-55-50). When gauge of metal in body differs from that in head, both must be indicated with slanting line between and with gauge of body indicated first (for example 14/12-55-50 for body 14 gauge and head 12 gauge).

§ 78.100-10 Size of markings.

(a) Size of markings (minimum): 1/2" high for 33-gallon or less, 3/4" for over 33 and not over 55 gallons.

§ 78.100-11 Type tests.

(a) Samples taken at random and closed as for use, shall withstand prescribed tests without leakage. Tests to be made of each type and size by each company starting production and to be repeated every four months. Samples last tested to be retained until further tests are made. The type tests are as follows:

(1) Test by dropping, filled with dry, finely powdered material to the authorized gross weight, from height of 4 feet onto solid concrete so as to strike diagonally on top chime, or when without chime seam, to strike on other circumferential seam; also additional drop test on any other parts which might be considered weaker than the chime. Closing devices and other parts projecting beyond chime or rolling hoops must also be capable of withstanding this test.

§ 78.101 Specification 6K; steel barrels or drums.

Removable head containers which will pass all required tests are authorized.

§ 78.101-1 Compliance.

(a) Required in all details.

§ 78.101-2 Rated capacity.

(a) Rated capacity as marked, see § 78.101-9(a) (3). Actual capacity of containers shall be not less than rated (marked) capacity plus 2 percent, nor

greater than rated capacity plus 2 percent plus 1 quart, except that for containers over 30 gallons marked capacity, actual capacity shall be not less than rated capacity plus 2 percent, nor greater than rated capacity plus 2 percent plus 2 quarts.

§ 78.101-3 Composition.

(a) Sheets for body and heads to be low carbon, open hearth or electric steel.

§ 78.101-5 Parts and dimensions.

(a) Parts and dimensions as follows:

Marked capacity not over (gallons)	Authorized gross weight (pounds)	Type of container	Minimum thickness, uncoated sheets (gauge)		Rolling hoops		
			Body sheet	Head sheet	Type	Minimum	
						Size (gauge or inch)	Weight (pounds per foot)
55	480	Straight side.....	18	18	I-bar ¹	3/4 x 1 1/4	1.25

¹ Rolled or swedged-in hoops permitted.

(b) Steel sheets of specified gauges shall comply with the following:

Gauge No.	Nominal thickness ¹ (inch)	Minimum thickness ¹ (inch)
18.....	0.0478	0.0428

¹ Thickness shall be measured at any point on the sheet not less than 1/4 inch from an edge.

§ 78.101-6 Rolling hoops.

(a) Separate hoops to have tight fit on shell and be firmly secured in place. Beading under rolling hoops or spot welding not permitted.

§ 78.101-7 Closures.

(a) Adequate to prevent leakage; gaskets required. Closures must be of screw-thread type or secured by positive fastening.

(b) Closing part (plug, cap, plate, etc., see Note 1) must be of metal as thick as prescribed for head of container; this not required for containers of 12 gallons or less when the opening to be closed is not over 2.3 inches in diameter. If unthreaded cap is used it must be provided with outside sealing devices which cannot be removed without destroying the cap or sealing device.

NOTE 1: This does not apply to cap seal over a closure which complies with all requirements.

§ 78.101-8 Defective containers.

(a) Leaks and other defects to be repaired by method used in constructing container, not by soldering.

§ 78.101-9 Marking.

(a) Marking on each container by embossing on head, except that such embossment must be on the permanent head for drums having removable heads, with raised marks, or by embossing or die stamping on footing on drums equipped with footings, or on metal plates securely attached to drum by brazing or welding not less than 20 percent of the perimeter, as follows:

(1) ICC-6K480. In addition, when the container is of stainless steel, the type of steel used in body and head sheets, as identified by American Iron

and Steel Institute type number, and also the letters HT following steel designation on containers subjected to stress relieving or heat treatment during manufacture (for example, ICC-6K480-304 or ICC-6K480-304 HT as applicable), shall be shown. These marks shall be understood to certify that the container complies with all specification requirements.

(2) Name or symbol (letters) of maker or other party assuming responsibility for compliance with specification requirements; this must be recorded with the Bureau of Explosives.

(3) Gauge of metal in thinnest part, rated capacity in gallons, and year of manufacture (for example, 18-55-50).

§ 78.101-10 Size of markings.

(a) Size of markings (minimum): 1/2" high for 33-gallon or less, 3/4" for over 33 and not over 55 gallons.

§ 78.101-11 Type tests.

(a) Samples taken at random and closed as for use, shall withstand prescribed tests without leakage. Tests to be made of each type and size by each company starting production and to be repeated every four months. Samples last tested to be retained until further tests are made. The type tests are as follows:

(1) Test by dropping, filled with dry, finely powdered material to the authorized gross weight, from height of 4 feet onto solid concrete so as to strike diagonally on top chime, or when without chime seam, to strike on other circumferential seam; also additional drop test on any other parts which might be considered weaker than the chime. Closing devices and other parts projecting beyond chime or rolling hoops must also be capable of withstanding this test.

(2) Hydrostatic pressure test of 15 pounds per square inch sustained for 5 minutes. Leakage through closure shall not constitute failure.

§ 78.101-12 Leakage test.

(a) Each container shall be tested, with seams under water or covered with

soapsuds or heavy oil, by interior air pressure of at least 7 pounds per square inch. Equally efficient means of testing are authorized upon demonstration and proof of satisfactory tests to representative of Bureau of Explosives. Leakers shall be rejected or repaired and re-tested. Removable head containers not required to be tested with heads in place except that samples taken at random and closed as for use, of each type and size, must be tested at start of production and repeated every four months.

Samples so tested must be retained until further tests are made.

§ 78.102 Specification 6D; cylindrical steel overpack, straight sided, for inside plastic container.

§ 78.102-1 Material requirements.

(a) Sheets for body and heads to be low carbon, open hearth or electric steel.

§ 78.102-2 Construction requirements.

(a) Construction requirements are as follows:

Rated capacity of inside plastic container not over (gallons)	Minimum thickness, uncoated sheets (gauge)		Body seams	Rolling hoops	Top or bottom head	Closures, when full removable head is used (gaskets not required)
	Body sheet	Head sheet				
5.....	24	24	Welded.....	None required.....	Double seamed or welded.....	Lug or plain ring seal.
15.....	20	20	do.....	Rolled or swaged.....	do.....	Do.
30.....	19	19	do.....	do.....	do.....	Bolted type ring closure, 18 gauge.
55.....	18	18	do.....	Rolled or swaged, or I-Bars, 3/4" x 1 1/4".....	do.....	Bolted type ring closure, 16 gauge.

(b) Steel sheets or parts of specified gauges shall comply with the following:

Gauge No.	Nominal thickness (inch) ¹	Minimum thickness (inch) ¹
16.....	0.0598	0.0533
18.....	.0478	.0428
19.....	.0418	.0378
20.....	.0359	.0324
24.....	.0239	.0209

¹ Thickness shall be measured at any point on the sheet not less than 1/4 inch from an edge.

(c) Two holes not exceeding 1/4 inch each are permitted diametrically opposite each other in the overpack body immediately above the double seam of the bottom chime or three holes not exceeding 3/16 inch in diameter on centers 120 degrees apart in the bottom head.

(1) Overpack interior shall be free of projections, burrs, or any edges that might cause damage to inside plastic container and shall be free of lubricants, oils, or any foreign matter.

(2) Top head may have not more than two holes of suitable size to provide for protruding closures.

(3) Overpack shall be constructed to provide a snug fit for inside plastic container.

§ 78.102-3 Tests.

(a) Steel overpack when assembled as for use, shall withstand the tests prescribed in specifications for inside plastic containers as detailed in Part 78 when authorized as combination packages in Part 73 of this chapter. The completed package must withstand these tests without producing a condition of the overpack that could result in potential damage to the inside container.

§ 78.102-4 Markings.

(a) Marking on each container by embossing on bottom head with raised marks with letters and figures not less than 1/2 inch high as follows:

(1) ICC-6D. These marks shall be understood to certify the steel container complies with all construction requirements of this specification.

(2) Name or symbol (letters) of maker; this must be recorded with the Bureau of Explosives.

(3) Gauge of metal in thinnest part, rated capacity of inside container in gallons, and year of manufacture (for example, 18-55-62). When gauge of metal in body differs from that in either head, both must be indicated with slanting line between and with gauge of body indicated first (for example, 18/16-55-62 for body 18 gauge and head 16 gauge).

§ 78.107 Specification 42B; aluminum drums.

§ 78.107-1 Compliance.

(a) Required in all details.

§ 78.107-2 Rated capacity.

(a) Rated capacity as marked, see § 78.107-9(a)(3). Not less than 5 gallons; actual capacity shall be rated capacity plus at least 2 percent.

§ 78.107-3 Composition.

(a) Body and heads of aluminum at least 99 percent pure, or an aluminum

base alloy of equivalent corrosion resistance and physical properties.

§ 78.107-4 Outage.

(a) Two percent of rated capacity, plus a maximum tolerance of 1 quart.

§ 78.107-5 Seams.

(a) Welded, including attachment of flanges for closures and other devices. Circumferential seams at least 3" from top of chime; chime seams not permitted.

§ 78.107-6 Parts and dimensions.

(a) Parts and dimensions as follows:

Marked capacity not over (gallons)	Minimum thickness of material (inch)	Rolling hoops required, type authorized, and minimum dimensions	
		I-bar, size (inch)	U-type, aluminum, thickness (inch)
10	0.110	3/4 x 1 1/4	0.130
30	.164	3/4 x 1 1/4	.193
55	.187	3/4 x 1 1/4	.234
110	.230	1 x 1 1/2	-----

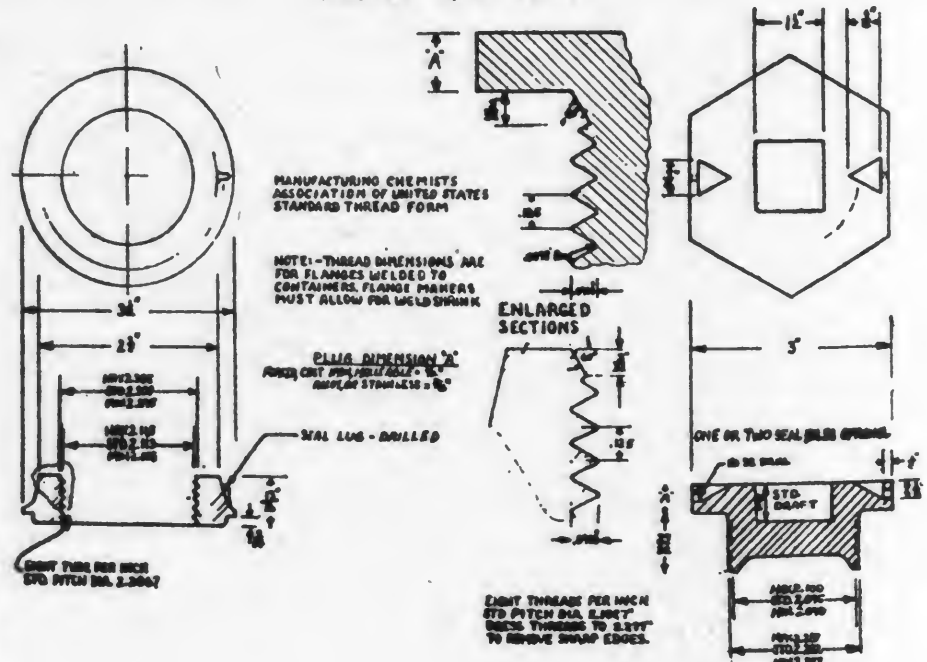
(b) Rolling hoops must be firmly secured in place and not over 19 inches apart; beading under hoops not permitted. If welding is employed, the welding must be continuous on each edge of hoop.

§ 78.107-7 Closures.

(a) Of screw-thread type or secured by screw-thread device; openings over 2.3" not authorized; suitable gaskets required.

(b) Threaded plugs, or caps, and flanges must be close fitting with gasket surfaces which bear squarely on each other when without gasket; they must have not over 8 threads per inch, with 5 complete threads engaged when gasket is in place, or not over 4 threads per inch, with 2 complete threads similarly engaged; two 3/16 inch drainage holes are authorized in flange. Thread form must conform to that shown by drawing below or be of a form that shall provide an equally efficient closure.

FLANGE AND PLUG



§ 78.107-8 Projections.

(a) Closing devices and other parts must not project beyond chime or rolling hoops.

§ 78.107-9 Marking.

(a) Marking on each container on top head by stamping with pressure dies, by embossing with raised marks, or plate attached by welding, as follows:

(1) ICC-42B. This mark shall be understood to certify that the container complies with all specification requirements.

(2) Name or symbol (letters) of maker; this must be registered with the Bureau of Explosives and located just above, below, or following the mark specified in paragraph (a) (1) of this section.

(3) Gauge of metal, Brown and Sharpe or equivalent decimal thickness in inches, at start of fabrication; rated capacity in gallons; year of manufacture (for example, 7-30-50 or 0.1442-30-50).

§ 78.107-10 Size of marking.

(a) Size of marking (minimum): 1/2" high for 30-gallon and smaller containers, 3/4" for over 30 and not over 55 gallons, and 1" for over 55 gallons.

§ 78.107-11 Type tests.

(a) Samples, taken at random and closed as for use, shall withstand prescribed tests without leakage. Tests to be made of each type and size by each company starting production and to be repeated every four months. Samples last tested to be retained until further tests are made. The type tests are as follows:

(1) Test by dropping, filled with water to 98 percent capacity, from height of 6 feet onto solid concrete so as to strike diagonally on chime, or when without chime seam, to strike on other circumferential seam; also additional test on any other parts which might be considered weaker than the chime.

(2) Hydrostatic pressure test of 60 pounds per square inch sustained for 5 minutes.

§ 78.107-12 Leakage test.

(a) Each container shall be tested, with seams under water or covered with soapsuds or heavy oil, by interior air pressure of at least 15 pounds per square inch. Equally efficient means of testing are authorized upon demonstration and proof of satisfactory tests to representative of Bureau of Explosives. Leakers shall be rejected or repaired and retested.

§ 78.107-13 Defective containers.

(a) Leaks and other defects shall be repaired by welding, using welding material of the same composition as originally used by the manufacturer of the drum or other approved aluminum base alloy of equal corrosion and strength qualities.

§ 78.108 Specification 42C; aluminum barrels or drums.

§ 78.108-1 Compliance.

(a) Required in all details.

§ 78.108-2 Rated capacity.

(a) Rated capacity as marked, see § 78.108-9(a)(3). Not less than 5 gallons; actual capacity shall be rated capacity plus at least 2 percent.

§ 78.108-3 Composition.

(a) Body and heads of aluminum at least 99 percent pure, or an aluminum base alloy of equivalent corrosion resistance and physical properties.

§ 78.108-4 Outage.

(a) Two percent of rated capacity, plus a maximum tolerance of 1 quart.

§ 78.108-5 Seams.

(a) Welded, including attachment of flanges for closures and other devices. Circumferential seams at least 3" from top of chime; chime seams not permitted.

§ 78.108-6 Parts and dimensions.

(a) Parts and dimensions as follows:

Marked capacity not over (gallons)	Type of container	Minimum thickness of material (inch)	Rolling hoops required, type authorized, and minimum dimensions	
			I-bar, size (inches)	U-type, aluminum, thickness (inch)
10.....	Straight side.	0.093	1/2 x 1 1/4	0.116
30.....	do.....	.129	3/4 x 1 1/4	.161
55.....	do.....	.155	3/4 x 1 1/2	.194
110.....	do.....	.192	1 x 1 1/2	
15.....	Bilge...	.110	Expanded from shell. ¹	
30.....	do.....	.150	Do.	
55.....	do.....	.180	Do.	

¹ Only required when side openings are used

(b) Rolling hoops must be firmly secured in place and not over 19 inches apart; beading under hoops not permitted. If welding is employed, the welding must be continuous on each edge of hoop.

§ 78.108-7 Closures.

(a) Of screw-thread type or secured by screw-thread device; openings over 2.3" not authorized; suitable gaskets required.

(b) Threaded plugs, or caps, and flanges must be close fitting with gasket surfaces which bear squarely on each other when without gasket; they must have not over 8 threads per inch, with 5 complete threads engaged when gasket is in place, or not over 4 threads per inch, with 2 complete threads similarly engaged; two 5/16 inch drainage holes are authorized in flange. Thread form must conform to that shown by drawing in paragraph (b) of § 78.107-7 or be of a form that shall provide an equally efficient closure.

§ 78.108-8 Projections.

(a) Closing devices and other parts must not project beyond chime or rolling hoops.

§ 78.108-9 Marking.

(a) Marking on each container on top head, by stamping with pressure dies, by embossing with raised marks, or plate attached by welding, as follows:

(1) ICC-42C. This mark shall be understood to certify that the container complies with all specification requirements.

(2) Name or symbol (letters) of maker; this must be registered with the Bureau of Explosives and located just above, below, or following the mark specified in subparagraph (1) of this paragraph.

(3) Gauge of metal, Brown and Sharpe or equivalent decimal thickness in inches, at start of fabrication; rated capacity in gallons; year of manufacture (for example, 7-30-50 or 0.1442-30-50).

§ 78.108-10 Size of marking.

(a) Size of marking (minimum): 1/2" high for 30-gallon and smaller containers, 3/4" for over 30 and not over 55 gallons, and 1" for over 55 gallons.

§ 78.108-11 Type tests.

(a) Samples, taken at random and closed as for use, shall withstand prescribed tests without leakage. Tests to be made of each type and size by each company starting production and to be repeated every four months. Samples last tested to be retained until further tests are made. The type tests are as follows:

(1) Test by dropping, filled with water to 98 percent capacity, from height of 6 feet onto solid concrete so as to strike diagonally on chime, or when without chime seam, to strike on other circumferential seam; also additional test on any other parts which might be considered weaker than the chime.

(2) Hydrostatic pressure test of 60 pounds per square inch sustained for 5 minutes.

§ 78.108-12 Leakage test.

(a) Each container shall be tested, with seams under water or covered with soapsuds or heavy oil, by interior air pressure of at least 15 pounds per square inch. Equally efficient means of testing are authorized upon demonstration and proof of satisfactory tests to representative of Bureau of Explosives. Leakers shall be rejected or repaired and retested.

§ 78.108-13 Defective containers.

(a) Leaks and other defects shall be repaired by welding, using welding material of the same composition as originally used by the manufacturer of the drum or other approved aluminum base alloy of equal corrosion and strength qualities.

§ 78.109 Specification 42D; aluminum drums.

§ 78.109-1 Compliance.

(a) Required in all details.

§ 78.109-2 Rated capacity.

(a) Rated capacity as marked, see § 78.109-9(a)(3). Not less than 5 gallons; actual capacity shall be rated capacity plus at least 2 percent.

§ 78.109-3 Composition.

(a) Body and heads of aluminum at least 99 percent pure, or an aluminum

base alloy of equivalent corrosion resistance and physical properties.

§ 78.109-4 Outage.

(a) Two percent of rated capacity, plus a maximum tolerance of 1 quart.

§ 78.109-5 Seams.

(a) Welded, including attachment of flanges for closures and other devices. Circumferential seams at least 3" from top of chime; chime seams not permitted.

§ 78.109-6 Parts and dimensions.

(a) Parts and dimensions as follows:

Marked capacity not over (gallons)	Minimum thickness of material (inch)	Rolling hoops required, type authorized, and dimensions	
		I-bar, size (inch)	U-type, aluminum, thickness (inch)
10	0.093	3/4 x 1 1/4	0.092
30	.102	3/4 x 1 1/4	.128
55	.123	3/4 x 1 1/4	.184
110	.154	1 x 1 1/2	-----

(b) Rolling hoops must be firmly secured in place and not over 19 inches apart; beading under hoops not permitted. If welding is employed, the welding must be continuous on each edge of hoop.

§ 78.109-7 Closures.

(a) Of screw-thread type or secured by screw-thread device; openings over 2.3" not authorized; suitable gaskets required. Vented closing devices of type approved by the Bureau of Explosives are authorized when specified by the purchaser.

(b) Threaded plugs, or caps, and flanges must be close fitting with gasket surfaces which bear squarely on each other when without gasket; they must have not over 8 threads per inch, with 5 complete threads engaged when gasket is in place, or not over 4 threads per inch, with 2 complete threads similarly engaged; two 1/8 inch drainage holes are authorized in flange. Thread form must conform to that shown by drawing in paragraph (b) of § 78.107-7 or be of a form that shall provide an equally efficient closure.

§ 78.109-8 Projections.

(a) Closing devices and other parts must not project beyond chime or rolling hoops.

§ 78.109-9 Marking.

(a) Marking on each container on top head, by stamping with pressure dies, by embossing with raised marks, or plate attached by welding, as follows:

(1) ICC-42D. This mark shall be understood to certify that the container complies with all specification requirements.

(2) Name or symbol (letters) of maker; this must be registered with the Bureau of Explosives and located just above, below, or following the mark specified in paragraph (a) (1) of this section.

(3) Gauge of metal, Brown and Sharpe or equivalent decimal thickness in inches, at start of fabrication; rated capacity in gallons; year of manufacture (for example, 7-30-50 or 0.1442-30-50).

§ 78.109-10 Size of marking.

(a) Size of marking (minimum): 1/2" high for 30-gallon and smaller containers, 3/4" for over 30 and not over 55 gallons, and 1" for over 55 gallons.

§ 78.109-11 Type tests.

(a) Samples, taken at random and closed as for use, shall withstand prescribed tests without leakage. Tests to be made of each type and size by each company starting production and to be repeated every four months. Samples last tested to be retained until further tests are made. The type tests are as follows:

(1) Test by dropping, filled with water to 98 percent capacity, from height of 4 feet onto solid concrete so as to strike diagonally on chime, or when without chime seam, to strike on other circumferential seam; also additional test on any other parts which might be considered weaker than the chime.

(2) Hydrostatic pressure test of 40 pounds per square inch sustained for 5 minutes.

§ 78.109-12 Leakage test.

(a) Each container shall be tested, with seams under water or covered with soapsuds or heavy oil, by interior air pressure of at least 10 pounds per square inch. Equally efficient means of testing are authorized upon demonstration and proof of satisfactory tests to representative of Bureau of Explosives. Leakers

Marked capacity not over (gallons)	Authorized gross weight not over (pounds)	Type of container	Minimum thickness of material (inch)		Rolling hoops
			Body	Head	
50	450	Bilge	0.091	0.102	None

§ 78.110-6 Closures.

(a) Adequate to prevent leakage; gaskets required.

(b) Closures must be of bolted ring type made of not less than 10 gauge carbon steel with drop forged threaded lugs and 5/8" minimum diameter cap screw.

§ 78.110-7 Defective containers.

(a) Leaks and other defects shall be repaired by welding, using welding material of same composition as parts being repaired.

§ 78.110-8 Marking.

(a) Marking on each container by embossing on head, except that such embossment must be on the permanent head for drums having removable heads, with raised marks, or by embossing or die stamping on footing on drums equipped with footings, or on metal plates securely attached to drum by brazing or welding not less than 20 percent of the perimeter, as follows:

(1) ICC-42F * * * ; stars to be replaced by the authorized gross weight (for example, ICC-42F450, etc.). This mark shall be understood to certify that the container complies with all specification requirements.

(2) Name or symbol (letters) of maker; this must be recorded with the Bureau of Explosives.

shall be rejected or repaired and re-tested.

§ 78.109-13 Defective containers.

(a) Leaks and other defects shall be repaired by welding, using welding material of the same composition as originally used by the manufacturer of the drum or other approved aluminum base alloy of equal corrosion and strength qualities.

§ 78.110 Specification 42F; aluminum barrels or drums.

Removable heads.

§ 78.110-1 Compliance.

(a) Required in all details.

§ 78.110-2 Rated capacity.

(a) Rated capacity as marked, see § 78.110-8 (a) (3). Actual capacity shall be not less than rated capacity, nor greater than rated capacity plus 2 percent plus 1 gallon.

§ 78.110-3 Composition.

(a) Body and heads of aluminum alloy 6061 or an aluminum base alloy of equivalent corrosion resistance and physical properties.

§ 78.110-4 Seams.

(a) None. Body shall be seamless.

§ 78.110-5 Parts and dimensions.

(a) Parts and dimensions as follows:

(3) Gauge of metal, Brown and Sharpe or equivalent decimal thickness in inches in thinnest part; rated capacity in gallons; and year of manufacture (for example, 11-50-52 or 0.0907-50-52). When gauge of metal in body differs from that in head, both must be indicated with slanting line between and with gauge of body indicated first (for example, 11/10-50-52 or 0.0907/0.1018-50-52 for body 11-gauge and head 10-gauge).

§ 78.110-9 Size of markings.

(a) Size of markings (minimum): 1/2" high for 33 gallons or less, 3/4" for over 33 gallons.

§ 78.110-10 Type tests.

(a) Samples, taken at random and closed as for use, shall withstand prescribed tests without leakage. Tests to be made of each type and size by each company starting production and to be repeated every 4 months. Samples last tested to be retained until further tests are made. The type tests are as follows:

(1) Test by dropping, filled with dry, finely powdered material to the authorized gross weight, from height of 4 feet onto solid concrete so as to strike diagonally on top chime, or when without chime seam to strike on other circumferential seam; also an additional drop test on any other parts which might be

considered weaker than the chime. Closing devices and other parts projecting beyond chime must also be capable of withstanding this test.

(2) Hydrostatic pressure test of 30 pounds per square inch sustained for 5 minutes. Leakage through closure shall not constitute failure.

§ 78.110-11 Leakage test.

(a) Each container shall be tested under water or covered with soapsuds or heavy oil, by interior air pressure of at least 15 pounds per square inch. Equally efficient means of testing are authorized upon demonstration and proof of satisfactory tests to representatives of Bureau of Explosives. Leakers shall be rejected or repaired and retested. Containers not required to be tested with heads in place, except that samples taken at random and closed as for use of each type and size, must be tested at start of production and repeated every 4 months. Samples so tested must be retained until further tests are made.

§ 78.111 Specification 42G; aluminum drums.

§ 78.111-1 Compliance.

(a) Required in all details.

§ 78.111-2 Rated capacity.

(a) Rated capacity as marked, see § 78.111-8(a)(3), 55 gallons; actual capacity shall be rated capacity plus at least 2 percent.

§ 78.111-3 Composition.

(a) Body and heads or drawn shells of aluminum alloy 5052, or an aluminum base alloy of equivalent corrosion resistance and physical properties.

§ 78.111-4 Outage.

(a) Two percent of rated capacity, plus a maximum tolerance of 2 quarts.

§ 78.111-5 Seams.

(a) Welded, including attachment of flanges for closures and other devices. Circumferential seam at least 3 inches from top of chime; chime seams not permitted.

§ 78.111-6 Parts and dimensions.

(a) At start of fabrication, aluminum alloy sheets shall have a minimum thickness of 0.102 inch and completed container shall have no wall thickness less than 0.081 inch.

(b) Rolled or swedged-in rolling hoops required.

(c) Footrings of suitable strength required and must be continuously welded around the outside periphery to the drum shell.

§ 78.111-7 Closures.

(a) Of screw-thread type or secured by screw-thread device; openings over 2.3 inches not authorized; suitable gaskets required.

(b) Threaded plugs, or caps, and flanges must be close fitting with gasket surfaces which bear squarely on each other when without gasket; they must have not over 12 threads per inch, with at least 3 threads engaged when gasket is in place; two $\frac{1}{8}$ -inch drainage holes are authorized in flange.

§ 78.111-8 Marking.

(a) Marking on each container on top head, by stamping with pressure dies, by embossing with raised marks, or plate attached by welding, as follows:

(1) ICC-42G. This mark shall be understood to certify that the container complies with all specification requirements.

(2) Name or symbol (letters) of maker; this must be registered with the Bureau of Explosives and located just above, below, or following the mark specified in subparagraph (1) of this paragraph.

(3) Gauge of metal, Brown and Sharpe or equivalent decimal thickness in inches, at start of fabrication; rated capacity in gallons; year of manufacture (for example, 7-30-50 or 0.1442-30-50).

§ 78.111-9 Size of marking.

(a) Size of marking (minimum): $\frac{3}{4}$ -inch high.

§ 78.111-10 Type tests.

(a) Samples, taken at random and closed as for use, shall withstand prescribed tests without leakage. Tests to be made of each type and size by each company starting production and to be repeated every four months. Samples last tested to be retained until further tests are made. The type tests are as follows:

(1) Test by dropping, filled with water to 98 percent capacity, from height of 4 feet onto solid concrete so as to strike diagonally on chime, or when without chime seam, to strike on other circumferential seam; also additional tests on any other parts which might be considered weaker than the chime.

(2) Hydrostatic pressure test of 40 pounds per square inch sustained for 5 minutes.

§ 78.111-11 Leakage test.

(a) Each container shall be tested, unsupported, with seams under water or covered with soapsuds or heavy oil, by interior air pressure of at least 15 pounds per square inch. Leaking or damaged drums shall be rejected or repaired and retested.

§ 78.111-12 Defective containers.

(a) Leaks and other defects shall be repaired by welding, using welding material of the same composition as originally used by the manufacturer of the drum or other approved aluminum base alloy of equal corrosion and strength qualities.

§ 78.112 Specification 42H; aluminum drums; removable head containers not authorized.

§ 78.112-1 Compliance.

(a) Required in all details.

§ 78.112-2 Rated capacity.

(a) Rated capacity as marked shall be 55 gallons, see § 78.112-10(a)(3). Minimum actual capacity of containers shall be not less than rated (marked) capacity plus 4 percent. Maximum actual capacity shall not be greater than rated (marked) capacity plus 5 percent.

§ 78.112-3 Composition.

(a) Body and heads shall be of aluminum alloy 5086-H32 or an aluminum base alloy of equivalent corrosion resistance and physical properties.

§ 78.112-4 Seams.

(a) Body seams welded.

(b) Head and chime seams welded or double-seamed.

§ 78.112-5 Chime reinforcement.

(a) Chime reinforcement required and shall be not less than 12-gauge galvanized steel commercial coating.

§ 78.112-6 Parts and dimensions.

(a) At start of fabrication, aluminum alloy sheets shall have a minimum thickness of 0.063 inch and completed container shall have no wall thickness less than 0.059 inch.

(b) Rolled or swedged-in rolling hoops required.

(c) Drum shall be of straight side type.

§ 78.112-7 Convex heads.

(a) Convex (crowned) heads, not extending beyond level of chime; minimum convexity of three-eighths inch required.

§ 78.112-8 Defective containers.

(a) Leaks and other defects shall be repaired by welding, using welding material of the same composition as originally used by the manufacturer of the drum or other approved aluminum base alloy of equal corrosion and strength qualities.

§ 78.112-9 Closures.

(a) Of screw-thread type or secured by screw-thread device; openings over 2.3 inches not authorized; suitable gaskets required.

(b) Threaded plugs, or caps, and flanges must be close fitting with gasket surfaces which bear squarely on each other when without gasket; they must have not over 12 threads per inch, with at least 3 threads engaged when gasket is in place; two five-sixths inch drainage holes are authorized in flange.

§ 78.112-10 Marking.

(a) Marking on each container on head, by stamping with pressure dies, by embossing with raised marks, or plate attached by welding, as follows:

(1) ICC-42H. This mark shall be understood to certify that the container complies with all specification requirements.

(2) Name or symbol (letters) of maker; this must be registered with the Bureau of Explosives and located just above, below, or following the mark specified in subparagraph (1) of this paragraph.

(3) Gauge of metal, decimal thickness in inches, at start of fabrication; rated capacity in gallons; year of manufacture (for example, 0.063-55-63).

§ 78.112-11 Size of marking.

(a) Size of marking (minimum): three-fourths inch high.

§ 78.112-12 Type tests.

(a) Samples, taken at random and closed as for use, shall withstand prescribed tests without leakage. Tests to

be made of each type and size by each company starting production and to be repeated every four months. Samples last tested to be retained until further tests are made or for one year, whichever period is shorter. The type tests are as follows:

(1) Test by dropping, filled with water to 98 percent capacity, from height of 4 feet onto solid concrete so as to strike diagonally on chime, or when without chime seam, to strike on other circumferential seam; also additional tests on any other parts which might be considered weaker than the chime.

(2) Hydrostatic pressure test of 40 pounds per square inch sustained for 5 minutes.

§ 78.112-13 Leakage test.

(a) Each container shall be tested, unsupported, with seams under water or covered with soapsuds or heavy oil, by interior air pressure of at least 15 pounds per square inch. Leaking or damaged drums shall be rejected or repaired and retested.

§ 78.115 Specification 17C; steel drums.

Single trip container. Removable head containers which will pass all required tests are authorized.

§ 78.115-1 Compliance.

(a) Required in all details.

§ 78.115-2 Rated capacity.

(a) Rated capacity as marked, see § 78.115-10(a)(3). Minimum actual capacity of containers shall be not less than rated (marked) capacity plus 4 percent. Maximum actual capacity shall not be greater than rated (marked) capacity plus 5 percent or rated (marked) capacity plus 4 percent plus 1 quart whichever is the greater.

§ 78.115-3 Composition.

(a) Sheets for body and heads to be low carbon, open hearth or electric steel.

§ 78.115-5 Seams.

(a) Body seams welded.

§ 78.115-6 Parts and dimensions.

(a) Parts and dimensions as follows:

Marked capacity not over (gallons)	Type of container	Minimum thickness, uncoated sheets (gauge)		Rolling hoops		
		Body sheet	Head sheet	Type	Minimum	
					Size (gauge or inch)	Weight (pounds per foot)
5 ¹	Straight side	24	24	None		
10	do	20	20	do		
30	do	18	18	(1)		
55	do	16	16	(1, 2)		

¹ Rolled or swaged in hoops.
² Each removable head drum body must have three rolled or swaged-in hoops with the centerline of one not more than 3 inches from the top curl.
³ A drum of 5 1/4 gallons marked capacity is authorized for shipment of the commodity specified in § 73.353 (d) of this chapter

(b) Steel sheets of specified gauges shall comply with the following:

Gauge No.	Nominal thickness ¹ (inch)	Minimum thickness ¹ (inch)
16	0.0508	0.0533
18	.0478	.0428
20	.0350	.0324
24	.0230	.0200

¹ Thickness shall be measured at any point on the sheet not less than 3/8 inch from an edge.

§ 78.115-7 Convex heads.

(a) Convex (crowned) heads, not extending beyond level of chime, required for drums of 25 gallons capacity or over; minimum convexity of 3/8 inch required.

§ 78.115-8 Closures.

(a) Adequate to prevent leakage; gaskets required.

(b) Closing part (plug, cap, plate, etc., see Note 1) must be of metal as thick as prescribed for head of container; this not required for containers of 12 gallons or less when the opening to be closed is not over 2.7 inches in diameter. If unthreaded cap is used it must be provided with outside sealing devices which cannot be removed without destroying the cap or sealing device.

NOTE 1: This does not apply to cap seal over a closure which complies with all requirements.

(c) For closure with threaded plug or cap, the seat (flange, etc.) for plug, or cap, must have 3 or more complete threads; two drainage holes of not over 1/4 inch diameter are allowed. Plug, or cap, must have sufficient length of thread to engage 3 threads when screwed home with gasket in place. Threaded closures having fewer threads are authorized for containers having a capacity of 12 gallons or less when such closures are approved by the Bureau of Explosives upon proof of satisfactory tests.

(d) Full removable head drums over 5 gallons capacity must be closed by means of 12 gauge bolted ring with drop forged lugs, one of which is threaded, and having 3/8 inch bolt and nut for drums not over 30 gallons capacity and 5/8 inch bolt and nut for drums over 30 gallons capacity. Five gallon drums must be of lug type closure with cover having at least 16 lugs. Equally efficient types of closures are authorized upon demonstration and proof of satisfactory tests to representative of Bureau of Explosives.

§ 78.115-9 Defective containers.

(a) Leaks and other defects to be repaired by method used in constructing container, not by soldering.

§ 78.115-10 Marking.

(a) Marking on each container by embossing on head except that such embossment must be on the permanent

head for drums having removable heads, with raised marks, or by embossing or die stamping on footing on drums equipped with footings, or on metal plates securely attached to drum by brazing or welding not less than 20 percent of the perimeter, as follows:

(1) ICC-17C. The letters STC; located near the ICC mark to indicate "single-trip container." In addition, when the container is of stainless steel, the type of steel used in body and head sheets as identified by American Iron and Steel Institute type number, and also the letters HT following steel designation on containers subjected to stress-relieving or heat-treatment during manufacture (for example, ICC-17C-304 or ICC-17C-304 HT as applicable) shall be shown. These marks shall be understood to certify that the container complies with all specification requirements.

(2) Name or symbol (letters) of maker or other party assuming responsibility for compliance with specification requirements; this must be recorded with the Bureau of Explosives.

(3) Gauge of metal in thinnest part, rated capacity in gallons, and year of manufacture (for example, 14-55-50). When gauge of metal in body differs from that in head, both must be indicated with slanting line between and with gauge of body indicated first (for example 14/12-55-50 for body 14 gauge and head 12 gauge).

§ 78.115-11 Size of markings.

(a) Size of markings (minimum): 1/2" high for 33 gallons or less, 3/4" for over 33 and not over 55 gallons.

§ 78.115-12 Type tests.

(a) Samples taken at random and closed as for use, shall withstand prescribed tests without leakage. Tests to be made of each type and size by each company starting production and to be repeated every four months. Samples last tested to be retained until further tests are made. The type tests are as follows:

(1) Test by dropping, filled with water to 98 percent capacity, from height of 4 feet onto solid concrete so as to strike diagonally on chime, or when without chime seam, to strike on other circumferential seam; also additional drop test on any other parts which might be considered weaker than the chime. Closing devices and other parts projecting beyond chime or rolling hoops must also be capable of withstanding this test.

(2) Hydrostatic pressure test of 40 pounds per square inch sustained for 5 minutes; except that full removable head drums must sustain 20 pounds per square inch.

§ 78.115-13 Leakage test.

(a) Each container shall be tested, with seams under water or covered with soapsuds or heavy oil, by interior air pressure of at least 15 pounds per square inch. Equally efficient means of testing are authorized upon demonstration and proof of satisfactory tests to representatives of Bureau of Explosives. Leakers shall be rejected or repaired and retested. Removable head containers not required

to be tested with heads in place except that samples taken at random and closed as for use, of each type and size, must be tested at start of production and repeated every four months. Samples so tested must be retained until further tests are made.

§ 78.116 Specification 17E; steel drums.

Single trip container. Removable head containers not authorized.

§ 78.116-1 Compliance.

(a) Required in all details.

§ 78.116-2 Rated capacity.

(a) Rated capacity as marked, see § 78.116-10(a)(3). Minimum actual

capacity of containers shall be not less than rated (marked) capacity plus 4 percent. Maximum actual capacity shall not be greater than rated (marked) capacity plus 5 percent or rated (marked) capacity plus 4 percent plus 1 quart whichever is the greater.

§ 78.116-3 Composition.

(a) Sheets for body and heads to be low carbon, open hearth or electric steel.

§ 78.116-5 Seams.

(a) Body seams welded.

§ 78.116-6 Parts and dimensions.

(a) Parts and dimensions as follows:

Marked capacity not over (gallons)	Type of container	Minimum thickness, uncoated sheets (gauge)		Rolling hoops		
		Body sheet	Head sheet	Type	Minimum	
					Size (gauge or inch)	Weight (pounds per foot)
8	Straight side	24	24	None		
10	do.	22	22	do.		
20	do.	19	19	(1)		
33	do.	18	18	(1)		

¹ Rolled or swedged in hoops.
² 20 gauge authorized.

(b) Steel sheets of specified gauges shall comply with the following:

Gauge No.	Nominal thickness ¹ (inch)	Minimum thickness ¹ (inch)
18	0.0478	0.0428
19	.0418	.0378
20	.0359	.0324
22	.0299	.0269
24	.0239	.0209

¹ Thickness shall be measured at any point on the sheet not less than 3/4 inch from an edge.

§ 78.116-7 Convex heads.

(a) Convex (crowned) heads, not extending beyond level of chime, required for drums of 25 gallons capacity or over. Convexity to be minimum of 3/8".

§ 78.116-8 Closures.

(a) Adequate to prevent leakage; gaskets required.

(b) Closing part (plug, cap, plate, etc., see Note 1) must be of metal as thick as prescribed for head of container: *Provided*, That thinner metal closures or closures of other material are authorized for containers of 12 gallons capacity or less when opening to be closed is not over 2.7 inches in diameter and closures, except threaded metal closures, are fitted with outside sealing devices which cannot be removed without destroying the closure or sealing device (see paragraph (d) of this section).

NOTE 1: This does not apply to cap seal over a closure which complies with all requirements.

(c) For closure with threaded plug or cap, the seat (flange, etc.) for plug, or cap, must have 3 or more threads; two drainage holes of not over 1/16 inch diameter are allowed. Plug, or cap, must have sufficient length of thread to engage 3 threads when screwed home with gas-

ket in place: *Provided*, That for containers having a capacity of 12 gallons and less the seat (flange, etc.) for plug, or cap, must have two or more complete threads and plug, or cap, must have sufficient length of thread to engage two threads when screwed home with gasket in place.

(d) Closures of screw-thread type or closed by positive means, of any material or design, may be authorized by the Bureau of Explosives for use, upon satisfactory proof of efficiency.

§ 78.116-9 Defective containers.

(a) Leaks and other defects to be repaired by method used in constructing container, not by soldering.

§ 78.116-10 Marking.

(a) Marking on each container by embossing on head with raised marks, or by embossing or die stamping on footing on drums equipped with foot-rings, or on metal plates securely attached to drum by brazing or welding not less than 20 percent of the perimeter as follows:

(1) ICC-17E. The letters STC; located near the ICC mark to indicate "single-trip container." In addition, when the container is of stainless steel, the type of steel used in body and head sheets as identified by American Iron and Steel Institute type number, and also the letters HT following steel designation on containers subjected to stress-relieving or heat-treatment during manufacture (for example, ICC-17E-304 or ICC-17E-304 HT as applicable) shall be shown. These marks shall be understood to certify that the container complies with all specification requirements.

(2) Name or symbol (letters) of maker or other party assuming responsibility for compliance with specification re-

quirements; this must be recorded with the Bureau of Explosives.

(3) Gauge of metal in thinnest part, rated capacity in gallons, and year of manufacture (for example, 12-55-50). When gauge of metal in body differs from that in head, both must be indicated with slanting line between and with gauge of body indicated first (for example 14/12-55-50 for body 14 gauge and head 12 gauge).

§ 78.116-11 Size of markings.

(a) Size of markings (minimum): 1/2" high for 33-gallon or less, 3/4" for over 33 and not over 55 gallons.

§ 78.116-12 Type tests.

(a) Samples taken at random closed as for use, shall withstand prescribed tests without leakage. Tests to be made of each type and size by each company starting production and to be repeated every four months. Samples last tested to be retained until further tests are made. The type tests are as follows:

(1) Test by dropping, filled with water to 98 percent capacity, from height of 4 feet onto solid concrete so as to strike diagonally on chime, or when without chime seam, to strike on other circumferential seam; also additional drop test on any other parts which might be considered weaker than the chime. Closing devices and other parts projecting beyond chime or rolling hoops must also be capable of withstanding this test.

(2) Hydrostatic pressure test of 15 pounds per square inch sustained for 5 minutes.

§ 78.116-13 Leakage test.

(a) Each container shall be tested, with seams under water or covered with soapsuds or heavy oil, by interior air pressure of at least 7 pounds per square inch for containers over 12 gallons capacity and at least 5 pounds for others. Equally efficient means of testing are authorized upon demonstration and proof of satisfactory tests to representative of Bureau of Explosives. Leakers shall be rejected or repaired and retested.

§ 78.117 Specification 17F; steel drums.

Single trip container. Removable head containers not authorized.

§ 78.117-1 Compliance.

(a) Required in all details.

§ 78.117-2 Rated capacity.

(a) Rated capacity as marked, see § 78.117-11(a)(3). Actual capacity of containers shall be not less than rated (marked) capacity plus 2 percent, nor greater than rated capacity plus 2 percent plus 1 quart, except that for containers over 30 gallons marked capacity actual capacity shall be not less than rated capacity plus 2 percent, nor greater than rated capacity plus 2 percent plus 2 quarts.

§ 78.117-3 Composition.

(a) Sheets for body and heads to be low carbon, open hearth or electric steel. Steel to be as high as practicable in tensile strength, having no loose oxide or scale.

§ 78.117-5 Seams.

- (a) Body seams welded.
- (b) Head and chime seams welded or double-seamed.
- (c) Flanges for closures welded in place.

§ 78.117-6 Chime reinforcement.

- (a) Chime reinforcement required to be not less than 12 gauge (see § 78.117-7 (b)).

§ 78.117-7 Parts and dimensions.

- (a) Parts and dimensions as follows:

Marked capacity not over (gallons)	Type of container	Minimum thickness, uncoated sheets (gauge)		Rolling hoops		
		Body sheet	Head sheet	Type	Minimum	
					Size	Weight
55.....	Straight side.....	16	16	(1)	-----	-----

¹ Rolled or swedged-in hoops. Use of I-bar hoops authorized.

(b) Steel sheets of specified gauges shall comply with the following:

Gauge No.	Nominal thickness ¹ (inch)	Minimum thickness ¹ (inch)
12.....	0.1046	0.0946
16.....	.0698	.0533

¹ Thickness shall be measured at any point on the sheet not less than 1/4 inch from an edge.

§ 78.117-11 Marking.

(a) Marking on each container by embossing on head with raised marks, or by embossing or die stamping on footing on drums equipped with footings, or on metal plates securely attached to drum by brazing or welding not less than 20 percent of the perimeter as follows:

- (1) ICC-17F. The letters STC; located near the ICC mark to indicate "single-trip container." In addition, when the container is of stainless steel, the type of steel used in body and head sheets as identified by American Iron and Steel Institute type number, and also the letters HT following steel designation on containers subjected to stress-relieving or heat-treatment during manufacture (for example, ICC-17F-304 or ICC-17F-304 HT as applicable) shall be shown. These marks shall be understood to certify that the container complies with all specification requirements.
- (2) Name or symbol (letters) of maker or other party assuming responsibility for compliance with specification requirements; this must be recorded with the Bureau of Explosives.
- (3) Gauge of metal in thinnest part, rated capacity in gallons, and year of manufacture (for example, 12-55-50).

§ 78.117-12 Size of markings.

(a) Size of markings (minimum): 1/2" high for 33-gallon or less, 3/4" for over 33 and not over 55 gallons.

§ 78.117-13 Type tests.

(a) Samples taken at random and closed as for use, shall withstand pre-

scribed tests without leakage. Tests to be made of each type and size by each company starting production and to be repeated every four months. Samples last tested to be retained until further tests are made. The type tests are as follows:

- (1) Test by dropping, filled with water to 98 percent capacity, from height of 6 feet onto solid concrete so as to strike diagonally on chime, or when without chime seam, to strike on other circumferential seam; also additional drop test on any other parts which might be considered weaker than the chime. Closing devices and other parts projecting beyond chime or rolling hoops must also be capable of withstanding this test.
- (2) Hydrostatic pressure test of 80 pounds per square inch sustained for 5 minutes.

§ 78.117-14 Leakage test.

(a) Each container shall be tested, with seams under water or covered with soapsuds or heavy oil, by interior air pressure of at least 15 pounds per square inch. Equally efficient means of testing are authorized upon demonstration and proof of satisfactory tests to representative of Bureau of Explosives. Leakers shall be rejected or repaired and re-tested.

§ 78.118 Specification 17H; steel drums. Single-trip container. Removable head required.

§ 78.118-1 Compliance.

- (a) Required in all details.

§ 78.118-2 Rated capacity.

(a) Rated capacity as marked, see § 78.118-10(a)(3). Minimum actual capacity of containers shall be not less than rated (marked) capacity plus 4 percent. Maximum actual capacity shall not be greater than rated (marked) capacity plus 5 percent or rated (marked) capacity plus 4 percent plus 1 quart whichever is the greater.

§ 78.118-3 Composition.

(a) Sheets for body and heads to be low carbon, open hearth or electric steel.

§ 78.118-5 Seams.

- (a) Body seams welded.

§ 78.118-6 Parts and dimensions.

- (a) Parts and dimensions as follows:

§ 78.117-8 Rolling hoops and convex heads.

- (a) Rolling hoops to be expanded. Alternate use of I-bar hoops authorized.
- (b) Convex heads. Convex (crowned) heads; minimum convexity to be 3/8 inch, with minimum chime height of 3/8 inch.

§ 78.117-9 Closures.

- (a) Adequate to prevent leakage; gaskets required.
- (b) Closing part (plug, cap, plate, etc., see Note 1) must be of metal as thick as prescribed for head of container; this not required for containers of 12 gallons or less when the opening to be closed is not over 2.3 inches in diameter. If unthreaded cap is used it must be provided with outside sealing devices which cannot be removed without destroying the cap or sealing device.

NOTE 1: This does not apply to cap seal over a closure which complies with all requirements.

(c) Closure must be of screw-thread type or fastened by screw-thread device.

(d) One opening not over 2.3 inches and one opening not over 3/4 inch allowed; both openings to be welded in one head only. Threads to be standard pipe thread of 11 threads per inch for the larger opening and 14 threads per inch for the 3/4-inch opening.

§ 78.117-10 Defective containers.

- (a) Leaks and other defects to be repaired by method used in constructing container, not by soldering.

Marked capacity not over (gallons)	Type of container	Minimum thickness, uncoated sheets (gauge)			Rolling hoops		
		Body sheet	Bottom head sheet	Removable head sheet	Type	Minimum	
						Size (gauge or inch)	Weight (pounds per foot)
5.....	Straight side.....	24	24	20	None	-----	-----
30.....	do.....	18	18	18	(1)	-----	-----
55.....	do.....	18	18	14	(2)	-----	-----

¹ Rolled or swedged in hoops.

² Each drum must have three rolled or swedged in hoops, one to be placed in the body near the top curl.

³ 16 gauge authorized provided there are one or more corrugations in the cover near the periphery.

(b) Steel sheets of specified gauge shall comply with the following:

Gauge No.	Nominal thickness ¹ (inch)	Minimum thickness ¹ (inch)
14.....	0.0747	0.0677
16.....	.0598	.0533
18.....	.0478	.0428
20.....	.0359	.0324
24.....	.0239	.0209

¹ Thickness shall be measured at any point on the sheet not less than 3/4 inch from an edge.

§ 78.118-7 Convex heads.

(a) Convex (crowned) heads, not extending beyond level of chime, required for drums of 25 gallons capacity or over; minimum convexity of 3/8 inch required.

§ 78.118-8 Closures.

(a) Adequate to prevent leakage; gaskets required.

(b) Drums over 5 gallons capacity must be closed by means of 12 gauge bolted ring with drop forged lugs, one of which is threaded, and having 3/8 inch bolt and nut for drums not over 30 gallons capacity and 5/8 inch bolt and nut for drums over 30 gallons capacity. Five gallon drums must be of lug type closure with cover having at least 16 lugs. Equally efficient types of closures are authorized upon demonstration and proof of satisfactory tests to representative of Bureau of Explosives.

(c) For closure with threaded plug or cap, the seat (flange, etc.) for plug, or cap, must have 3 or more threads; two drainage holes of not over 1/16 inch diameter are allowed. Plug, or cap, must have sufficient length of thread to engage 3 threads when screwed home with gasket in place: *Provided*, That for containers having a capacity of 12 gallons and less the seat (flange, etc.) for plug, or cap, must have two or more complete threads and plug, or cap, must have sufficient length of thread to engage two threads when screwed home with gasket in place.

§ 78.118-9 Defective containers.

(a) Leaks and other defects to be repaired by method used in constructing container, not by soldering.

§ 78.118-10 Marking.

(a) Marking on each container by embossing on head, except that such embossment must be on the permanent head for drums having removable heads, with raised marks, or by embossing or die stamping on footing on drums equipped with footings, or on metal plates securely attached to drum by brazing or welding not less than 20 percent of the perimeter, as follows:

(1) ICC-17H. The letters STC; located near the ICC mark to indicate "single-trip container." In addition, when the container is of stainless steel, the type of steel used in body and head sheets as identified by American Iron and Steel Institute type number, and also the letters HT following steel designation on containers subjected to stress-relieving or heat-treatment during manufac-

ture (for example, ICC-17H-304 or ICC-17H-304 HT as applicable) shall be shown. These marks shall be understood to certify that the container complies with all specification requirements.

(2) Name or symbol (letters) of maker or other party assuming responsibility for compliance with specification requirements; this must be recorded with the Bureau of Explosives.

(3) Gauge of metal in thinnest part, rated capacity in gallons, and year of manufacture (for example, 12-55-50). When gauge of metal in body differs from that in head, both must be indicated with slanting line between and with gauge of body indicated first (for example 14/12-55-50 for body 14 gauge and head 12 gauge).

§ 78.118-11 Size of markings.

(a) Size of markings (minimum): 1/2" high for 33-gallon or less, 3/4" for over 33 and not over 55 gallons.

§ 78.118-12 Type tests.

(a) Samples taken at random and closed as for use, shall withstand prescribed tests without leakage. Tests to be made of each type and size by each company starting production and to be repeated every four months. Samples last tested to be retained until further tests are made. The type tests are as follows:

(1) Test by dropping, filled with water to 98 percent capacity, from height of 4 feet onto solid concrete so as to strike diagonally on chime, or when without chime seam, to strike on other circumferential seam; also additional drop test on any other parts which might be considered weaker than the chime. Closing devices and other parts projecting beyond chime or rolling hoops must also be capable of withstanding this test.

(2) Hydrostatic pressure test of 15 pounds per square inch sustained for 5 minutes.

Marked capacity not over (gallons).....	30.....	55.....
Type of container.....	Straight side.....	Straight side.
Minimum thickness, uncoated sheets ¹	Body sheet: 19 ²	Body sheet: 18 ³ .
Gauge.....	Head sheet: 19 ²	Head sheet: 18 ³ .
Type of rolling hoops.....	Rolled or swedged in hoops....	Rolled or swedged in hoops.

¹ Thickness shall be measured at any point on the sheet not less than 3/4 inch from an edge.
² 19 gauge steel shall have nominal thickness of 0.0418 inch and minimum thickness of 0.0378 inch.
³ 18 gauge steel shall have nominal thickness of 0.0478 inch and minimum thickness of 0.0428 inch.

§ 78.119-7 Flat or convexed heads.

(a) When heads are convexed (crowned) they shall not extend within 1/4 inch of the chime level; maximum convexity 1 1/2 inch for 55-gallon drums.

§ 78.119-8 Closures.

(a) Adequate to prevent leakage; gaskets required. Closure must be of screw-thread type or fastened by screw-thread device.

(b) Closing part (plug, cap, plate, etc., see Note 1) must be of metal as thick as prescribed for head of container; this not required for containers of 12 gallons or less when the opening to be closed is not over 2.3" diameter and the closing part is constructed, or fitted with sealing device, so that it cannot be removed without destroying it or the sealing device.

§ 78.118-13 Leakage test.

(a) Each container shall be tested, with seams under water or covered with soapsuds or heavy oil, by interior air pressure of at least 7 pounds per square inch for containers over 12 gallons capacity and at least 5 pounds for others. Equally efficient means of testing are authorized upon demonstration and proof of satisfactory tests to representative of Bureau of Explosives. Leakers shall be rejected or repaired and retested. Containers not required to be tested with heads in place except that samples taken at random and closed as for use, of each type and size, must be tested at start of production and repeated every four months. Samples so tested must be retained until further tests are made.

§ 78.119 Specification 17X; steel barrels or drums.

Single trip container. Removable head containers not authorized.

§ 78.119-1 Compliance.

(a) Required in all details.

§ 78.119-2 Rated capacity.

(a) Rated capacity as marked, see § 78.119-70(a) (3). Minimum actual capacity of containers shall be not less than rated (marked) capacity plus 4 percent. Maximum actual capacity shall not be greater than rated (marked) capacity plus 5 percent or rated (marked) capacity plus 4 percent plus 1 quart whichever is the greater.

§ 78.119-3 Composition.

(a) Sheets for body and heads to be low carbon, open hearth or electric steel.

§ 78.119-5 Seams.

(a) Body seams welded.
 (b) Head and chime seams welded or double-seamed.

§ 78.119-6 Parts and dimensions.

(a) Parts and dimensions as follows:

NOTE 1: This does not apply to a cap seal over a closure when closure complies with all requirements.

(c) For closure with threaded plug or cap, the seat (flange, etc.) for plug, or cap, must have 3 or more complete threads; two drainage holes of not over 1/16" diameter are allowed only in flanges having at least 5 threads. Plug, or cap, must have sufficient length of thread to engage 3 threads when screwed home with gasket in place.

§ 78.119-9 Defective containers.

(a) Leaks and other defects to be repaired by method used in constructing containers, not to be soldered.

§ 78.119-10 Marking.

(a) Marking on each container by embossing on head with raised marks as follows:

(1) ICC-17X. The letters STC; located near the ICC mark to indicate "single-trip container." In addition, when the container is of stainless steel, the type of steel used in body and head sheets as identified by American Iron and Steel Institute type number, and also the letters HT following steel designation on containers subjected to stress-relieving or heat-treatment during manufacture (for example, ICC-17X-304 or ICC-17X-304 HT as applicable) shall be shown. These marks shall be understood to certify that the container complies with all specification requirements.

(2) Name or symbol (letters) of maker or other party assuming responsibility for compliance with specification requirements; this must be recorded with the Bureau of Explosives.

(3) Gauge of metal in thinnest part, rated capacity in gallons, and year of manufacture (for example, 18-55-50).

(4) Steel barrels or drums manufactured prior to March 31, 1941, which are in compliance with this specification except as to marking may be accepted as permitted by § 73.22 of this chapter without necessity of having the marking embossed on the head in raised letters. This shipping paper shall, however, certify that the drum is in compliance.

§ 78.119-11 Size of markings.

(a) Size of markings (minimum): $\frac{3}{4}$ inch high.

§ 78.119-12 Type tests.

(a) Samples, taken at random and closed as for use, shall withstand prescribed tests without leakage. Tests to be repeated every four months. Samples last tested to be retained until further tests are made. The type tests are as follows:

(1) Test by dropping filled with water to 98 percent capacity from height of 4 feet onto solid concrete, so as to strike diagonally on chime seam; also additional drop test on any other parts which might be considered weaker than the chime. Closing devices and other parts projecting beyond chime or rolling hoops must also be capable of withstanding this test.

(2) Hydrostatic pressure test of 15 pounds per square inch sustained for 5 minutes.

§ 78.119-13 Leakage test.

(a) Each container shall be tested, with seams under water or covered with soapsuds or heavy oil, by interior air pressure of at least 7 pounds per square inch. Equally efficient means of testing are authorized upon demonstration and proof of satisfactory tests to representative of Bureau of Explosives. Leakers shall be rejected or repaired and retested.

§ 78.130 Specification 37K; steel drums.

Single trip container. Removable head containers which will pass all required tests are authorized.

§ 78.130-1 Compliance.

(a) Required in all details.

§ 78.130-2 Rated capacity.

(a) Rated capacity as marked, see § 78.130-8(a)(3). Actual capacity not less than rated (marked) capacity plus 2 percent, not greater than rated capacity plus 2 percent plus 1 quart.

§ 78.130-3 Composition.

(a) Sheets for body and heads to be low carbon, open hearth or electric steel.

§ 78.130-5 Parts and dimensions.

(a) Parts and dimensions as follows:

Marked capacity not over (gallons)	Authorized gross weight not over (pounds)	Type of container	Welded side seam required	Minimum thickness uncoated sheets (gauge)	
				Body sheet	Head sheet
55	275	Straight side.	Yes...	22	22

(b) Steel sheets of specified gauges shall comply with the following:

Gauge No.	Nominal thickness ¹ (inch)	Minimum thickness ¹ (inch)
22.....	0.0299	0.0269

¹ Thickness shall be measured at any point on the sheet not less than $\frac{3}{8}$ inch from an edge.

§ 78.130-6 Closure required.

(a) Adequate to prevent leakage; to be of bolted ring or lever lock ring types only; sponge rubber gaskets required; flowed-in gaskets not permitted.

§ 78.130-7 Defective containers.

(a) Leaks and other defects to be repaired by method used in constructing container, not by soldering.

§ 78.130-8 Marking.

(a) Marking on each container by embossing on head, except that such embossment must be on the permanent head for drums having removable heads, with raised marks, or by embossing or die stamping on footing on drums equipped with footings, or on metal plates securely attached to drum by brazing or welding not less than 20 percent of the perimeter, as follows:

(1) ICC-37K275. This mark shall be understood to certify that the container complies with all specification requirements.

(2) Name or symbol (letters) of maker or other party assuming responsibility for compliance with specification requirements; this must be recorded with the Bureau of Explosives.

(3) Gauge of metal in thinnest part, rated capacity in gallons, and year of manufacture (for example, 18-55-50). When gauge of metal in body differs

from that in head, both must be indicated with slanting line between and with gauge of body indicated first (for example 14/12-55-50 for body 14 gauge and head 12 gauge).

(4) The letters STC; located near the ICC mark to indicate "single-trip container".

§ 78.130-9 Size of markings.

(a) Size of markings (minimum): $\frac{1}{2}$ " high for 30-gallon or less, $\frac{3}{4}$ " for over 30 gallons.

§ 78.130-10 Type test.

(a) Samples, taken at random and closed as for use, shall withstand prescribed test without leakage. Tests to be made of each type and size by each company starting production and to be repeated every four months. Sample last tested to be retained until further tests are made. The type test is as follows:

(1) Test by dropping, filled with dry, finely powdered material to the authorized gross weight, from height of 4 feet onto solid concrete so as to strike diagonally on top chime. Closing devices and other parts projecting beyond chime or rolling hoops must also be capable of withstanding this test.

§ 78.131 Specification 37A; steel drums.

Single trip container. Removable head required.

§ 78.131-1 Compliance.

(a) Required in all details.

§ 78.131-2 Rated capacity.

(a) Rated capacity as marked, see § 78.131-9(a)(2). Minimum actual capacity of containers shall be not less than rated (marked) capacity plus 4 percent for containers not over 12 gallons capacity. Maximum actual capacity of containers not over 12 gallons capacity shall be not greater than rated (marked) capacity plus 5 percent or rated (marked) capacity plus 4 percent plus 1 quart whichever is the greater; for others, minimum actual capacity shall be not less than rated (marked) capacity plus 2 percent and maximum actual capacity shall not be greater than rated (marked) capacity plus 3 percent or rated (marked) capacity plus 2 percent plus 1 quart whichever is the greater.

§ 78.131-3 Composition.

(a) Sheets for body and heads to be hot-rolled or cold-rolled, low carbon, open-hearth or electric steel or standard commercial quality.

§ 78.131-5 Seams.

(a) Side seams must be welded; or locked and soldered when 28-gauge tin plate is used for containers of 2-gallon capacity or less.

§ 78.131-6 Capacities, weights, type, and gauges.

(a) Capacities, weights, type, and gauges must be as follows:

Marked capacity not over (gallons)	Authorized gross weight not over (pounds)	Type of container	Minimum thickness, uncoated sheets ¹ (gauge)		Minimum ring gauge bolted type ²
			Body sheet ³	Head sheet	
2	40	Straight side	28	28	Lug.
5	60	do.	26	26	Lug or plain ring seal.
5	80	do.	24	24	
10	160	do.	24	24	18, plain.
55	160	do.	26	26	
55	275	do.	24	24	Do.
55	350	do.	24	24	16, 2 inch overlap.
55	480	do.	22	22	

¹ All gauges specified are minimum except as provided by Part 73 of this chapter. Heavier (but not lighter) gauges may be specified if shipper so desires.
² Equally efficient closing devices may be authorized by the Bureau of Explosives upon demonstration of their ability to withstand tests prescribed in § 78.131-11.
³ Containers of 16 gallons capacity and over must have 2 swedged or corrugated rolling hoops of sufficient height to clear the closing device when the drum is rolled.
⁴ A gross weight of 490 pounds is authorized when defined by Part 73 of this chapter (see § 73.164 (a)(2) of this chapter).

(b) Steel sheets of specified gauges shall comply with the following:

Gauge No.	Nominal thickness ¹ (inch)	Minimum thickness ¹ (inch)
22	0.0299	0.0269
24	.0239	.0209
26	.0179	.0159
28	0.0149	0.0129

¹ Thickness shall be measured at any point on the sheet not less than 3/4 inch from an edge.

§ 78.131-7 Closures.

(a) Closures of the type specified in the above table adequate to prevent leakage; gaskets required, all closures to be of the full-removable head type. Curl at top of shell for all drums 30 gallons capacity and larger must have a minimum diameter of 7/16 inch, and so made as to form a circular section with the under portion substantially in contact with the vertical shell. The removable head must have a minimum depth of 3/4 inch and the cover bib must be large enough to extend to the horizontal center line of the top curl when the drum is sealed with the gasket in place. Drums of less than 30 gallons capacity may be made with an outside curl diameter of 3/8 inch minimum and a head depth of 3/4 inch minimum; except that for drums less than 16 gallons capacity the outside curl diameter may be 5/32 inch and the cover depth may be 3/8 inch minimum.

(b) The closing ring must be so constructed that the bottom leg will extend well inside the vertical center line of the shell curl but must not touch the shell (recommended clearance is 1/16 inch minimum, 3/32 inch maximum) when sealed for usage. The top leg of the locking ring must have sufficient length to extend well inside the vertical center line of the curl on the shell. Closing rings must have a 2 inch overlap at joint when gross weight of drum exceeds 275 pounds. Overlap is not required for drums of 275 pounds or less gross weight. The clearance between ends of rings without overlap should be a minimum of 1/8 inch and a maximum of 1/2 inch.

(c) Closures or fittings in the removable head of any type capable of withstanding test prescribed by § 78.131-11 are authorized.

§ 78.131-8 Defective containers.

(a) Defective containers to be repaired by method used in constructing

container. Soldering not authorized, except for tin plated steel as authorized by § 78.131-5.

§ 78.131-9 Marking.

(a) Marking on each container by embossing on head, except that such embossment must be on the permanent head for drums having removable heads, with raised marks, or by embossing or die stamping on footing on drums equipped with footings, or on metal plates securely attached to drum by brazing or welding not less than 20 percent of the perimeter, as follows:

(1) ICC-37A * * *. Stars to be replaced by the authorized gross weight, or less, at which the container was type tested (for example, ICC-37A150). This mark shall be understood to certify that the container complies with all specification requirements.

(2) Gauge of metal in thinnest part, rated capacity in gallons, and year of manufacture (for example, 24-55-54). When gauge of metal in body differs from that in either head, both must be indicated with slanting line between and with gauge of body indicated first (for example, 22/24-55-54 for a container having 22 gauge body, 22 gauge bottom head and 24 gauge top head).

(3) Name or symbol (letters) of maker or other party assuming responsibility for compliance with specification requirements; this must be recorded with the Bureau of Explosives.

(4) The letters STC; located near the ICC mark to indicate "single-trip container".

§ 78.131-10 Size of markings.

(a) Size of markings, not less than 1/2 inch high for all containers.

§ 78.131-11 Type test.

(a) Samples, taken at random and closed as for use, shall withstand prescribed test without leakage. Tests to be made of each type and size by each company starting productions and to be repeated every four months. Samples last tested to be retained until further tests are made. The type test is as follows:

(b) Test by dropping on top chime, or other part considered to be weaker, with drum filled to normal loading depth and to the gross weight at which container is marked with dry powdered material, and

topped with at least two inches of a finely divided, dry, free-flowing powder of the following sieve analysis:

- % retained on 42 mesh=Trace (max.).
- % retained on 50 mesh=3% (max.).
- % retained on 100 mesh=88% (min.).

A material such as sodium bicarbonate is recommended. Container shall be dropped from a height of 4 feet onto solid concrete so as to strike diagonally on the chime and so positioned when equipped with bolted ring type closure that crush pattern will terminate at closure joint. Closing devices and other parts projecting beyond chime or rolling hoops must be capable of withstanding this test. No disc or material other than regular gaskets in closure part is permitted for test purposes.

§ 78.132 Specification 37B; steel drums.

Single trip container. Removable head not authorized.

§ 78.132-1 Compliance.

(a) Required in all details.

§ 78.132-2 Rated capacity.

(a) Rated capacity as marked, see § 78.132-9(a)(2). Minimum actual capacity of containers shall be not less than rated (marked) capacity plus 4 percent for containers not over 12 gallons capacity. Maximum actual capacity of containers not over 12 gallons capacity shall be not greater than rated (marked) capacity plus 5 percent or rated (marked) capacity plus 4 percent plus 1 quart whichever is the greater; for others, minimum actual capacity shall be not less than rated (marked) capacity plus 2 percent and maximum actual capacity shall not be greater than rated (marked) capacity plus 3 percent or rated (marked) capacity plus 2 percent plus 1 quart whichever is the greater.

§ 78.132-3 Composition.

(a) Sheets or body and heads to be hot-rolled or cold-rolled, low carbon, open hearth, or electric steel of standard commercial quality.

§ 78.132-5 Seams.

(a) Side seams may be welded, Gordon lock, or other equally efficient construction.

§ 78.132-6 Capacities, weights, type and gauges.

(a) Capacities, weights, type and gauges must be as follows:

Marked capacity not over (gallons)	Authorized gross weight not over (pounds)	Type of container	Minimum thickness, uncoated sheets (gauge)	
			Body sheet ¹	Head sheet
5	60	Straight side	28	28
55	275	do.	26	26
55	450	do.	24	24
55	650	do.	22	22

¹ Containers of 16 gallons capacity and over must have small or series corrugations rolled into the shell or 2 swedged or corrugated rolling hoops.

² Twenty-four (24) gauge top head and cover authorized.

(b) Steel sheets of specified gauges shall comply with the following:

Gauge No.	Nominal thickness ¹ (inch)	Minimum thickness ¹ (inch)
22	0.0299	0.0289
24	.0239	.0209
26	.0179	.0159
28	.0149	.0129

¹ Thickness shall be measured at any point on the sheet not less than 1/8 inch from an edge.

§ 78.132-7 Closures.

(a) Closures shall be of any type that will withstand prescribed drop tests without leakage, see § 78.132-11. Openings shall not exceed 9 inches in diameter in containers of 16-gallon capacity and larger nor 6 1/2 inches in diameter in containers less than 16-gallon capacity. Larger openings may be authorized upon demonstration and proof of satisfactory closure test to the Bureau of Explosives. Gaskets required when necessary.

§ 78.132-8 Defective containers.

(a) To be repaired by method used in constructing container except that Gordon lock, or other similarly constructed seam must be welded. Soldering not authorized.

§ 78.132-9 Marking.

(a) Marking on each container by embossing on head with raised marks, or by embossing or die stamping on footring on drums equipped with footrings, or on metal plates securely attached to drum by brazing or welding not less than 20 percent of the perimeter, as follows:

(1) ICC-37B * * *. Stars to be replaced by the authorized gross weight, or less at which container was type tested (for example, ICC-37B450, etc.). This marking shall be understood to certify that the container complies with all specification requirements.

(2) Gauge of metal in thinnest part (except closure cover), rated capacity in gallons, and year of manufacture (for example, 24-55-54). When gauge of metal in body differs from that in either head, both must be indicated with slanting line between and with gauge of body indicated first (for example, 22/24-55-54 for a container having 22-gauge body, 22-gauge bottom head and 24-gauge top head).

(3) Name or symbol (letters) of maker or other party assuming responsibility for compliance with specification requirements; this must be recorded with the Bureau of Explosives.

(4) The letters STC; located near the ICC mark to indicate "single-trip container".

§ 78.132-10 Size of markings.

(a) Size of markings (minimum), not less than 1/2 inch high for all containers.

§ 78.132-11 Type test.

(a) Samples, taken at random and closed as for use, shall withstand prescribed test without leakage. Test to be made of each type and size by each company starting production and to be repeated every four months. Sample last tested to be retained until further tests are made. The type test is as follows:

(b) Test by dropping on top chime, filled with dry finely powdered material to the gross weight at which container is marked, from a height of 4 feet onto solid concrete so as to strike diagonally on the chime and so positioned as to strike, in the case of offset openings, at the point on the chime nearest the opening. Closing devices and other parts projecting beyond chimes must also be capable of withstanding this test.

§ 78.133 Specification 37P; steel drums with polyethylene liner.

Nonreusable containers.

§ 78.133-1 Compliance.

(a) Required in all details.

§ 78.133-2 Rated capacity of assembled composite containers.

(a) Rated capacity as marked, see § 78.133-9. Minimum actual capacity of

containers shall be not less than rated (marked) capacity, plus 4 percent. Maximum actual capacity shall not be greater than rated (marked) capacity, plus 5 percent or rated (marked) capacity plus 4 percent plus 1 quart whichever is the greater.

§ 78.133-3 Steel composition.

(a) Sheets for body and heads to be low carbon, open hearth or electric steel.

§ 78.133-4 Seams.

(a) Side seams welded.

(b) Chime of permanent head, double seamed.

§ 78.133-5 Parts and dimensions for steel drums.

(a) Parts and dimensions for steel drums shall be as follows:

Drums for plastic liner of rated capacity not over (gallons)	Type of container ^{1,2}	Body sheet (gauge)	Bottom head sheet (gauge)	Removable head sheet (gauge)	Type of removable head closure
5	Straight side, single bead	26	26	24	Ring seal, bolted ring, lug cover.
6 1/4	Straight side, single bead	24	24	24	Ring seal, bolted ring, lug cover.
15	Straight side ³	22	22	19	Ring seal, bolted ring, lug cover.

¹ Drum interior shall be free of projections, burrs, or any edges that will cause damage to liners, and shall be free of lubricants, oil or other foreign matter. Drum shall provide a snug fit for the plastic liner.

² One hole not over 3/16 inch in diameter permitted in body or a head, or two 1/8 inch holes in bottom head near the chime.

³ For containers up to 10 gallons capacity, a single rolled or swedged bead in body near top curl required; for containers of 10 gallons and greater capacity, 2 rolled or swedged rolling hoops in drum body required.

⁴ Twenty (20) gauge authorized.

(b) Steel sheets of specified gauges shall comply with the following:

Gauge No.	Nominal thickness ¹ (inch)	Minimum thickness ¹ (inch)
19	0.0418	0.0378
20	.0359	.0324
22	.0299	.0269
24	.0239	.0209
26	.0179	.0159

¹ Thickness shall be measured at any point on the sheet not less than 1/8 inch from edge.

§ 78.133-6 Liner.

(a) Each metal drum shall contain a contour fitting polyethylene liner having heat-sealed seams or a one-piece seamless molded polyethylene unit, attached to the pour opening in the removable head so as to provide a container that is completely resistant to lading when closed as for use.

(b) Polyethylene liner or molded unit shall be fabricated throughout of virgin polyethylene tubing or mold material, which may include a low percentage of elastomeric polymer having minimum thickness of 0.010 inch and having the following physical properties:

(1) Resin should have a maximum melt index value of 1.8 plus 0.4 per 10 minutes, and shall have a minimum average molecular weight of 21,000, as determined in accordance with methods acceptable to the Bureau of Explosives.

§ 78.133-7 Closure.

(a) Closure shall be resistant to lading and adequate to prevent leakage. Openings in removable head shall not be over 2.85 inches in diameter. Vent-

ing closures are permitted when required by Part 73 of this chapter.

§ 78.133-8 Defective containers.

(a) Repaired polyethylene liners are not authorized.

§ 78.133-9 Marking.

(a) Marking on the permanent head of each container by embossing with raised marks as follows:

(1) ICC-37P. The letters NRC located just above or below the ICC mark to indicate a nonreusable container. These marks shall be understood to certify that the container complies with all specification requirements.

(2) Name or symbol (letters) of maker or other party assuming responsibility for compliance with specification requirements; this must be recorded with the Bureau of Explosives.

(3) Gauge of metal in thinnest part, rated capacity of assembled composite container in gallons, and year of manufacture (for example, 24-5-57). When gauge of metal in body differs from that in head, both must be indicated with slanting line between and with gauge of body indicated first (for example, 26/24-5-57 for body 26-gauge and head 24-gauge).

§ 78.133-10 Size of markings.

(a) Size of markings (minimum) 1/2 inch high.

§ 78.133-11 Type tests.

(a) Three samples of each size container manufactured taken at random, filled with water to 98 percent of actual capacity and closed as for use, shall

withstand drop tests from height of 4 feet onto solid concrete as prescribed by subparagraphs (1), (2) and (3) of this paragraph, without leakage or potentially hazardous rupture of outside container. Tests shall be made at start of production and repeated at 4-month intervals thereafter. Samples last tested shall be retained until subsequent tests are conducted. No single container shall be expected to withstand more than one of the following:

- (1) Diagonal drop on top chime.
- (2) Diagonal drop on bottom chime.
- (3) Flat drop on side of drum.

(b) Completely assembled composite containers of each size manufactured, filled to 98 percent of actual capacity with water, shall be capable of withstanding a vibration test by placing the container on the vibration table anchored in such manner that all horizontal motion shall be restricted and only vertical motion allowed. The test shall be performed for one hour using an am-

Rated capacity of inside plastic container not over (gallons)	Minimum thickness, uncoated sheets (gauge)		Body seams	Rolling hoops	Top or bottom head	Closures, when full removable head is used (gaskets not required)
	Body sheet	Head sheet				
5.....	26	26	Welded.....	None required....	Double seamed..	Lug or plain ring seal.
15.....	24	24	do.....	Rolled or swedged.....	do.....	Do.
30.....	24	24	do.....	do.....	do.....	Bolted type ring closure, 18 gauge.
55.....	24	24	do.....	do.....	do.....	Bolted type ring closure, 16 gauge.

(b) Steel sheets or parts of specified gauges shall comply with the following:

Gauge No.	Nominal thickness (inch) ¹	Minimum thickness (inch) ¹
16.....	.0598	.0533
18.....	.0478	.0423
24.....	.0239	.0209
26.....	.0179	.0159

¹ Thickness shall be measured at any point on the sheet not less than 3/4 inch from an edge.

(c) Two holes not exceeding 1/4 inch each are permitted diametrically opposite each other in the overpack body immediately above the double seam of the bottom chime or three holes not exceeding 3/16 inch in diameter on centers 120 degrees apart in the bottom head.

(1) Overpack interior shall be free of projections, burrs, or any edges that might cause damage to inside plastic container and shall be free of lubricants, oils, or any foreign matter.

(2) Top head may have not more than two holes of suitable size to provide for protruding closures.

(3) Overpack shall be constructed to provide snug fit for inside plastic container.

§ 78.134-3 Tests.

(a) Steel overpack when assembled as for use, shall withstand the tests prescribed in specifications for inside plastic containers as detailed in Part 78 when authorized as combination packages in Part 73 of this chapter. The completed package must withstand these tests without producing a condition of the overpack that could result in potential damage to the inside container.

plitude of one inch at a frequency that causes the test container to be raised from the floor of the table to such a degree that a piece of paper or flat steel strap or tape can be passed between the table and the container.

§ 78.133-12 Test.

(a) Each assembled container shall be tested by retaining at least 1 1/2 pounds per square inch air pressure at equilibrium without showing pressure drop on a suitable gauge.

§ 78.134 Specification 37M; cylindrical steel overpack, straight sided for inside plastic container; nonreusable containers.

§ 78.134-1 Material requirements.

(a) Sheets for body and heads to be low carbon, open hearth or electric steel.

§ 78.134-2 Construction requirements.

(a) Construction requirements are as follows:

§ 78.134-4 Marking.

(a) Marking on each container by embossing on bottom head with raised marks with letter and figures not less than 1/2 inch high as follows:

(1) ICC-37M. The letters NRC located near the ICC mark to indicate "Non-reusable container." These marks shall be understood to certify the steel container complies with all construction requirements of this specification.

(2) Name or symbol (letters) of maker; this must be recorded with the Bureau of Explosives.

(3) Gauge of metal in thinnest part, rated capacity of the inside container in gallons, and year of manufacture (for example, 24-55-62). When gauge of metal in body differs from that in either head, both must be indicated with slanting line between and with gauge of body indicated first (for example, 24/22-55-62 for a container having 24-gauge body and 22-gauge top head).

§ 78.135 Specification 37C; steel drums. Nonreusable container. Removable head required.

§ 78.135-1 Compliance.

(a) Required in all details.

§ 78.135-2 Rated capacity.

(a) Rated capacity as marked (see § 78.135-8). Maximum actual capacity of containers shall be not greater than rated (marked) capacity plus 5 percent or rated (marked) capacity plus 4 percent plus 1 quart whichever is the greater.

§ 78.135-3 Composition.

(a) Sheets for body and heads to be hot-rolled or cold-rolled, low carbon,

open-hearth or electric steel of standard commercial quality.

§ 78.135-4 Seams.

(a) Side seams must be welded.

§ 78.135-5 Capacities, weights, type and gauges.

(a) Capacities, weights, type and gauges must be as follows:

Marked capacity not over (gallon)	Authorized gross weight not over (pounds)	Type of container	Minimum thickness, uncoated sheets (gauge)		
			Body sheet	Bottom head sheet ¹	Removable head sheet ²
5.....	80.....	Straight side.	28	28	26

¹ Bottom head must have three inwardly-embossed circumferential beads.

² Removable head must have two inwardly-embossed circumferential beads.

³ Removable head must have not less than 16 lugs spaced not more than 1/4 inch apart.

(b) Steel sheets of specified gauges shall comply with the following:

Gauge No.	Nominal thickness ¹ (inch)	Minimum thickness ¹ (inch)
26.....	0.0179	0.0159
28.....	0.0149	0.0129

¹ Thickness shall be measured at any point on the sheet not less than 3/4 inch from an edge.

§ 78.135-6 Closures.

(a) Closures shall be capable of withstanding test prescribed by § 78.135-10. Removable head may be equipped with leakproof fittings for filling.

§ 78.135-7 Defective containers.

(a) Defective containers to be repaired by method used in constructing container.

§ 78.135-8 Marking.

(a) Marking on each container by embossing on the permanent head as follows:

(1) ICC-37C**. Stars to be replaced by the authorized gross weight, or less, at which container was type tested (for example, ICC-37C80). This mark shall be understood to certify that the container complies with all specification requirements.

(2) Gauge of metal in thinnest part, rated capacity, and year of manufacture (for example, 26-5-64). When gauge of metal in body differs from that in either head, both must be indicated with slanting line between and with gauge of body indicated first (for example, 28/26-5-64) for a container having 28-gauge body, 28-gauge bottom head, and 26-gauge removable head.

(3) Name or symbol (letters) of maker or other party assuming responsibility for compliance with specification requirements; this must be recorded with the Bureau of Explosives.

(4) The letters NRC; located near the ICC mark to indicate "nonreusable container."

§ 78.135-9 Size of markings.

(a) Size of markings, not less than 1/2 inch for all containers.

§ 78.135-10 Type test.

(a) Samples, taken at random and closed as for use, shall withstand prescribed test without leakage. Tests to be made of each type and size by each company starting production and to be repeated every four months. Samples last tested to be retained until further tests are made. The type test is as follows:

(b) Test by dropping on top chime, or other part considered to be weaker, with drum filled to normal loading depth and to the gross weight at which container is marked with dry powdered material, and topped with at least two inches of a finely divided, dry, free-flowing powder of the following sieve analysis:

- Percent retained on 42 mesh—Trace (maximum).
- Percent retained on 50 mesh—3 percent (maximum).
- Percent retained on 100 mesh—88 percent (minimum).

A material such as sodium bicarbonate is recommended. Container shall be dropped from a height of 4 feet onto solid concrete so as to strike diagonally on the chime. Closing devices and other parts projecting beyond chime or rolling hoops must be capable of withstanding this test. No disc or material other than regular gaskets in closure part is permitted for test purposes.

§ 78.136 Specification 42E; aluminum drums.

Single-trip container.

§ 78.136-1 Compliance.

(a) Required in all details.

§ 78.136-2 Rated capacity.

(a) Rated capacity as marked, see § 78.136-9(a)(3), 55 gallons; actual capacity shall be rated capacity plus at least 2 percent.

§ 78.136-3 Composition.

(a) Body and heads of aluminum alloy 5052. Plastic closure plugs authorized if suitably resistant to action of lading.

§ 78.136-4 Outage.

(a) Two percent of rated capacity, plus a maximum tolerance of 1 quart.

§ 78.136-5 Seams.

(a) Welded, including attachment of flanges for closures and other devices. Circumferential seams at last 3" from top of chime; chime seams not permitted.

§ 78.136-6 Parts and dimensions.

(a) To be a minimum of 0.064 inch thick.

(b) Rolled or swedged in rolling hoops required.

§ 78.136-7 Closures.

(a) Of screw-thread type or secured by screw-thread device; openings over 2.3 inches not authorized; suitable gaskets required; head openings only permitted. Vented closing devices of type approved by the Bureau of Explosives are authorized when specified by the purchaser.

(b) Threaded plugs, or caps, and flanges must be close fitting with gasket

surfaces which bear squarely on each other when without gasket; they must have not over 12 threads per inch, with at least 3 threads engaged when gasket is in place; two $\frac{1}{16}$ -inch drainage holes are authorized in flange.

§ 78.136-8 Head rings.

(a) Must be of 14 Brown and Sharpe gauge (0.064") tack-welded to each head.

§ 78.136-9 Marking.

(a) Marking on each container on top head, by stamping with pressure dies, by embossing with raised marks, or plate attached by welding, as follows:

(1) ICC-42E. This mark shall be understood to certify that the container complies with all specification requirements. The letters STC; located just below or above the ICC mark to indicate "single-trip container".

(2) Name or symbol (letters) of maker; this must be registered with the Bureau of Explosives and located just above, below, or following the mark specified in subparagraph (1) of this paragraph.

(3) Gauge of metal, Brown and Sharpe, at start of fabrication; rated capacity in gallons; year of manufacture (for example, 7-30-50).

§ 78.136-10 Size of marking.

(a) Size of marking (minimum): 1 inch high.

§ 78.136-11 Type tests.

(a) Samples, taken at random and closed as for use, shall withstand prescribed tests without leakage. Tests to be made of each type and size by each company starting production and to be

repeated every four months. Samples last tested to be retained until further tests are made. The type tests are as follows:

(1) Test by dropping, filled with water to 98 percent capacity, from height of 6 feet onto solid concrete so as to strike diagonally on chime, or when without chime seam, to strike on other circumferential seam; also additional test on any other parts which might be considered weaker than the chime.

(2) Hydrostatic pressure test of 60 pounds per square inch sustained for 5 minutes.

§ 78.136-12 Leakage test.

(a) Each container shall be tested, with seams under water or covered with soapsuds or heavy oil, by interior air pressure of at least 10 pounds per square inch. Leakers shall be rejected or repaired and retested.

§ 78.136-13 Defective containers.

(a) Leaks and other defects shall be repaired by welding, using welding material of the same composition as originally used by the manufacturer of the drum or other approved aluminum base alloy of equal corrosion and strength qualities.

§ 78.140 Specification 13; metal kegs.

§ 78.140-1 Compliance.

(a) Required in all details.

§ 78.140-2 Composition.

(a) To be open-hearth or electric steel, box annealed dead soft; carbon not over 0.14 percent.

§ 78.140-3 Parts and dimensions.

(a) Parts and dimensions as follows:

	Gross weight of kegs and contents			
	Not over 15 pounds	Not over 30 pounds ¹	Over 30 pounds but not over 75 pounds	Over 75 pounds but not over 150 pounds
Thickness of material:				
Body.....	30 gauge.....	28 gauge.....	24 gauge.....	24 gauge.
Head.....	do.....	do.....	28 gauge.....	28 gauge.
Width of lap for side seam ²	$\frac{1}{4}$ inch.....	$\frac{3}{8}$ inch.....	$\frac{1}{2}$ inch.....	$\frac{1}{2}$ inch.
Number of corrugations in each end of body.....	3.....	3.....	5.....	7.
Minimum depths of corrugations.....	$\frac{1}{4}$ inch.....	$\frac{3}{8}$ inch.....	$\frac{1}{2}$ inch.....	$\frac{3}{8}$ inch.
Width of laps on body and head seams ²	$\frac{1}{4}$ inch.....	$\frac{1}{2}$ inch.....	$\frac{3}{4}$ inch.....	$\frac{1}{2}$ inch.
Width of laps on head for head seams ²	$\frac{1}{4}$ inch.....	$\frac{3}{8}$ inch.....	$\frac{1}{2}$ inch.....	$\frac{3}{4}$ inch.
Head seams.....	Double lap.....	Double lap.....	Double lap.....	Single lap.

¹ Smokeless powder 32 pounds gross.

² Dimension requirements do not apply for kegs manufactured with double-seamed, compound-lined chime seams and lapped and soldered side seam.

NOTE: Dimensions of materials specified are minimum requirements. Gauge specified is for commercial plate, United States standard. Corrugations not required in body of kegs for gross weights not over 7 pounds.

§ 78.140-4 Seams.

(a) For gross weight over 75 pounds, all seams welded, brazed, soldered, or riveted; rivets at not over 5" centers.

§ 78.140-5 Closures.

(a) Slide type. Metal holder, for slide, securely fastened to head; washer of suitable material 0.025" thick; metal drop with depression to fit into bunghole and hold washer in place; metal slide to cover the foregoing. Positive fastening required between slide and slide holder to prevent leakage in transit; friction fastening not authorized.

(b) Cap or plug type. Metal holder, for cap or plug, securely fastened to head; metal cap or plug, with gasket

when necessary to prevent sifting. Positive fastening required between cap, or plug, and holder to prevent leakage in transit; friction fastening not authorized.

§ 78.140-6 Marking.

(a) Marking on each container by embossing on head with raised marks as follows:

(1) ICC-13. This mark shall be understood to certify that the container complies with all specification requirements.

§ 78.140-7 Size of markings.

(a) Size of markings (minimum): $\frac{5}{16}$ " high.

§ 78.140-8 Type test.

(a) Keg filled with fine, dry sand in weight equal to that of shipment must be capable of withstanding, without leakage, 4 successive drops of 4 feet on the head onto solid concrete. Tests to be made of each type and size by each company manufacturing this type of container and to be repeated every six months while in production. If production is discontinued and is resumed, this requirement will also apply if prescribed tests have not been made within the previous six-month period. Samples last tested to be retained until further tests are made.

§ 78.140-9 Filling with contents.

(a) *Lining.* Cloth bag lining required for gross weight over 32 pounds; neck of bag to be securely tied.

§ 78.140-10 Additional keg.

(a) *Stove-pipe keg.* Authorized only for shipments loaded by shipper and to be unloaded by consignee and for gross weight of 30 pounds. Must comply with all requirements, except § 78.140-5, and also with the following:

(1) Length to be about 4 times diameter; cap (slip cover) to have snug fit over body with 3" overlap.

(2) Contents to be enclosed in double paper tubes, with pasted seams, not over 2½" diameter and made of tough manila paper weighing at least 50 pounds per 480 sheets 24" x 36"; outside tube to be waxed. Ends of tubes to be folded and tucked between folds of tube to prevent leakage.

NOTE 1: Because of the present emergency and until further order of the Commission, a ream may consist of 500 sheets.

§ 78.141 Specification 13A; metal drums.**§ 78.141-1 Compliance.**

(a) Required in all details.

§ 78.141-2 Type.

(a) Straight sided; authorized only for material cast solid and with filling end head applied after material is loaded and closed in the manner prescribed in § 78.141-6. No other openings permitted.

§ 78.141-3 Composition.

(a) To be low carbon, open-hearth or electric steel.

§ 78.141-4 Heads and body.

(a) *Heads.* To be not less than 28 gauge United States standard.

(b) *Body.* To be not less than 28 gauge United States standard.

§ 78.141-5 Seams.

(a) Must be welded.

§ 78.141-6 Heads.

(a) To be attached by means of double lapped-seam.

§ 78.141-7 Marking.

(a) Marking on each container by embossing on head with raised marks as follows:

(1) ICC-13A. This mark shall be understood to certify that the container complies with all specification requirements.

(2) Size of markings (minimum): ⅛ inch high.

§ 78.141-8 Type tests.

(a) Drum filled and closed as for shipment must be capable of withstanding, without rupture, 4 successive drops of 4 feet on the head onto solid concrete.

(b) Drum must be capable of withstanding hydrostatic pressure test of 30 pounds per square inch, sustained for 5 minutes.

(c) Tests to be made of each type and size by each company manufacturing this type of container and to be repeated every six months while in production. If production is discontinued and is resumed, this requirement will also apply if prescribed tests have not been made within the previous six-month period. Samples last tested to be retained until further tests are made.

§ 78.146 Specification 32A; metal cases, riveted or lock-seamed.**§ 78.146-1 Compliance.**

(a) Required in all details.

§ 78.146-2 Gauge standards.

(a) United States standards for sheet metal; American or Brown and Sharpe for wire.

§ 78.146-3 Covers.

(a) To have at least 1" lap on body and to fit with clearance not over ⅛"; lapped corners to be welded.

§ 78.146-4 Edge protection.

(a) Open edges of body must be turned or rolled inward; front open edge of cover must be turned or rolled outward. Not required for material at least 20-gauge thick or for "trailer" cases.

§ 78.146-5 Bottom protection.

(a) Face on which case will ordinarily rest must be reinforced with continuous angle straps, or be fitted with trunk corners, or be double thickness along edges. Not required for cases of at least 20-gauge metal or of not over 1 reel capacity or for "trailer" cases.

§ 78.146-6 Hinges.

(a) To be of continuous loop type with loops of steel wire at least 7-gauge, welded; hinge straps at least 18-gauge securely welded or riveted.

§ 78.146-7 Carrying handles.

(a) Any type of adequate strength.

§ 78.146-8 Closing devices.

(a) To be of sufficient strength and efficiency to prevent injury or unfastening in tests (§ 78.146-14) or in transit.

§ 78.146-9 Rivets.

(a) At least ⅝" diameter; length to furnish efficient heads; split rivets not authorized except for attachment of lining.

§ 78.146-10 Rivet reinforcement.

(a) Hinges, fastening devices, and handles, when riveted in place, must have additional inside reinforcement of steel, at least as thick as in case, through which rivets must pass. Not required when case is made of at least 20-gauge material throughout.

§ 78.146-11 Lining.

(a) Required throughout; to be hard-surfaced fiberboard at least 0.125" thick and with strength of 800 pounds, Mullen or Cady test, or wooden lining at least 0.25" thick.

§ 78.146-12 Metal partitions.

(a) Metal partitions (when used) to be as thick as body of case, permanently fastened to the case, and lined the same as the case.

§ 78.146-13 Protective coating.

(a) Steel cases must be of galvanized material or protected from corrosion by paint, lacquer, or other adequate coating.

§ 78.146-14 Type tests.

(a) Cases completely filled as for shipment must be capable of withstanding 4 successive drops onto solid concrete from a height of 6 feet without rupture of case or permanent damage to or unfastening of closing device. Tests to be made by dropping on cover, seam, or any corner.

§ 78.146-15 Marking.

(a) Marking on each container by the maker with plain and permanent marks at least ½" high as follows:

(1) ICC-32A. This mark shall be understood to certify that the container complies with all specification requirements.

(2) Name or symbol (letters) of maker; this must be registered with the Bureau of Explosives and located just above, below, or following the mark specified in subparagraph (1) of this paragraph.

§ 78.146-16 Cases with capacity (approx.) not over 9,000 feet of 1⅜" film.

(a) Compliance with §§ 78.146-1 to 78.146-15 required. Seams to be lock-seams or riveted. Material to be steel, at least 20-gauge. 2 hinges, 1 fastening device, and 1 carrying handle required.

§ 78.146-17 Cases with capacity (approx.) not over 8,000 feet of 1⅜" film or 4,500 feet of 2½" film.

(a) Construction as in § 78.146-16, except: 22-gauge material authorized; 1 hinge authorized for single-reel cases.

§ 78.146-18 Cases with capacity not over 1 reel of 10" diameter.

(a) Construction as in § 78.146-16, except: 24-gauge material and 1 hinge authorized.

§ 78.146-19 Cases with capacity not over 500 feet of film, "Trailer Cases".

(a) Construction as in § 78.146-16, except: 26-gauge material and 1 hinge of any type authorized.

§ 78.147 Specification 32B; metal cases, welded or riveted.**§ 78.147-1 Compliance.**

(a) Required in all details.

§ 78.147-2 Gauge standards.

(a) United States standard for sheet metal; American or Brown and Sharpe for wire.

§ 78.147-3 Covers.

(a) To have at least 1" lap on body and to fit with clearance not over $\frac{1}{2}$ "; lapped corners to be welded.

§ 78.147-4 Edge protection.

(a) Open edges of body must be turned or rolled inward; front open edge of cover must be turned or rolled outward. Not required for material at least 20-gauge thick or for "trailer" cases.

§ 78.147-5 Bottom protection.

(a) Face on which case will ordinarily rest must be reinforced with continuous angle straps, or be fitted with trunk corners, or be double thickness along edges. Not required for cases of at least 20-gauge metal or of not over 1 reel capacity or for "trailer" cases.

§ 78.147-6 Hinges.

(a) To be of continuous loop type with loops of steel wire at least 7-gauge, welded; hinge straps at least 18-gauge securely welded or riveted.

§ 78.147-7 Carrying handles.

(a) Any type of adequate strength.

§ 78.147-8 Closing devices.

(a) To be of sufficient strength and efficiency to prevent injury or unfastening in tests (§ 78.147-14) or in transit.

§ 78.147-9 Rivets.

(a) At least $\frac{5}{32}$ " diameter; length to furnish efficient heads; split rivets not authorized except for attachment of lining.

§ 78.147-10 Rivet reinforcement.

(a) Hinges, fastening devices, and handles, when riveted in place, must have additional inside reinforcement of steel, at least as thick as in case, through which rivets must pass. Not required when case is made of at least 20-gauge material throughout.

§ 78.147-11 Lining.

(a) Required throughout; to be hard-surfaced fiberboard at least 0.125" thick and with strength of 800 pounds, Mullen or Cady test, or wooden lining at least 0.25" thick.

§ 78.147-12 Metal partitions.

(a) Metal partitions (when used) to be as thick as body of case, permanently fastened to the case, and lined the same as the case.

§ 78.147-13 Protective coating.

(a) Steel cases must be of galvanized material or protected from corrosion by paint, lacquer, or other adequate coating.

§ 78.147-14 Type tests.

(a) Cases completely filled as for shipment must be capable of withstanding 4 successive drops onto solid concrete from a height of 6 feet without rupture of case or permanent damage to or unfastening of closing device. Tests to be made by dropping on cover, seam, or any corner.

§ 78.147-15 Marking.

(a) Marking on each container by the maker with plain and permanent marks at least $\frac{1}{2}$ " high as follows:

(1) ICC—32B. This mark shall be understood to certify that the container complies with all specification requirements.

(2) Name or symbol (letters) of maker; this must be registered with the Bureau of Explosives and located just above, below, or following the mark specified in subparagraph (1) of this paragraph.

§ 78.147-16 Cases with capacity (approximate) not over 12,000 feet of $1\frac{1}{8}$ " film or 6,000 feet of $2\frac{1}{2}$ " film.

(a) Compliance with §§ 78.147-1 to 78.147-15 required. Seams to be welded or riveted. Material to be steel, or aluminum-manganese alloy, at least 18-gauge. 2 hinges, 2 fastening devices spaced as for hinges, and 2 carrying handles required.

§ 78.147-17 Cases with capacity (approximate) not over 9,000 feet of $1\frac{3}{8}$ " film.

(a) Compliance with §§ 78.147-1 to 78.147-16, except: 1 fastening device and 1 carrying handle authorized.

§ 78.147-18 Cases with capacity (approximate) not over 8,000 feet of $1\frac{3}{8}$ " film or 4,500 feet of $2\frac{1}{2}$ " film.

(a) Construction as in § 78.147-16, except: 20-gauge material, 1 fastening device, and 1 carrying handle authorized; 1 hinge authorized for single-reel cases. Detachable covers (no hinges) with $\frac{3}{4}$ " lap on body and efficiency to prevent displacement in tests, are authorized. Trailer cases, capacity not over 500 feet of film, no handle required. Cover lap not less than full one-half inch.

§ 78.148 Specification 32C; metal trunks.

§ 78.148-1 Design.

(a) To be designed to contain film in film-reel cans and projecting apparatus only; other articles not authorized therein.

§ 78.148-2 Strength.

(a) To be of strength and efficiency to carry contents in ordinary handling without damage to trunk or contents.

§ 78.148-3 Compartments.

(a) Separate compartments required for each reel of film and for projecting apparatus; each compartment to be constructed so that, in closing, it will have no cracks or openings.

§ 78.148-4 Compartment linings.

(a) Each film compartment to be made of, or lined throughout with, sheet metal; this metal to be protected against contact with film-reel can by a substantial interlining of fiberboard or equivalent.

§ 78.148-5 Marking.

(a) Marking on each container by the maker with plain and permanent marks at least $\frac{1}{2}$ " high applied on 2" by 4" metal plate securely riveted to top of cover of trunk as follows:

(1) ICC—32C. This mark shall be understood to certify that the container complies with all specification requirements.

(2) Name or symbol (letters) of maker; this must be registered with the Bureau of Explosives and located just above, below, or following the mark specified in subparagraph (1) of this paragraph.

§ 78.149 Specification 32D; metal boxes for old and worn-out motion-picture film no longer exhibitable.

§ 78.149-1 Compliance.

(a) Required in all details.

§ 78.149-2 Gauge standards.

(a) United States standard for sheet metal; American or Brown and Sharpe for wire.

§ 78.149-3 Material.

(a) Material to be steel; body and bottom at least 16-gauge; cover at least 18-gauge.

§ 78.149-4 Joints and seams.

(a) All joints and seams to be welded or riveted.

§ 78.149-5 Cover.

(a) Cover must be tight-fitting, to prevent entrance of sparks, with provision for secure fastening to be locked or sealed.

§ 78.149-6 Type tests.

(a) Cases completely filled as for shipment must be capable of withstanding 4 successive drops onto solid concrete from a height of 4 feet without rupture of case or permanent damage to or unfastening of closing device. Tests to be made by dropping on cover, seam, or any corner.

§ 78.149-7 Marking.

(a) Marking on each container by the maker with plain and permanent marks at least $\frac{1}{2}$ " high as follows:

(1) ICC—32D. This mark shall be understood to certify that the container complies with all specification requirements.

(2) Name or symbol (letters) of maker; this must be registered with the Bureau of Explosives and located just above, below, or following the mark specified in subparagraph (1) of this paragraph.

§ 78.150 Specification 33A; polystyrene cases. Nonreusable containers.

§ 78.150-1 Material requirements.

(a) Expandable polystyrene, molded to produce a completely fused closed cell composition having a minimum density of 1.25 pounds per cubic foot.

§ 78.150-2 Design.

(a) The case is to consist of two parts, a bottom section with pockets for the inside containers and a top section that covers, and interlocks with, the bottom section. Both the bottom and top sections shall be designed to provide a snug fit for the inside containers.

§ 78.150-3 Construction.

(a) The case shall be constructed in accordance with the following minimum thicknesses:

Side walls and bottoms.....	$\frac{3}{4}$ inch.
Between inside containers.....	$\frac{1}{2}$ inch.
Top	$\frac{3}{4}$ inch (see Note 1).

NOTE 1: In recesses for closure caps for inside containers ¼ inch thickness is permissible; closure caps shall not be in contact with inside of top section.

§ 78.150-4 Closing for shipment.

(a) The cases shall be closed for shipment with a pressure sensitive paper tape having not less than 1½ inches width and a tensile strength at least 55 pounds per inch of width, or tape of equivalent strength. The tape shall completely encircle the case, with overlap not less than one inch in length, in one direction so as to transverse the top-bottom section joint in vertical manner. If the design of the case is such that the tape is subject to abrasion in transportation and handling, tape shall also be applied similarly on the same axis but at 90°.

§ 78.150-5 Gross weight authorized.

(a) Fifty pounds maximum.

§ 78.150-6 Test for completed package.

(a) Cases, with inside containers filled with water enclosed as for shipment, shall be capable of withstanding 4-foot flap drops onto solid concrete without leakage from or breakage of any inside container, and without producing any condition that would result in potential damage to the inside container. A minimum of four cases shall be tested, each case not being subjected to more than one test. Each test is to consist of six 4-foot drops once each side, bottom and top.

(b) Tests prescribed by paragraph (a) of this section must be conducted by the shipper assembling the completed package prior to initial use, and each 6 months thereafter. The tests must also be repeated on the change of any components or design of the package. Records of tests and results must be maintained.

§ 78.150-7 Marking.

(a) On each container. Symbol as follows:

ICC-33A

These marks shall be understood to certify that the outer container complies with all the construction requirements of the specification.

(1) The letters NRC, located just above or below the ICC mark, to indicate a nonreusable container.

(2) Name or symbol (letters) of manufacturer and plant making the case; these must be registered with the Bureau of Explosives. These marks shall be located on the same face as the marks specified in this paragraph.

(3) Size of markings: Specification markings prescribed in this paragraph must be at least ½ inch high; other markings must be legible.

Subpart E—Specifications for Wooden Barrels, Kegs, Boxes, Kits, and Drums

§ 78.155 Specification 10A; wooden barrels and kegs (tight).

§ 78.155-1 Compliance.

(a) Required in all details.

§ 78.155-2 Staves and heading.

(a) To be of white oak, chestnut oak, red oak, black cherry, Douglas fir, beech, sweet birch, yellow birch, sugar (hard) maple, or Scandinavian pine; quarter sawed with the grain, from straight-grained timber, so no annual ring shall slope over half the thickness of stave or head; thoroughly kiln dried, moisture content 7 percent to 11 percent; free from rotten sap, checks, pitch pockets, cat faces, seed and worm holes in excess of 15 in one container, and other defects that show through on both sides.

§ 78.155-3 Hoops.

(a) Hoops to be of cooperage-grade hoop steel.

§ 78.155-4 Staves.

(a) Staves to be sawed evenly and circular; croze center to be within 1⅞" of end of stave; stave end to have ⅞" free from bevel.

§ 78.155-5 Heading.

(a) Heading of uniform thickness and properly circled; planed on outside and properly jointed and glued, or doweled and flagged; dowel diameter not over ⅜" thickness of head.

§ 78.155-6 The barrel.

(a) Stave joints reasonably flush on outside. Lathing is forbidden.

(b) Worm and seed holes to be plugged; over 15 not authorized in one container.

§ 78.155-7 Parts required and dimensions.

(a) Parts required and dimensions as follows (10 percent excess capacity authorized):

(1) Staves, when finished on outside:

Capacity of container, not over	Maximum			Minimum	
	Length	Width	Bilge circle	Staves	Thickness
Gallons	Inches	Inches	Inches	Number	Inch
50.....	34	6	84	19	¾
30.....	30	5	74	16	¾
15.....	24	4½	64	14	¾
10.....	22	4¼	50	12	¾
5.....	18	4	40	10	¾

Foregoing thicknesses are of staves finished on one side. One-sixteenth inch must be added for unfinished staves.

Foregoing maximum lengths are authorized to be increased 6 percent or less, provided the thickness of stave is increased at least one-sixteenth inch for each increase of 1 inch in length or fraction thereof.

(2) Heading, after planing:

Capacity of container, not over	Maximum		Minimum	
	Pieces	Diameter	Thickness	Width
Gallons	Number	Inches	Inch	Inches
50.....	6	21	1	2½
30.....	6	18	1¼	2½
15.....	6	14	1½	2
10.....	6	13	¾	2
5.....	4	11	¾	2

(3) Hoops, number and size:

Capacity of container, not over (gallons)	Minimum number of hoops	Minimum size of hoops (inches in width and Birmingham gauge)							
		Head		1st quarter		2d quarter		Bilge	
		Inch	Gauge	Inch	Gauge	Inch	Gauge	Inch	Gauge
50.....	8	1¾	18	1¼	18	1¼	18	1¾	17
30.....	8	1½	17	1¼	19	-----	-----	1½	18
15.....	6	1½	18	1¼	19	-----	-----	1¼	19
10.....	6	1½	19	1	19	-----	-----	1¼	19
5.....	6	1½	19	1	19	-----	-----	1	19

Because of the present emergency and until further order of the Commission, head hoops of 17 gauge are authorized.

§ 78.155-8 Closures.

(a) To be such as to prevent leakage in transit. Bungholes in staves must be not over 2" diameter.

§ 78.155-9 Lining.

(a) To be as prescribed in Part 73 of this chapter or otherwise appropriate for the contents.

§ 78.155-10 Type test.

(a) Sample container at least 2 days old shall not increase more than 10 percent on diameter of head when all hoops above bilge are removed.

§ 78.155-11 Leakage test.

(a) Required for each lined container; by pressure at time of sizing or air pressure of at least 5 pounds per square inch; leakers to be repaired and retested.

§ 78.155-12 Marking.

(a) Marking on each container by the maker. By hot branding iron on head as follows:

(1) ICC-10A. This mark shall be understood to certify that the container complies with all specification requirements.

(2) Name or symbol (letters) of maker; this must be registered with the Bureau of Explosives and located just above, below, or following the mark specified in subparagraph (1) of this paragraph.

(3) Date of manufacture (for example, 7-50 for July 1950) located near the maker's mark.

NOTE 1: Because of the present emergency and until further order of the Commission, date of manufacture may be omitted.

§ 78.155-13 Size of markings.

(a) Size of markings (minimum): ¾" high for over 30-gallon size, ½" for others.

§ 78.156 Specification 10B; wooden barrels and kegs (tight).

§ 78.156-1 Compliance.

(a) Required in all details.

§ 78.156-2 Staves and heading.

(a) To be of white oak, chestnut oak, red oak, black cherry, Douglas fir, beech,

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sweet birch, yellow birch, sugar (hard) maple, or Scandinavian pine; quarter sawed with the grain, from straight-grained timber, so no annual ring shall slope over half the thickness of stave or head; thoroughly kiln dried, moisture content 7 percent to 11 percent; free from rotten sap, checks, pitch pockets, cat faces, seed and worm holes in excess of 15 in one container, and other defects that show through on both sides.

§ 78.156-3 Hoops.

(a) To be of cooperage-grade hoop steel.

§ 78.156-4 Staves.

(a) Staves to be sawed evenly and circular; croze center to be within 1/8" of end of stave; stave end to have 1/8" free from bevel.

§ 78.156-5 Heading.

(a) Heading of uniform thickness and properly circled; planed on outside and properly jointed and glued, or doweled and flagged; dowel diameter not over 5/12" thickness of head.

§ 78.156-6 The barrel.

(a) Stave joints reasonably flush on outside. Lathing is forbidden.
 (b) Worm and seed holes to be plugged; over 15 not authorized in one container.

§ 78.156-7 Parts required and dimensions.

(a) Parts required and dimensions as follows (10 percent excess capacity authorized):

(1) Staves, when finished on outside:

Capacity of container, not over	Maximum			Minimum	
	Length	Width	Bilge Circle	Staves	Thickness
Gallons	Inches	Inches	Inches	Number	Inch
50.....	34	6	84	19	1 1/4
30.....	30	5	74	16	5/8
15.....	24	4 1/4	54	14	9/16
10.....	22	4 1/4	50	12	1/2
5.....	18	4	40	10	3/4

Foregoing thicknesses are of staves finished on one side. One-sixteenth inch must be added for unfinished staves. Foregoing maximum lengths are authorized to be increased 6 percent or less, provided the thickness of stave is increased at least one-sixteenth inch for each increase of 1 inch in length or fraction thereof.

(2) Heading, after planing:

Capacity of container, not over	Maximum		Minimum	
	Pieces	Diameter	Thickness	Width
Gallons	Number	Inches	Inch	Inches
50.....	6	21	3/4	2 1/4
30.....	6	18	5/8	2 1/4
15.....	5	14	9/16	2
10.....	5	13	1/2	2
5.....	4	11	3/4	2

NOTE 1: Because of the present emergency and until further order of the Commission, for barrels of not over 50 gallons capacity, maximum number of pieces may be 7 provided they have a minimum thickness of 3/8 inch.

(3) Hoops, number and size:

Capacity of container, not over (gallons)	Minimum number of hoops	Minimum size of hoops (inches in width and Birmingham gauge)							
		Head		First quarter		Second quarter		Bilge	
		Inch	Gauge	Inch	Gauge	Inch	Gauge	Inch	Gauge
50	18	1 1/4	17	1 1/4	18	1 1/4	18	1 1/4	17
30	6	1 1/4	18	1 1/4	19	1 1/4	18	1 1/4	18
15	6	1 1/4	19	1 1/4	19	1 1/4	18	1 1/4	19
10	6	1 1/4	19	1	19	1 1/4	18	1 1/4	19
5	6	1	19	1	19	1 1/4	18	1 1/4	19

¹ Because of the present emergency and until further order of the Commission, the minimum number of hoops is authorized to be reduced to 6 by eliminating second quarter hoops.

² Because of the present emergency and until further order of the Commission, the minimum number of hoops is authorized to be reduced to 4 by eliminating first quarter hoops if head and bilge hoops of 1 1/4 inch by 17 gauge are used.

³ 2 inch by 18 gauge hoops are also authorized.

§ 78.156-8 Closures.

(a) To be such as to prevent leakage in transit. Bung holes in staves must be not over 2" diameter.

§ 78.156-9 Lining.

(a) To be as prescribed in Part 73 of this chapter or otherwise appropriate for the contents.

§ 78.156-10 Type test.

(a) Sample container at least 2 days old shall not increase more than 10 percent on diameter of head when all hoops above bilge are removed.

§ 78.156-11 Leakage test.

(a) Required for each lined container; by pressure at time of sizing or air pressure of at least 5 pounds per square inch; leakers to be repaired and retested.

§ 78.156-12 Marking.

(a) Marking on each container by the maker. By hot branding iron on head as follows:

(1) ICC-10B. This mark shall be understood to certify that the container complies with all specification requirements.

(2) Name or symbol (letters) of maker; this must be registered with the Bureau of Explosives and located just above, below, or following the mark specified in subparagraph (1) of this paragraph.

(3) Date of manufacture (for example, 7-50 for July 1950) located near the maker's mark.

NOTE 1: Because of the present emergency and until further order of the Commission, date of manufacture may be omitted.

§ 78.156-13 Size of markings.

(a) Size of markings (minimum): 3/4" high for over 30-gallon size, 1/2" for others.

§ 78.157 Compliance.

§ 78.157-1 Compliance.

(a) Required in all details.

§ 78.157-2 Staves and heading.

(a) To be of white oak, chestnut oak, red oak, black cherry, Douglas fir, beech, sweet birch, yellow birch, sugar (hard) maple, or Scandinavian pine; quarter sawed with the grain, from straight-grained timber, so no annual ring shall slope over half the thickness of stave or head; thoroughly kiln dried, moisture content 7 percent to 11 percent; free from rotten sap, checks, pitch pockets, cat faces, seed and worm holes in excess of 15 in one container, and other defects that show through on both sides.

§ 78.157-3 Hoops.

(a) To be of cooperage-grade hoop steel.

§ 78.157-4 Staves.

(a) Staves to be sawed evenly and circular; croze center to be within 1/8" of end of stave; stave end to have 1/8" free from bevel.

§ 78.157-5 Heading.

(a) Heading of uniform thickness and properly circled; planed on outside and properly jointed and glued, or doweled and flagged; dowel diameter not over 5/12" thickness of head.

§ 78.157-6 The barrel.

(a) Stave joints reasonably flush on outside. Lathing is forbidden.
 (b) Worm and seed holes to be plugged; over 15 not authorized in one container.

§ 78.157-7 Parts required and dimensions.

(a) Parts required and dimensions as follows (10 percent excess capacity authorized):

(1) Staves, when finished on outside:

Capacity of container, not over	Maximum			Minimum	
	Length	Width	Bilge circle	Staves	Thickness
Gallons	Inches	Inches	Inches	Number	Inch
50.....	34	6	84	19	1 1/4
30.....	30	5	74	16	5/8
15.....	24	4 1/4	54	14	9/16
10.....	22	4 1/4	50	12	1/2
5.....	18	4	40	10	3/4

Foregoing thicknesses are of staves finished on one side. One-sixteenth inch must be added for unfinished staves. Foregoing maximum lengths are authorized to be increased 6 percent or less, provided the thickness of stave is increased at least one-sixteenth inch for each increase of 1 inch in length or fraction thereof.

(2) Heading after planing:

Capacity of container, not over	Maximum		Minimum	
	Pieces	Diameter	Thickness	Width
Gallons	Number	Inches	Inch	Inches
50.....	6	21	3/4	2 1/4
30.....	6	18	5/8	2 1/4
15.....	5	14	9/16	2
10.....	5	13	1/2	2
5.....	4	11	3/4	2

NOTE 1: Because of the present emergency and until further order of the Commission, for barrels of not over 50 gallons capacity, maximum number of pieces may be 7 provided they have a minimum thickness of 3/8 inch.

(3) Hoops, number and size:

Capacity of container, not over (gallons)	Minimum number of hoops	Minimum size of hoops (inches in width and Birmingham gauge)							
		Head		1st quarter		2d quarter		Bilge	
		Inch	Gauge	Inch	Gauge	Inch	Gauge	Inch	Gauge
50	6	1 3/4	17	1 1/2	18	-----	-----	1 1/2	17
30	6	1 1/2	18	1 1/2	19	-----	-----	1 1/2	18
15	6	1 1/2	19	1 1/4	19	-----	-----	1 1/2	19
10	6	1 1/4	19	1	19	-----	-----	1 1/4	19
5	6	1	19	1	19	-----	-----	1	19

§ 78.157-8 Closures.

(a) To be such as to prevent leakage in transit. Bung holes in staves must be not over 2" diameter.

§ 78.157-9 Lining.

(a) To be as prescribed in Part 73 of this chapter or otherwise appropriate for the contents.

§ 78.157-10 Type test.

(a) Sample container at least 2 days old shall not increase more than 10 percent on diameter of head when all hoops above bilge are removed.

§ 78.157-11 Leakage test.

(a) Required for each lined container; by pressure at time of sizing or air pressure of at least 5 pounds per square inch; leakers to be repaired and retested.

§ 78.157-12 Marking.

(a) Marking on each container by the maker. By hot branding iron on head as follows:

(1) ICC-10C. This mark shall be understood to certify that the container complies with all specification requirements.

(2) Name or symbol (letters) of maker; this must be registered with the Bureau of Explosives and located just above, below, or following the mark specified in subparagraph (1) of this paragraph.

(3) Date of manufacture (for example, 7-50 for July, 1950) located near the maker's mark.

NOTE 1: Because of the present emergency and until further order of the Commission, date of manufacture may be omitted.

§ 78.157-13 Size of markings.

(a) Size of marking (minimum): 3/4" high for over 30-gallon size, 1/2" for others.

§ 78.160 Specification 11A; wooden barrels and kegs (slack).

§ 78.160-1 Compliance.

(a) Required in all details.

§ 78.160-2 Classification of woods.

(a) As follows:

GROUP A

Oak. Sycamore.
 Beech. Hackberry.
 Maple. Birch.
 Elm. Douglas fir.
 Red Gum. White ash.

GROUP B

Cottonwood. Pine.
 Basswood. Chestnut.
 Tupelo gum. Willow.

NOTE 1: Because of the present emergency and until further order of the Commission, cottonwood and poplar are authorized to be included in Group A woods.

§ 78.160-3 Staves.

(a) Staves of Group A woods, No. 1 grade, kiln dried; of uniform thickness, well equalized, circled, and jointed; minimum thickness 5 staves to 1 7/8"; maximum width 5 1/2".

(b) To be tongued and grooved.

§ 78.160-4 Heading.

(a) Heading to be No. 1 grade, kiln dried, uniform thickness, turned true to size, dressed on one side, and jointed and glued.

§ 78.160-5 Metal hoops.

(a) Hoops of cooperage-grade hoop steel with one edge beaded or rolled.

§ 78.160-6 Wooden hoops.

(a) No. 1 grade colled elm at least 5/32" x 5/32" x 1 3/8"; ends joined by 1 staple and 2 additional nails or staples clinched on the inside or by 4 nails or 3 staples clinched on the inside.

§ 78.160-7 Parts and dimensions.

(a) Parts and dimensions as follows:

Authorized net weight (pounds)	Heading			Staves	Metal hoops ¹		
	Diameter not over ² (inch)	Thickness at least			Length not over ³ (inch)	Width (inch) by Birmingham wire gauge (minimum)	
		Wood group				Head	Quarter and bilge
350	16	1 1/2	1 1/2	3	28 1/2			1 1/2 x 23	1 1/2 x 23
450	16	1 1/2	1 1/2	3	28 1/2	1 1/2 x 23	1 1/2 x 23
600	16	1 1/2	1 1/2	3	28 1/2	1 1/2 x 23	1 1/2 x 23
350	17	1 1/2	1 1/2	4	30	1 1/2 x 23	1 1/2 x 23
450	17	1 1/2	1 1/2	4	30	1 1/2 x 23	1 1/2 x 23
600	17	1 1/2	1 1/2	4	30	1 1/2 x 23	1 1/2 x 23
350	19	1 1/2	1 1/2	5	34	1 1/2 x 22	1 1/2 x 23
450	19	1 1/2	1 1/2	5	34	1 1/2 x 22	1 1/2 x 23
600	19	1 1/2	1 1/2	5	34	1 1/2 x 22	1 1/2 x 23
350	21	1 1/2	1 1/2	5	34	1 1/2 x 21	1 1/2 x 23
450	1 21	3/4	3/4	5	34	1 1/2 x 21	1 1/2 x 23
600	1 21	3/4	3/4	5	34	1 1/2 x 21	1 1/2 x 23

¹ Head battens required; at least 1 1/2" x 3 1/4"; ends rounded to fit chime; securely nailed to heads.

² Quarter hoops not required for 350 pounds authorized net weight.

³ Tolerance of 1/4" authorized.

⁴ Wooden hoops authorized: 8 for 350 pounds net; 10 for 450 pounds net; 12 for 600 pounds net.

§ 78.160-3 Head liners.

(a) Required as provided in § 78.160-13.

§ 78.160-9 Marking.

(a) Marking on each container to be applied by the maker on top head as follows:

(1) ICC-11A; followed by the authorized gross weight (authorized net weight plus tare weight; for example, ICC-11A475, etc.). This mark shall be understood to certify that the container complies with all specification requirements.

(2) Name or symbol (letters) of maker; this must be registered with the Bureau of Explosives and located just above, below, or following the mark specified in subparagraph (1) of this paragraph.

§ 78.160-10 Size of marking.

(a) Size of marking (minimum): 3/4" high for head diameter over 17"; 1/2" high for others.

§ 78.160-11 Heads.

(a) To fit well in croze and be secured by nails or staples at 8" spacing through hoops into heads.

§ 78.160-12 Head battens (when required by § 78.160-7).

(a) To be fastened at each end by 1/2" metal strapping nailed over chime and under hoops.

§ 78.160-13 Head liners.

(a) To extend across grain, circle at least 1/2 of circumference, and be nailed or stapled at 5" intervals. Required for containers with wooden hoops when net weight of contents is to exceed 250 pounds.

§ 78.160-14 Quarter and bilge hoops.

(a) To be driven and fastened by 4 fasteners for each hoop; puncture fastening at 8" intervals authorized for metal hoops.

§ 78.161 Specification 11B; wooden barrels and kegs (slack).

§ 78.161-1 Compliance.

(a) Required in all details.

§ 78.161-2 Classification of woods.

(a) As follows:

GROUP A

Oak. Hackberry.
 Beech. Birch.
 Maple. Douglas fir.
 Elm. White ash.
 Red Gum.
 Sycamore.

GROUP B

Cottonwood. Pine.
 Basswood. Chestnut.
 Tupelo gum. Willow.

NOTE 1: Because of the present emergency and until further order of the Commission, cottonwood and poplar are authorized to be included in Group A woods.

§ 78.161-3 Staves.

(a) Staves of Group A woods, No. 1 grade, kiln dried; of uniform thickness,

well equalized, circled, and jointed; minimum thickness 5 staves to 1 1/4"; maximum width 5 1/2". Group B woods authorized for 24" or shorter staves.

§ 78.161-4 Heading.

(a) Heading to be No. 1 grade, kiln-dried, uniform thickness, turned true to size, dressed on one side, and jointed.

§ 78.161-5 Metal hoops.

(a) Hoops of cooperage-grade hoop steel with one edge beaded or rolled.

§ 78.161-6 Wooden hoops.

(a) No. 1 grade coiled elm at least 5/32" x 5/32" x 1 1/4"; ends joined by 1 staple and 2 additional nails or staples clinched on the inside or by 4 nails or 3 staples clinched on the inside.

§ 78.161-7 Parts and dimensions.

(a) Parts and dimensions as follows:

Authorized net weight (pounds)	Heading		Staves	Metal hoops ¹	Width (inch) by Birmingham wire gauge (minimum)	
	Diameter not over ² (inches)	Thickness at least				Number of pieces not over	Length not over^{3} (inches)
		Wood group				
		A (inch)	B (inch)	Head				Quarter and bilge
350	16	1/2	3	28 1/2	1 1/4 x 23	1 1/4 x 23
450	16	1/2	3	28 1/2	1 1/4 x 23	1 1/4 x 23
600	16	1/2	3	28 1/2	1 1/4 x 23	1 1/4 x 23
350	17	1/2	4	30	1 1/4 x 23	1 1/4 x 23
450	17	1/2	4	30	1 1/4 x 23	1 1/4 x 23
600	17	1/2	4	30	1 1/4 x 23	1 1/4 x 23
350	19	1/2	5	34	1 1/4 x 23	1 1/4 x 23
450	19	1/2	5	34	1 1/4 x 23	1 1/4 x 23
600	19	1/2	5	34	1 1/4 x 23	1 1/4 x 23
350	21	1/2	5	34	1 1/4 x 21	1 1/4 x 23
					or 2 x 22	1 1/4 x 23
450	21	3/8	5	34	1 1/4 x 21	1 1/4 x 23
					or 2 x 22	1 1/4 x 23
600	21	3/8	5	34	1 1/4 x 21	1 1/4 x 23
					or 2 x 22	1 1/4 x 23

¹ Head battens required; at least 1/4" x 3 1/2"; ends rounded to fit chime; securely nailed to heads.
² Quarter hoops not required for 350 pounds authorized net weight.
³ Tolerance of 1/8" authorized.
⁴ Wooden hoops authorized: 8 for 350 pounds net; 10 for 450 pounds net; 12 for 600 pounds net.

§ 78.161-8 Head liners.

(a) Required as provided in § 78.161-13.

§ 78.161-9 Marking.

(a) Marking on each container to be applied by the maker on top head as follows:

(1) ICC-11B; followed by the authorized gross weight (authorized net weight plus tare weight; for example, ICC-11B370, etc.). This mark shall be understood to certify that the container complies with all specification requirements.

(2) Name or symbol (letters) of maker; this must be registered with the Bureau of Explosives and located just above, below, or following the mark specified in subparagraph (1) of this paragraph.

§ 78.161-10 Size of marking.

(a) Size of marking (minimum): 3/4" high for head diameter over 17"; 1/2" high for others.

§ 78.161-11 Heads.

(a) Heads to fit well in croze and be secured by nails or staples at 8" spacing through hoops into heads.

§ 78.161-12 Head battens (when required by § 78.161-7).

(a) To be fastened at each end by 1/2" metal strapping nailed over chime and under hoops.

§ 78.161-13 Head liners.

(a) To extend across grain, circle at least 1/2 of circumference, and be nailed or stapled at 5" intervals. Required for containers with wooden hoops when net weight of contents is to exceed 250 pounds.

§ 78.161-14 Quarter and bilge hoops.

(a) To be redriven and fastened by 4 fasteners for each hoop; puncture fastening at 8" intervals authorized for metal hoops.

§ 78.165 Specification 14; wooden boxes, nailed.

§ 78.165-1 Compliance.

(a) Required in all details.

§ 78.165-2 Lumber.

(a) White pine or wood of at least equal strength, well seasoned, commercially dry, and free from decay, loose knots, knots that would interfere with nailing, and other defects that would materially lessen the strength. Grain of wood in cleats must not cross cleat within one-half its length.

§ 78.165-3 Nails.

(a) Cement coated, except as otherwise authorized, or screws of equal efficiency.

§ 78.165-4 Ends, sides, tops, and bottoms.

(a) Ends, sides, tops, and bottoms, as follows:
 (1) Parts of 1-piece.
 (2) Parts Linderman-joint glued.
 (3) Parts tongued, grooved, and glued.
 (4) Parts butt-joint glued, provided the joined surfaces are planed before gluing so as to assure full contact. After immersion in water for 24 hours at 70° F, the part must not fall at the joint when it is broken.

(b) Tongued, grooved and glued joints in uncleated ends must also be fastened with corrugated fasteners not over 8" apart, within 3" of each end of joint and having penetration 4/5 thickness of end.

§ 78.165-5 Cleated ends.

(a) Double cleated, 2 vertical and 2 horizontal. Nails staggered at 2" intervals and clinched; cement coating not required.

§ 78.165-6 Sides, tops, and bottoms.

(a) Of size to extend out over cleats, if any.

§ 78.165-7 Lock and dovetail corners.

(a) Glued.

§ 78.165-8 Parts and dimensions.

(a) Parts and dimensions as follows:

Authorized gross weight (maximum) (pounds)	Type of box	Thickness of lumber (minimum)				Nails (minimum size) ⁴	
		Ends ¹	Sides	Tops and bottoms ²	Cleats	Into ends or cleats	Into sides
		Inches	Inch	Inch	Inches	Penny	Penny
35	Lock ¹ Corner	3/4	3/4	3/4		5d	5d
65	Lock ¹ Corner	3/4	3/4	3/4		5d	5d
75	Plain Nailed	3/4	3/4	3/4		7d	5d
75	Double Cleat	3/4	3/4	3/4	1/2 x 1 1/2	5d	
140	Plain Nails	1 1/4	3/4	3/4		8d	7d
140	Lock ¹ Corner	3/4	3/4	3/4		7d	7d
140	Double Cleat	3/4	3/4	3/4	3/4 x 1 1/4	7d	7d

¹ Or dovetail.
² Tops and bottoms may be made of paper covered veneer board of good quality Douglas fir, or lumber of equal quality, having minimum thickness of 1/4 inch and free from decay, objectionable knots that interfere with nailing, splits, gaps, and other defects that materially lessen the strength. Paper covering shall be at least Kraft untreated liner-board having a basis weight of 42 pounds per 1,000 square feet and shall be secured to veneer core by adhesive in such manner as to form a satisfactorily laminated board. Board ends must be provided with such reinforcement as may be necessary to provide strength for nailing.
³ As provided by § 78.65 (a) (1), Note 1, of this chapter, boxes, having inside metal containers which are tightly and securely closed, may be equipped with hand holes in each end which must be not more than one inch by four inches and centered laterally not nearer than 1 1/4 inches from top edge of end of box.
⁴ Coated wire staples are authorized in lieu of nails when used for fastening tops to boxes. Staples must be of such size and spaced and driven as to provide closure efficiency equivalent to that in §§ 78.165-11 and 78.165-12.

§ 78.165-9 Joints in sides and ends.

(a) Staggered; except for ends cleated as prescribed.

§ 78.165-10 Tops and bottoms.

(a) Must fit evenly on frame of box.

§ 78.165-11 Cleated boxes.

(a) Sides, top, and bottom must be secured to ends by nails driven into cleats, not into end boards.

§ 78.165-12 Nails in each nailing edge (minimum number).

(a) At least equal to length of edge in inches divided by 2; when number of nails is at least equal to length of edge divided by 1 1/4, 4d nails are authorized where 5d nails are prescribed.

Exception: Eight inch spacing authorized for nailing tops and bottoms to sides.

NOTE 1: Because of the present emergency and until further order of the Commission,

the following exception is authorized for nailing tops to boxes: When 7d and 8d nails are required by § 78.165-8, 6d nails are authorized if number of nails used is at least equal to length of end edge divided by 1 1/4 and length of side edge divided by 6.

§ 78.165-13 Marking.

(a) Marking on each box with letters and figures at least 1/2" high in rectangle as follows:



(1) This mark shall be understood to certify that box complies with all specification requirements.

§ 78.168 Specification 15A; wooden boxes, nailed.

§ 78.168-1 Compliance.

(a) Required in all details.

§ 78.168-2 Closed¹ box.

(a) Parts and pieces to be in close contact.

§ 78.168-3 Ends.

(a) One-piece, or equivalent (see § 78.168-5), or cleated as prescribed; joints tongued, grooved, and glued. Style 1 or style 6 boxes may have milled depressions in each end of box for hand-holds, of not more than 3/8 inch in depth and not exceeding one-third of the width of the box, only when ends are of lumber at least 3/4 inch in thickness.

(b) As provided by § 73.65 (a) (1), Note 1, of this chapter, wooden boxes, having inside metal containers which are tightly and securely closed, may be equipped with hand holes in each end which must be not more than one inch by four inches and centered laterally not nearer than 1 1/8 inches from top edge of end of box.

§ 78.168-4 Sides, top, and bottom.

(a) Joints tongued, grooved, and glued, or one-piece equivalent, except that boxes for shipment of high explosives may have tops and bottoms made of paper-covered veneer board of good quality Douglas fir, or lumber of equal quality, having minimum thickness of 1/8 inch and free from decay, objectionable knots that interfere with nailing, splits, gaps, and other defects that materially lessen the strength. Paper covering shall be at least kraft untreated linerboard having a basis weight of 42 pounds per 1,000 square feet and shall be secured to veneer core by adhesive in such manner as to form a satisfactorily laminated board. Board ends must be provided with such reinforcement as may be necessary to provide strength for nailing, and when used lumber thicknesses specified by § 78.168-12 do not apply.

§ 78.168-5 One-piece equivalents.

(a) Parts are considered equivalent to one-piece as follows:

- (1) Parts Linderman-joint glued.
- (2) Parts at least 1/2" thick, tongued and grooved and glued, with 2 or more corrugated fasteners on each joint.

(3) Parts butt-joint glued, provided the joined surfaces are planed before gluing, so as to assure full contact. After immersion in water for 24 hours at 70° F. the part must not fail at the joint when it is broken.

(b) Corrugated fasteners (as prescribed for one-piece equivalents): 1" wide; penetration 1/2 thickness of part; within 3" of end of joint and not over 8" apart; for 3 or more, drive alternately into opposite sides of part.

§ 78.168-6 Gluing efficiency.

(a) Shall be determined for boxes for gross weight of 150 pounds or less. When filled with sand and sawdust to marked gross weight, the boxes must be able to withstand 8 drops of 12", one on each corner, onto solid concrete without exposure of contents.

§ 78.168-7 Lumber.

(a) To be well seasoned, commercially dry, and free from decay, loose knots that would interfere with nailing, and other defects that would materially lessen the strength. Grain of wood in cleats must not cross cleat within 1/2 its length.

§ 78.168-8 Nails.

(a) Cement coated, unless otherwise authorized herein, of size specified for "sinkers" and "coolers" as generally known to the trade.

§ 78.168-9 Grouping of principal woods.

(a) Grouping as follows:

GROUP 1

- White pine. Chestnut.
- Norway pine. Sugar pine.
- Aspen (popple). Cypress.
- Spruce. Basswood.
- Western (yellow) pine. Willow.
- Cottonwood. Noble fir.
- Balsam fir. Magnolia.
- Yellow poplar. Buckeye.
- Cedar. White fir.
- Redwood. Alpine fir.
- Butternut. Lodgepole pine.
- Cucumber. Jack pine.

GROUP 2

- Southern yellow pine. Douglas fir.
- Hemlock. Larch (tamarack).
- North Carolina pine.

GROUP 3

- White elm. Black gum.
- Red gum. Black ash.
- Sycamore. Tupelo.
- Pumpkin ash. Maple—soft or silver.

GROUP 4

- Hard maple. Birch.
- Beech. Rock elm.
- Oak. Hickory.
- Hackberry. White ash.

§ 78.168-10 Width of pieces.

(a) At least 2 1/2".

§ 78.168-11 Width of cleats.

(a) Twice the prescribed thickness plus 3/4".

§ 78.168-12 Thickness of lumber.

(a) Nailed boxes not cleated (Style 1). Authorized gross weight not over 100 pounds, see Note 1. Sides as in Table 1;

top and bottom as in Table 1A; ends as in Table 5.

(b) Glued-lock-corner boxes (Style 6). Authorized gross weight not over 150 pounds. Sides as in Table 3; top and bottom as in Table 1A; ends as in Table 3A. Or, sides as in Table 2; top and bottom as in Table 1A; end as in Table 4.

(c) Single-cleated boxes (Style 4 or 5). Authorized gross weight not over 200 pounds, see Note 2. Sides as in Table 1; top and bottom as in Table 1A; ends and cleats as in Table 3A.

(d) Double-cleated boxes (Style 2, 2 1/2, or 3). Authorized gross weight not over 500 pounds, see Note 3. Sides as in Table 1; top and bottom as in Table 1A; end and cleats as in Table 2A. Or, sides as in Table 1; top and bottom as in Table 1A; cleats as in Table 3B; ends not thinner than thickest side or top.

NOTE 1: When group 2 woods are used the gross weight may be increased to 110 pounds.

NOTE 2: When group 2 woods are used the gross weight may be increased to 220 pounds.

NOTE 3: When group 2 woods are used the gross weight may be increased to 550 pounds.

(e) Tables are as follows (dimensions of materials finished or resawed):

TABLE 1

Depth of box (inches)	Not over 8"	Not over 9"	Not over 10"	Not over 12"	Not over 14"	Over 14"	Minimum thickness of part					
							Inches	Inches	Inch	Inch	Inch	Inch
15	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	
25	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	
35	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	
45	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	
55	3/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	
65	3/4	3/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	
75	3/4	3/4	3/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	
85	3/4	3/4	3/4	3/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	
100	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	
125	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	
150	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	
175	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	
200	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	
250	3/4	3/4	1 1/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	
300	1 1/4	1 1/4	3/4	1 1/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	
350	1 1/4	3/4	1 1/4	3/4	1 1/4	3/4	3/4	3/4	3/4	3/4	3/4	
400	1	1 1/4	3/4	1 1/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	
500	1 1/4	1 1/4	1	1 1/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	

TABLE 1A

Width of box (inches)	Not over 8"	Not over 9"	Not over 10"	Not over 12"	Not over 14"	Over 14"	Minimum thickness of part					
							Inches	Inches	Inch	Inch	Inch	Inch
15	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	
25	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	
35	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	
45	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	
55	3/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	
65	3/4	3/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	
75	3/4	3/4	3/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	
85	3/4	3/4	3/4	3/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	
100	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	
125	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	
150	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	
175	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	
200	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	
250	1 1/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	
300	1 1/4	1 1/4	3/4	1 1/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	
350	1 1/4	3/4	1 1/4	3/4	1 1/4	3/4	3/4	3/4	3/4	3/4	3/4	
400	1	1 1/4	3/4	1 1/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	
500	1 1/4	1 1/4	1	1 1/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	

¹ Openings for filling device of inside container authorized if device is properly protected.

RULES AND REGULATIONS

TABLE 2

Table with 7 columns: Depth of box (inches), Not over 8", Not over 9", Not over 10", Not over 12", Not over 14", Over 14". Rows list authorized gross weight (pounds) from 15 to 600.

TABLE 2A

Table with 7 columns: Smallest dimension of end, Not over 8", Not over 9", Not over 10", Not over 12", Not over 14", Over 14". Rows list authorized gross weight (pounds) from 15 to 600.

TABLE 3

Table with 7 columns: Depth of box (inches), Not over 8", Not over 9", Not over 10", Not over 12", Not over 14", Over 14". Rows list authorized gross weight (pounds) from 15 to 600.

TABLE 3A

Table with 7 columns: Smallest dimension of end, Not over 8", Not over 9", Not over 10", Not over 12", Not over 14", Over 14". Rows list authorized gross weight (pounds) from 15 to 600.

TABLE 3B

Table with 7 columns: Smallest dimension of end, Not over 8", Not over 9", Not over 10", Not over 12", Not over 14", Over 14". Rows list authorized gross weight (pounds) from 15 to 600.

TABLE 4

Table with 7 columns: Smallest dimension of end, Not over 8", Not over 9", Not over 10", Not over 12", Not over 14", Over 14". Rows list authorized gross weight (pounds) from 15 to 150.

TABLE 5

Table with 7 columns: Smallest dimension of end, Not over 8", Not over 9", Not over 10", Not over 12", Not over 14", Over 14". Rows list authorized gross weight (pounds) from 15 to 100.

§ 78.168-13 Reduced thicknesses.

(a) Reduction in thicknesses is authorized as in paragraphs (a) to (d) of this section except that reduced thicknesses must be not less than:

(1) Sides, top, and bottom: Minimum 5/16" for boxes up to 35 pounds authorized gross weight and 3/8" above that weight.

(2) Ends or cleats: Minimum 7/16".

(b) Sides of one-piece or equivalent: 12 1/2 percent.

(c) Any part or cleat of Group 3 or 4 wood: 20 percent.

(d) Sides, top, and bottom when to be strapped as per § 78.168-19 (b): 20 percent for 1 strap; 35 percent for 2 straps.

CONVERSION TABLE

Conversion table with 4 columns: Specified thickness (inches), Reduced thickness corresponding to percent reduction (12 1/2, 20, 35). Rows list specified thicknesses from 3/8 to 1 1/2.

§ 78.168-14 Assembly.

(a) By nailing; screws, hinges and hasp, or other device of equal efficiency are authorized; nails should be driven flush.

§ 78.168-15 Nails and nailing.

(a) Cement coated nails of size and with spacing detailed in §§ 78.168-16 and 78.168-17.

(b) At cleated edges drive at least 40 percent of nails into cleats.

(c) Nails fastening cleats to be staggered and clinch 1/8"; uncoated nails authorized.

(d) Nailing tops and bottoms to sides permitted but not required.

§ 78.168-16 Nails; kind and dimensions.

(a) Cement³ coated of gauge and length as for "sinkers" and "coolers" as generally known to the trade; size¹ in "penny" as follows:

Species of wood holding points of nails	Thickness of material holding points of nails (inches)											
	3/8 or less	1/2	5/8	3/4	7/8	1 1/8	1 1/4	1 3/8	1 1/2	1 5/8	1 3/4	1 7/8 or more
Group 1.....	4	5	5	6	7	7	8	8	8	9	9	10
Group 2.....	4	4	5	5	6	6	7	7	7	8	8	9
Group 3.....	3	4	4	4	5	5	6	6	7	7	7	8
Group 4.....	3	3	4	4	4	5	5	6	6	6	7	7

§ 78.168-17 Nail spacing.¹

(a) Nail spacing as follows:

Nails (size)	Maximum spacing when driven into end and cleats	
	Side grain	End grains
	Inches	Inches
Threepenny.....	1 1/4	1
Fourpenny.....	1 1/4	1 1/4
Fivepenny.....	1 1/4	1 1/4
Sixpenny.....	2	1 1/4
Sevenpenny.....	2 1/4	2
Eightpenny.....	2 1/4	2 1/4
Ninepenny.....	2 1/4	2 1/4
Tenpenny.....	3	2 1/4

(4) Size of flat straps must be as follows:

Authorized gross weight (pounds)	Cross-section size when number of straps is—		
	1	2	3
	Inch	Inch	Inch
50.....	1/4 x 0.020	3/8 x 0.015	-----
100.....	1/4 x 0.020	3/8 x 0.018	-----
200.....	3/8 x 0.023	3/8 x 0.020	1/2 x 0.018
300.....	-----	3/8 x 0.023	1/2 x 0.020
400.....	-----	3/8 x 0.020	1/2 x 0.023
500.....	-----	3/8 x 0.023	5/8 x 0.023

(5) Wires, Washburn and Moen gauge, authorized as follows:

Authorized gross weight (pounds)	Gauge of wires when number of straps is—		
	1	2	3
	50.....	12	14
100.....	11	12	-----
200.....	9	11	12
300.....	-----	10	11
400.....	-----	10	11
500.....	-----	9	10

§ 78.169 Specification 15B; wooden boxes, nailed.

§ 78.169-1 Compliance.

(a) Required in all details.

§ 78.169-2 Closed¹ box.

(a) Parts and pieces to be in close contact.

§ 78.169-3 Ends.

(a) One-piece, or equivalent see (§ 78.169-5); or cleated as prescribed with joints tongued and grooved.

§ 78.169-4 Sides, top, and bottom.

(a) Joints tongued and grooved, or one-piece equivalent.

§ 78.169-5 One-piece equivalents.

(a) Parts are considered equivalent to one-piece as follows:

- (1) Parts Linderman-joint glued.
- (2) Parts at least 1/2" thick, tongued and grooved and glued, with 2 or more corrugated fasteners on each joint.
- (3) Parts at least 1/2" thick, tongued and grooved and fastened with 3 or more corrugated fasteners on each joint.

¹ Openings for filling device of inside container authorized if device is properly protected.

² Uncoated nails authorized when increased 25 percent in number.

³ Nails 1-penny smaller authorized when spaced as for 2-penny smaller. Nails 2-penny smaller authorized, but not less than 3-penny, when thickness of material nailed through does not exceed 1/2 of thickness of material holding points of nails.

(4) Parts butt-joint glued, provided the joined surfaces are planed before gluing, so as to assure full contact. After immersion in water for 24 hours at 70° F. the part must not fail at the joint when it is broken.

(b) Corrugated fasteners (as prescribed for one-piece equivalents): 1" wide; penetration 4/5 thickness of part; within 3" of end of joint and not over 8" apart; for 3 or more, drive alternately into opposite sides of part.

§ 78.169-6 Gluing efficiency.

(a) Shall be determined for boxes for gross weight of 150 pounds or less. When filled with sand and sawdust to marked gross weight, the boxes must be able to withstand 8 drops of 12", one on each corner, onto solid concrete without exposure of contents.

§ 78.169-7 Lumber.

(a) To be well seasoned, commercially dry, and free from decay, loose knots, knots that would interfere with nailing and other defects that would materially lessen the strength. Grain of wood in cleats must not cross cleat within 1/2 its length.

§ 78.169-8 Nails.

(a) Cement coated, unless otherwise authorized herein, of size specified for "sinkers" and "coolers" as generally known to the trade.

§ 78.169-9 Grouping of principal woods.

(a) Grouping as follows:

GROUP 1

- White pine.
- Norway pine.
- Aspen (popple).
- Spruce.
- Western (yellow) pine.
- Cottonwood.
- Balsam fir.
- Yellow poplar.
- Chestnut.
- Sugar pine.
- Cypress.
- Basswood.

- Willow.
- Noble fir.
- Magnolia.
- Buckeye.
- White fir.
- Cedar.
- Redwood.
- Butternut.
- Cucumber.
- Alpine fir.
- Lodgepole pine.
- Jack pine.

GROUP 2

- Southern yellow pine.
- Hemlock.
- North Carolina pine.
- Douglas fir.
- Larch (tamarack).

GROUP 3

- White elm.
- Red gum.
- Sycamore.
- Pumpkin ash.
- Black gum.
- Black ash.
- Tupelo.
- Maple—soft or silver.

GROUP 4

- Hard maple.
- Beech.
- Oak.
- Hackberry.
- Birch.
- Rock elm.
- Hickory.
- White ash.

§ 78.169-10 Width of pieces.

(a) At least 2 1/2".

§ 78.169-11 Width of cleats.

(a) Twice the prescribed thickness plus 3/4".

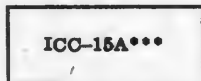
§ 78.169-12 Thickness of lumber.

(a) Nailed boxes not cleated (Style 1). Authorized gross weight not over 100 pounds, see Note 1. Sides as in Table 1; top and bottom as in Table 1A; ends as in Table 5.

(b) Glued-lock-corner boxes (Style 6): Authorized gross weight not over

§ 78.168-18 Marking.

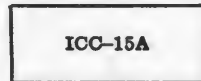
(a) Marking on each box with letters and figures at least 1/2" high in rectangle as follows:



(1) The stars must be replaced by authorized gross weight (for example, ICC-15A100, etc.). This mark shall be understood to certify that box complies with all specification requirements.

(b) The words "ONE STRAP", or "TWO STRAPS", etc., when straps are required (see § 78.168-13 (d)); this to be placed above or below the rectangle.

(c) Marks may also be applied as follows:



NO STRAP XXX LBS.
ONE STRAP XXX LBS.
TWO STRAPS XXX LBS.

(1) The "X's" must be replaced by authorized gross weights as authorized for the strapping conditions.

§ 78.168-19 Closing for shipment.

(a) Box to be securely closed. Nails, if used, to be as prescribed in §§ 78.168-16 and 78.168-17.

(b) Metal straps, as specified by marks on box, must encircle sides, top, and bottom as follows:

- (1) One nailless strap: At center of box.
- (2) Two or more nailless straps: Outer two about 1/6 of box length from ends and other equally spaced between.
- (3) Nailed straps: At ends of sides, top, and bottom; use same size nails as for closing and space not over twice as far apart.

¹ To determine number of nails, divide length of nailing edge by spacing; fractions greater than 1/2 are considered as whole numbers.

150 pounds. Sides as in Table 3; top and bottom as in Table 1A; ends as in Table 3A. Or, sides as in Table 2; top and bottom as in Table 1A; ends as in Table 4.

(c) Single-cleated boxes (Style 4 or 5): Authorized gross weight not over 200 pounds, see Note 2. Sides as in Table 1; top and bottom as in Table 1A; ends and cleats as in Table 3A.

(d) Double-cleated boxes (Style 2, 2½, or 3): Authorized gross weight not over 500 pounds, see Note 3. Sides as in Table 1; top and bottom as in Table 1A; end and cleats as in Table 2A. Or, sides as in Table 1; top and bottom as in Table 1A; cleats as in Table 3B; ends not thinner than thickest side or top.

NOTE 1: When group 2 woods are used the gross weight may be increased to 110 pounds.

NOTE 2: When group 2 woods are used the gross weight may be increased to 220 pounds.

NOTE 3: When group 2 woods are used the gross weight may be increased to 550 pounds.

(e) Tables are as follows (dimensions of materials finished or resawed).

TABLE 1

Depth of box (inches)	Not over 8"	Not over 9"	Not over 10"	Not over 12"	Not over 14"	Over 14"
Authorized gross weight (pounds)	Minimum thickness of part					
	Inches	Inches	Inch	Inch	Inch	Inch
15.....	5/16	5/16	5/16	5/16	5/16	5/16
25.....	5/16	5/16	5/16	5/16	5/16	5/16
35.....	5/16	5/16	5/16	5/16	5/16	5/16
45.....	1/4	1/4	1/4	1/4	1/4	1/4
55.....	3/8	3/8	3/8	3/8	3/8	3/8
65.....	1/2	1/2	1/2	1/2	1/2	1/2
75.....	5/8	5/8	5/8	5/8	5/8	5/8
85.....	3/4	3/4	3/4	3/4	3/4	3/4
100.....	7/8	7/8	7/8	7/8	7/8	7/8
125.....	1	1	1	1	1	1
150.....	1	1	1	1	1	1
175.....	1	1	1	1	1	1
200.....	1	1	1	1	1	1
250.....	1	1	1	1	1	1
300.....	1	1	1	1	1	1
350.....	1	1	1	1	1	1
400.....	1	1	1	1	1	1
500.....	1	1	1	1	1	1

TABLE 1A

Width of box (inches)	Not over 8"	Not over 9"	Not over 10"	Not over 12"	Not over 14"	Over 14"
Authorized gross weight (pounds)	Minimum thickness of part					
	Inches	Inches	Inch	Inch	Inch	Inch
15.....	5/16	5/16	5/16	5/16	5/16	5/16
25.....	5/16	5/16	5/16	5/16	5/16	5/16
35.....	5/16	5/16	5/16	5/16	5/16	5/16
45.....	1/4	1/4	1/4	1/4	1/4	1/4
55.....	3/8	3/8	3/8	3/8	3/8	3/8
65.....	1/2	1/2	1/2	1/2	1/2	1/2
75.....	5/8	5/8	5/8	5/8	5/8	5/8
85.....	3/4	3/4	3/4	3/4	3/4	3/4
100.....	7/8	7/8	7/8	7/8	7/8	7/8
125.....	1	1	1	1	1	1
150.....	1	1	1	1	1	1
175.....	1	1	1	1	1	1
200.....	1	1	1	1	1	1
250.....	1	1	1	1	1	1
300.....	1	1	1	1	1	1
350.....	1	1	1	1	1	1
400.....	1	1	1	1	1	1
500.....	1	1	1	1	1	1

TABLE 2

Depth of box (inches)	Not over 8"	Not over 9"	Not over 10"	Not over 12"	Not over 14"	Over 14"
Authorized gross weight (pounds)	Minimum thickness of part					
	Inches	Inches	Inches	Inch	Inch	Inch
15.....	1/4	1/4	1/4	1/4	1/4	1/4
25.....	1/4	1/4	1/4	1/4	1/4	1/4
35.....	3/8	3/8	3/8	3/8	3/8	3/8
45.....	1/2	1/2	1/2	1/2	1/2	1/2
55.....	5/8	5/8	5/8	5/8	5/8	5/8
65.....	3/4	3/4	3/4	3/4	3/4	3/4
75.....	5/8	5/8	5/8	5/8	5/8	5/8
85.....	3/4	3/4	3/4	3/4	3/4	3/4
100.....	7/8	7/8	7/8	7/8	7/8	7/8
125.....	1	1	1	1	1	1
150.....	1	1	1	1	1	1
175.....	1	1	1	1	1	1
200.....	1	1	1	1	1	1
250.....	1	1	1	1	1	1
300.....	1	1	1	1	1	1
350.....	1	1	1	1	1	1
400.....	1	1	1	1	1	1
500.....	1	1	1	1	1	1

TABLE 2A

Smallest dimension of end	Not over 8"	Not over 9"	Not over 10"	Not over 12"	Not over 14"	Over 14"
Authorized gross weight (pounds)	Minimum thickness of part					
	Inches	Inches	Inches	Inch	Inch	Inch
15.....	1/4	1/4	1/4	1/4	1/4	1/4
25.....	1/4	1/4	1/4	1/4	1/4	1/4
35.....	3/8	3/8	3/8	3/8	3/8	3/8
45.....	1/2	1/2	1/2	1/2	1/2	1/2
55.....	5/8	5/8	5/8	5/8	5/8	5/8
65.....	3/4	3/4	3/4	3/4	3/4	3/4
75.....	5/8	5/8	5/8	5/8	5/8	5/8
85.....	3/4	3/4	3/4	3/4	3/4	3/4
100.....	7/8	7/8	7/8	7/8	7/8	7/8
125.....	1	1	1	1	1	1
150.....	1	1	1	1	1	1
175.....	1	1	1	1	1	1
200.....	1	1	1	1	1	1
250.....	1	1	1	1	1	1
300.....	1	1	1	1	1	1
350.....	1	1	1	1	1	1
400.....	1	1	1	1	1	1
500.....	1	1	1	1	1	1

TABLE 3

Depth of box (inches)	Not over 8"	Not over 9"	Not over 10"	Not over 12"	Not over 14"	Over 14"
Authorized gross weight (pounds)	Minimum thickness of part					
	Inches	Inches	Inches	Inches	Inches	Inches
15.....	5/16	5/16	5/16	5/16	5/16	5/16
25.....	5/16	5/16	5/16	5/16	5/16	5/16
35.....	5/16	5/16	5/16	5/16	5/16	5/16
45.....	1/4	1/4	1/4	1/4	1/4	1/4
55.....	3/8	3/8	3/8	3/8	3/8	3/8
65.....	1/2	1/2	1/2	1/2	1/2	1/2
75.....	5/8	5/8	5/8	5/8	5/8	5/8
85.....	3/4	3/4	3/4	3/4	3/4	3/4
100.....	7/8	7/8	7/8	7/8	7/8	7/8
125.....	1	1	1	1	1	1
150.....	1	1	1	1	1	1
175.....	1	1	1	1	1	1
200.....	1	1	1	1	1	1
250.....	1	1	1	1	1	1
300.....	1	1	1	1	1	1
350.....	1	1	1	1	1	1
400.....	1	1	1	1	1	1
500.....	1	1	1	1	1	1

TABLE 3A

Smallest dimension of end	Not over 8"	Not over 9"	Not over 10"	Not over 12"	Not over 14"	Over 14"
Authorized gross weight (pounds)	Minimum thickness of part					
	Inches	Inches	Inches	Inches	Inches	Inches
15.....	1/4	1/4	1/4	1/4	1/4	1/4
25.....	1/4	1/4	1/4	1/4	1/4	1/4
35.....	3/8	3/8	3/8	3/8	3/8	3/8
45.....	1/2	1/2	1/2	1/2	1/2	1/2
55.....	5/8	5/8	5/8	5/8	5/8	5/8
65.....	3/4	3/4	3/4	3/4	3/4	3/4
75.....	5/8	5/8	5/8	5/8	5/8	5/8
85.....	3/4	3/4	3/4	3/4	3/4	3/4
100.....	7/8	7/8	7/8	7/8	7/8	7/8
125.....	1	1	1	1	1	1
150.....	1	1	1	1	1	1
175.....	1	1	1	1	1	1
200.....	1	1	1	1	1	1
250.....	1	1	1	1	1	1
300.....	1	1	1	1	1	1
350.....	1	1	1	1	1	1
400.....	1	1	1	1	1	1
500.....	1	1	1	1	1	1

TABLE 3B

Smallest dimension of end	Not over 8"	Not over 9"	Not over 10"	Not over 12"	Not over 14"	Over 14"
Authorized gross weight (pounds)	Minimum thickness of part					
	Inches	Inches	Inches	Inches	Inches	Inches
15.....	1/4	1/4	1/4	1/4	1/4	1/4
25.....	1/4	1/4	1/4	1/4	1/4	1/4
35.....	3/8	3/8	3/8	3/8	3/8	3/8
45.....	1/2	1/2	1/2	1/2	1/2	1/2
55.....	5/8	5/8	5/8	5/8	5/8	5/8
65.....	3/4	3/4	3/4	3/4	3/4	3/4
75.....	5/8	5/8	5/8	5/8	5/8	5/8
85.....	3/4	3/4	3/4	3/4	3/4	3/4
100.....	7/8	7/8	7/8	7/8	7/8	7/8
125.....	1	1	1	1	1	1
150.....	1	1	1	1	1	1
175.....	1	1	1	1	1	1
200.....	1	1	1	1	1	1
250.....	1	1	1	1	1	1
300.....	1	1	1	1	1	1
350.....	1	1	1	1	1	1
400.....	1	1	1	1	1	1
500.....	1	1	1	1	1	1

TABLE 4

Smallest dimension of end	Not over 8"	Not over 9"	Not over 10"	Not over 12"	Not over 14"	Over 14"
Authorized gross weight (pounds)	Minimum thickness of part					
	Inch	Inch	Inch	Inch	Inch	Inch
15.....	1/4	1/4	1/4	1/4	1/4	1/4
25.....	1/4	1/4	1/4	1/4	1/4	1/4
35.....	3/8	3/8	3/8	3/8	3/8	3/8
45.....	1/2	1/2	1/2	1/2	1/2	1/2
55.....	5/8	5/8	5/8	5/8	5/8	5/8
65.....	3/4	3/4	3/4	3/4	3/4	3/4
75.....	5/8	5/8	5/8	5/8	5/8	5/8
85.....	3/4	3/4	3/4	3/4	3/4	3/4
100.....	7/8	7/8	7/8	7/8	7/8	7/8
125.....	1	1	1	1	1	1
150.....	1	1	1	1	1	1

TABLE 5

Smallest dimension of end	Not over 8"	Not over 9"	Not over 10"	Not over 12"	Not over 14"	Over 14"
Authorized gross weight (pounds)	Minimum thickness of part					
	Inch	Inch	Inch	Inch	Inch	Inch
15.....	1/4	1/4	1/4	1/4	1/4	1/4
25.....	1/4	1/4	1/4	1/4	1/4	1/4
35.....	3/8	3/8	3/8	3/8	3/8	3/8
45.....	1/2	1/2	1/2	1/2	1/2	1/2
55.....	5/8	5/8	5/8	5/8	5/8	5/8
65.....	3/4	3/4	3/4	3/4	3/4	3/4
75.....	5/8	5/8	5/8	5		

§ 78.169-13 Reduced thickness.

(a) Reduction in thicknesses is authorized as in paragraphs (a) to (d) of this section except that reduced thicknesses must be not less than:

(1) Sides, top, and bottom: Minimum 5/16" for boxes up to 35 pounds authorized gross weight and 3/8" above that weight.

(2) Ends or cleats: Minimum 7/16".

(b) Sides of one-piece or equivalent: 12 1/2 percent.

(c) Any part or cleat of Group 3 or 4 wood: 20 percent.

(d) Sides, top, and bottom when to be strapped as per § 78.169-19(b): 20 percent for 1 strap; 35 percent for 2 straps.

CONVERSION TABLE

Specified thickness (inches)	Reduced thickness corresponding to percent reduction		
	12 1/2	20	35
3/32	1/4	1/4	1/4
1/16	3/32	1/4	1/4
1 1/32	5/16	3/32	1/4
3/8	7/16	1/2	3/4
1/2	1/2	1 1/32	3/4
5/8	5/8	1 1/32	3/4
3/4	3/4	3/4	3/4
7/8	7/8	7/8	7/8
1	1	1	1
1 1/8	1 1/8	1 1/8	1 1/8
1 1/4	1 1/4	1 1/4	1 1/4
1 1/2	1 1/2	1 1/2	1 1/2
1 3/4	1 3/4	1 3/4	1 3/4
2	2	2	2
2 1/4	2 1/4	2 1/4	2 1/4
2 1/2	2 1/2	2 1/2	2 1/2
2 3/4	2 3/4	2 3/4	2 3/4
3	3	3	3

Species of wood holding points of nails	Thickness of material holding points of nails (inches)										
	3/8 or less	7/16	1/2	5/8	3/4	7/8	1 1/8	1 1/4	1 3/8	1 1/2	1 5/8 or more
Group 1.....	4	5	5	6	7	7	8	8	8	9	10
Group 2.....	4	4	5	5	6	6	7	7	7	8	9
Group 3.....	3	4	4	5	5	6	6	7	7	7	8
Group 4.....	3	3	4	4	4	5	5	6	6	7	7

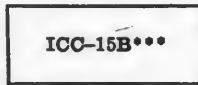
§ 78.169-17 Nail spacing.¹

(a) Nail spacing as follows:

Nails (size)	Maximum spacing when driven into end and cleats	
	Side grain	End grains
	Inches	Inches
Threepenny.....	1 1/4	1
Fourpenny.....	1 1/2	1 1/4
Fivepenny.....	1 3/4	1 1/2
Sixpenny.....	2	1 3/4
Sevenpenny.....	2 1/4	2
Eightpenny.....	2 3/4	2 1/4
Ninepenny.....	2 3/4	2 3/4
Tenpenny.....	3	2 3/4

§ 78.169-18 Marking.

(a) Marking on each box with letters and figures at least 1/2" high in rectangle as follows:



(1) The stars must be replaced by authorized gross weight (for example, ICC-15B125, etc.). This mark shall be understood to certify that box complies with all specification requirements.

(b) The words "ONE STRAP", or "TWO STRAPS", etc., when straps are required (see § 78.169-13 (d)); this to be placed above or below the rectangle.

(c) Marks may also be applied as follows:



NO STRAP XXX LBS.
ONE STRAP XXX LBS.
TWO STRAPS XXX LBS.

(1) The "X's" must be replaced by authorized gross weights as authorized for the strapping conditions.

§ 78.169-19 Closing for shipment.

(a) Box to be securely closed. Nails, if used, to be as prescribed in §§ 78.169-16 and 78.169-17.

(b) Metal straps, as specified by marks on box, must encircle sides, top, and bottom as follows:

(1) One nailless strap: At center of box.

(2) Two or more nailless straps: Outer two about 1/6 of box length from ends and other equally spaced between.

¹To determine number of nails, divide length of nailing edge by spacing; fractions greater than 1/2 are considered as whole numbers.

(3) Nailed straps: At ends of sides, top, and bottom; use same size nails as for closing and space not over twice as far apart.

(4) Size of flat straps must be as follows:

Authorized gross weight (pounds)	Cross-section size when number of straps is—		
	1	2	3
	Inch	Inch	Inch
50.....	1/2 x 0.020	3/4 x 0.015	.....
100.....	5/8 x 0.020	7/8 x 0.018	.....
200.....	3/4 x 0.023	7/8 x 0.020	1 1/4 x 0.018
300.....	.....	7/8 x 0.023	1 1/4 x 0.020
400.....	.....	7/8 x 0.020	1 1/4 x 0.023
500.....	.....	7/8 x 0.023	1 1/4 x 0.023

(5) Wires, Washburn and Moen gauge, authorized as follows:

Authorized gross weight (pounds)	Gauge of wires when number of straps is—		
	1	2	3
50.....	12	14	.....
100.....	11	12	.....
200.....	9	11	12
300.....	.....	10	11
400.....	.....	10	11
500.....	.....	9	10

§ 78.169-14 Assembly.

(a) By nailing; screws, hinges and hasp, or other device of equal efficiency are authorized; nails should be driven flush.

§ 78.169-15 Nails and nailing.

(a) Cement coated nails of size and with spacing detailed in §§ 78.169-16 and 78.169-17.

(b) At cleated edges drive at least 40 percent of nails into cleats.

(c) Nails fastening cleats to be staggered and clinch 1/8"; uncoated nails authorized.

(d) Nailing tops and bottoms to sides permitted but not required.

§ 78.169-16 Nails; kind and dimensions.

(a) Cement¹ coated of gauge and length as for "sinkers" and "coolers" as generally known to the trade; size² in "penny" as follows:

¹Uncoated nails authorized when increased 25 percent in number.

²Nails 1-penny smaller authorized when spaced as for 2-penny smaller. Nails 2-penny smaller authorized, but not less than 3-penny, when thickness of material nailed through does not exceed 1/2 of thickness of material holding points of nails.

§ 78.170 Specification 15C; wooden boxes, nailed.

§ 78.170-1 Compliance.

(a) Required in all details.

§ 78.170-2 Closed* box.

(a) Parts and pieces to be in close contact.

§ 78.170-3 Ends.

(a) One-piece, or equivalent (see § 78.170-4); or cleated as prescribed.

§ 78.170-4 One-piece equivalents.

(a) Parts are considered equivalent to one-piece as follows:

(1) Parts Linderman-joint glued.

(2) Parts at least 1/2" thick, tongued and grooved and glued, with 2 or more corrugated fasteners on each joint.

(3) Parts at least 1/2" thick fastened with 3 or more corrugated fasteners on each joint.

(4) Parts butt-joint glued, provided the joined surfaces are planed before gluing, so as to assure full contact. After immersion in water for 24 hours at 70° F. the part must not fail at the joint when it is broken.

*Openings for filling device of inside container authorized if device is properly protected.

(b) Corrugated fasteners (as prescribed for one-piece equivalents): 1" wide; penetration 3/4 thickness of part; within 3" of end of joint and not over 8" apart; for 3 or more, drive alternately into opposite sides of part.

§ 78.170-5 Gluing efficiency.

(a) Shall be determined for boxes for gross weight of 150 pounds or less. When filled with sand and sawdust to marked gross weight, the boxes must be able to withstand 8 drops of 12", one on each corner, onto solid concrete without exposure of contents.

§ 78.170-6 Lumber.

(a) To be well seasoned, commercially dry, and free from decay, loose knots that would interfere with nailing, and other defects that would materially lessen the strength. Grain of wood in cleats must not cross cleat within 1/2 its length.

§ 78.170-7 Nails.

(a) Cement coated, unless otherwise authorized herein, of size specified for "sinkers" and "coolers" as generally known to the trade.

§ 78.170-8 Grouping of principal woods.

(a) Grouping as follows:

GROUP 1

- White pine. Willow.
Norway pine. Noble fir.
Aspen (popple). Magnolia.
Spruce. Buckeye.
Western (yellow) pine. White fir. Cedar.
Cottonwood. Redwood.
Balsam fir. Butternut.
Yellow poplar. Cucumber.
Chestnut. Alpine fir.
Sugar pine. Lodgepole pine.
Cypress. Jack pine.
Basswood.

GROUP 2

- Southern yellow pine. Douglas fir.
Hemlock. Larch (tamarack).
North Carolina pine.

GROUP 3

- White elm. Black gum.
Red gum. Black ash.
Sycamore. Tupelo.
Pumpkin ash. Maple—soft or silver.

GROUP 4

- Hard maple. Birch.
Beech. Rock elm.
Oak. Hickory.
Hackberry. White ash.

§ 78.170-9 Width of pieces.

(a) At least 2 1/2".

§ 78.170-10 Width of cleats.

(a) Twice the prescribed thickness plus 3/4".

§ 78.170-11 Thickness of lumber.

(a) Nailed boxes not cleated (Style 1): Authorized gross weight not over 100 pounds, see Note 1. Sides as in Table 1; top and bottom as in Table 1A; ends as in Table 5.

(b) Glued-lock-corner boxes (Style 8): Authorized gross weight not over 150 pounds. Sides as in Table 3; top and

bottom as in Table 1A; ends as in Table 3A. Or, sides as in Table 2; top and bottom as in Table 1A; ends as in Table 4.

(c) Single-cleated boxes (Style 4 or 5): Authorized gross weight not over 200 pounds, see Note 2. Sides as in Table 1; top and bottom as in Table 1A; ends and cleats as in Table 3A.

(d) Double-cleated boxes (Style 2, 2 1/2, or 3): Authorized gross weight not over 500 pounds, see Note 3. Sides as in Table 1; top and bottom as in Table 1A; end and cleats as in Table 2A. Or, sides as in Table 1; top and bottom as in Table 1A; cleats as in Table 3B; ends not thinner than thickest side or top.

NOTE 1: When group 2 woods are used the gross weight may be increased to 110 pounds.

NOTE 2: When group 2 woods are used the gross weight may be increased to 220 pounds.

NOTE 3: When group 2 woods are used the gross weight may be increased to 550 pounds.

(e) Tables are as follows (dimensions of materials finished or resawed):

TABLE 1

Table with 7 columns: Depth of box (inches), Not over 8", Not over 9", Not over 10", Not over 12", Not over 14", Over 14". Rows include Authorized gross weight (pounds) and Minimum thickness of part (Inches).

TABLE 1A

Table with 7 columns: Width of box (inches), Not over 8", Not over 9", Not over 10", Not over 12", Not over 14", Over 14". Rows include Authorized gross weight (pounds) and Minimum thickness of part (Inches).

TABLE 2

Table with 7 columns: Depth of box (inches), Not over 8", Not over 9", Not over 10", Not over 12", Not over 14", Over 14". Rows include Authorized gross weight (pounds) and Minimum thickness of part (Inches).

TABLE 2A

Table with 7 columns: Smallest dimension of end, Not over 8", Not over 9", Not over 10", Not over 12", Not over 14", Over 14". Rows include Authorized gross weight (pounds) and Minimum thickness of part (Inches).

TABLE 3

Table with 7 columns: Depth of box (inches), Not over 8", Not over 9", Not over 10", Not over 12", Not over 14", Over 14". Rows include Authorized gross weight (pounds) and Minimum thickness of part (Inches).

TABLE 3A

Smallest dimension of end	Not over 8"	Not over 9"	Not over 10"	Not over 12"	Not over 14"	Over 14"	Minimum thickness of part								
							Inches	Inches	Inches	Inches	Inches	Inches			
15.....	1 3/16	1 3/16	1 3/16	1 3/16	1 3/16	1 3/16	1 3/16	1 3/16	1 3/16	1 3/16	1 3/16	1 3/16	1 3/16	1 3/16	1 3/16
25.....	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8
35.....	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2
45.....	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16
55.....	9/16	9/16	9/16	9/16	9/16	9/16	9/16	9/16	9/16	9/16	9/16	9/16	9/16	9/16	9/16
65.....	5/8	5/8	5/8	5/8	5/8	5/8	5/8	5/8	5/8	5/8	5/8	5/8	5/8	5/8	5/8
75.....	1 1/16	1 1/16	1 1/16	1 1/16	1 1/16	1 1/16	1 1/16	1 1/16	1 1/16	1 1/16	1 1/16	1 1/16	1 1/16	1 1/16	1 1/16
85.....	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4
100.....	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4
125.....	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4
150.....	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4
175.....	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4
200.....	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4
250.....	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4
300.....	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4
350.....	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4
400.....	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4
500.....	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4

TABLE 3B

Smallest dimension of end	Not over 8"	Not over 9"	Not over 10"	Not over 12"	Not over 14"	Over 14"	Minimum thickness of part								
							Inches	Inches	Inches	Inches	Inches	Inches			
15.....	1 3/16	1 3/16	1 3/16	1 3/16	1 3/16	1 3/16	1 3/16	1 3/16	1 3/16	1 3/16	1 3/16	1 3/16	1 3/16	1 3/16	1 3/16
25.....	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8
35.....	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2
45.....	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16
55.....	9/16	9/16	9/16	9/16	9/16	9/16	9/16	9/16	9/16	9/16	9/16	9/16	9/16	9/16	9/16
65.....	5/8	5/8	5/8	5/8	5/8	5/8	5/8	5/8	5/8	5/8	5/8	5/8	5/8	5/8	5/8
75.....	1 1/16	1 1/16	1 1/16	1 1/16	1 1/16	1 1/16	1 1/16	1 1/16	1 1/16	1 1/16	1 1/16	1 1/16	1 1/16	1 1/16	1 1/16
85.....	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4
100.....	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4
125.....	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4
150.....	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4
175.....	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4
200.....	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4
250.....	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4
300.....	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4
350.....	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4
400.....	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4
500.....	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4

TABLE 4

Smallest dimension of end	Not over 8"	Not over 9"	Not over 10"	Not over 12"	Not over 14"	Over 14"	Minimum thickness of part								
							Inch	Inch	Inch	Inch	Inch	Inch			
15.....	1 3/16	1 3/16	1 3/16	1 3/16	1 3/16	1 3/16	1 3/16	1 3/16	1 3/16	1 3/16	1 3/16	1 3/16	1 3/16	1 3/16	1 3/16
25.....	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8
35.....	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2
45.....	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16
55.....	9/16	9/16	9/16	9/16	9/16	9/16	9/16	9/16	9/16	9/16	9/16	9/16	9/16	9/16	9/16
65.....	5/8	5/8	5/8	5/8	5/8	5/8	5/8	5/8	5/8	5/8	5/8	5/8	5/8	5/8	5/8
75.....	1 1/16	1 1/16	1 1/16	1 1/16	1 1/16	1 1/16	1 1/16	1 1/16	1 1/16	1 1/16	1 1/16	1 1/16	1 1/16	1 1/16	1 1/16
85.....	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4

TABLE 4—Continued

Smallest dimension of end	Not over 8"	Not over 9"	Not over 10"	Not over 12"	Not over 14"	Over 14"	Minimum thickness of part								
							Inches	Inches	Inches	Inches	Inches	Inches			
100.....	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4
125.....	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4
150.....	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4

TABLE 5

Smallest dimension of end	Not over 8"	Not over 9"	Not over 10"	Not over 12"	Not over 14"	Over 14"	Minimum thickness of part								
							Inch	Inch	Inch	Inch	Inch	Inch			
15.....	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4
25.....	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8
35.....	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2
45.....	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16
55.....	9/16	9/16	9/16	9/16	9/16	9/16	9/16	9/16	9/16	9/16	9/16	9/16	9/16	9/16	9/16
65.....	5/8	5/8	5/8	5/8	5/8	5/8	5/8	5/8	5/8	5/8	5/8	5/8	5/8	5/8	5/8
75.....	1 1/16	1 1/16	1 1/16	1 1/16	1 1/16	1 1/16	1 1/16	1 1/16	1 1/16	1 1/16	1 1/16	1 1/16	1 1/16	1 1/16	1 1/16
85.....	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4
100.....	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

§ 78.170-12 Reduced thicknesses.

(a) Reduction in thickness is authorized as in paragraphs (a) to (d) of this section except that reduced thicknesses must be not less than:

- (1) Sides, top, and bottom: Minimum 1/4" for boxes up to 150 pounds authorized gross weight and 3/8" above that weight.
- (2) Ends or cleats: Minimum 7/16".
- (b) Sides of one-piece or equivalent: 12 1/2 percent.
- (c) Any part or cleat of Group 3 or 4 wood: 20 percent.
- (d) Sides, top, and bottom when to be strapped as per § 78.170-18(b): 20 percent for 1 strap; 35 percent for 2 straps.

CONVERSION TABLE

Specified thickness (inches)	Reduced thickness corresponding to percent reduction		
	12 1/2	20	35
3/32	1/4	1/4	1/4
1/16	3/32	1/4	1/4
1/8	1/4	3/32	1/4
3/16	5/32	1/4	1/4
1/4	3/8	1/4	1/4
5/16	7/16	3/8	1/4
3/8	1/2	7/16	1/4
7/16	5/8	1/2	1/4
1/2	3/4	1/2	1/4
5/8	3/4	3/4	1/4
3/4	3/4	3/4	1/4
7/8	3/4	3/4	1/4
1	3/4	3/4	1/4

§ 78.170-13 Assembly.

(a) By nailing; screws, hinges and hasp, or other device of equal efficiency are authorized; nails should be driven flush.

§ 78.170-14 Nails and nailing.

(a) Cement coated nails of size and with spacing detailed in §§ 78.170-15 and 78.170-16.

(b) At cleated edges drive at least 40 percent of nails into cleats.

(c) Nails fastening cleats to be staggered and clinch 1/8"; uncoated nails authorized.</

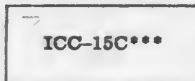
§ 78.170-16 Nail spacing.¹

(a) Nail spacing as follows:

Nails (size)	Maximum spacing when driven into end and cleats	
	Side grain	End grains
	Inches	Inches
Threepenny.....	1 1/4	1
Fourpenny.....	1 1/4	1 1/4
Fivepenny.....	1 3/4	1 1/2
Sixpenny.....	2	1 3/4
Sevenpenny.....	2 1/4	2
Eightpenny.....	2 1/2	2 1/4
Ninepenny.....	2 3/4	2 1/2
Tenpenny.....	3	2 3/4

§ 78.170-17 Marking.

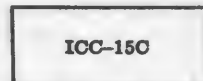
(a) Marking on each box with letters and figures at least 1/2" high in rectangle as follows:



(1) The stars must be replaced by authorized gross weight (for example, ICC-15C100, etc.). This mark shall be understood to certify that box complies with all specification requirements.

(b) The words "ONE STRAP", or "TWO STRAPS", etc., when straps are required (see § 78.170-12(d)); this to be placed above or below the rectangle.

(c) Marks may also be applied as follows:



NO STRAP XXX LBS.
ONE STRAP XXX LBS.
TWO STRAPS XXX LBS.

(1) The "X's" must be replaced by authorized gross weights as authorized for the strapping conditions.

§ 78.170-18 Closing for shipment.

(a) Box to be securely closed. Nails, if used, to be as prescribed in §§ 78.170-15 and 78.170-16.

(b) Metal straps, as specified by marks on box, must encircle sides, top, and bottom as follows:

(1) One nailless strap: At center of box.

(2) Two or more nailless straps: Outer two about 1/6 of box length from ends and other equally spaced between.

(3) Nailed straps: At ends of sides, top, and bottom; use same size nails as for closing and space not over twice as far apart.

(4) Size of flat straps must be as follows:

Authorized gross weight (pounds)	Cross-section size when number of straps is—		
	1	2	3
	Inch	Inch	Inch
50.....	1/4 x 0.020	3/8 x 0.015	.....
100.....	3/8 x 0.020	1/2 x 0.018	.....
200.....	1/2 x 0.023	3/4 x 0.020	1/4 x 0.018
300.....	.....	1/2 x 0.023	1/4 x 0.020
400.....	.....	3/4 x 0.020	1/4 x 0.023
500.....	.....	1/2 x 0.023	1/4 x 0.023

¹ To determine number of nails, divide length of nailing edge by spacing; fractions greater than 1/2 are considered as whole numbers.

(5) Wires, Washburn and Moen gauge, authorized as follows:

Authorized gross weight (pounds)	Gauge of wires when number of straps is—		
	1	2	3
50.....	12	14	.....
100.....	11	12	.....
200.....	9	11	12
300.....	.....	10	11
400.....	.....	10	11
500.....	.....	9	10

§ 78.171 Specification 15D; wooden boxes, nailed.

§ 78.171-1 Compliance.

(a) Required in all details.

§ 78.171-2 Spaces between boards.

(a) Space 4" wide authorized except that bottom pieces must be in close contact with each other and with sides and ends.

§ 78.171-3 Ends.

(a) One-piece, or equivalent (see § 78.171-5); or cleated as prescribed.

§ 78.171-4 Handles.

(a) Containers may be provided with suitable handles at discretion of shipper. Handles must be of dimensions specified herein, consisting of horizontal strips or cleats extending across top of each side or each end; handles which do not project 3 inches beyond the vertical edges of the container must be mounted to leave at least 1/16 inch open space between handle and box, or be at least 3/4 inch thick, or be of cross section at least equal to cleats required for single-cleated boxes of corresponding size and gross weight. Extension of cleats or side boards is acceptable for projecting handles.

Authorized gross weight, maximum (pounds):	Handles, minimum cross section (inches)
100.....	1/2 x 1 1/4
150.....	1/2 x 2 3/4
200.....	3/4 x 2 1/2
300.....	3/4 x 3 1/2
400.....	1 1/16 x 3 1/2

§ 78.171-5 One-piece equivalents.

(a) Parts are considered equivalent to one-piece as follows:

(1) Parts Linderman-joint glued.

(2) Parts at least 1/2" thick, tongued and grooved and glued, with 2 or more corrugated fasteners on each joint.

(3) Parts at least 1/2" thick fastened with 3 or more corrugated fasteners on each joint.

(4) Parts butt-joint glued, provided the joined surfaces are planed before gluing, so as to assure full contact. After immersion in water for 24 hours at 70° F. the part must not fall at the joint when it is broken.

(b) Corrugated fasteners (as prescribed for one-piece equivalents). 1" wide; penetration 1/2 thickness of part; within 3" of end of joint and not over 8" apart; for 3 or more, drive alternately into opposite sides of part.

§ 78.171-6 Gluing efficiency.

(a) Shall be determined for boxes for gross weight of 150 pounds or less. When filled with sand and sawdust to marked

gross weight, the boxes must be able to withstand 8 drops of 12", one on each corner, onto solid concrete without exposure of contents.

§ 78.171-7 Lumber.

(a) To be well seasoned, commercially dry, and free from decay, loose knots, knots that would interfere with nailing, and other defects that would materially lessen the strength. Grain of wood in cleats must not cross cleat within 1/2 its length.

§ 78.171-8 Nails.

(a) Cement coated, unless otherwise authorized herein, of size specified for "sinkers" and "coolers" as generally known to the trade.

§ 78.171-9 Grouping of principal woods.

(a) Grouping as follows:

GROUP 1

White pine.	Yellow poplar.
Norway pine.	Chestnut.
Aspen (popple).	Sugar pine.
Spruce.	Cypress.
Western (yellow) pine.	Basswood.
Cottonwood.	Willow.
Balsam fir.	Noble fir.
Buckeye.	Magnolia.
White fir.	Cucumber.
Cedar.	Alpine fir.
Redwood.	Lodgepole pine.
Butternut.	Jack pine.

GROUP 2

Southern yellow pine.	Douglas fir.
Hemlock.	Larch (tamarack).
North Carolina pine.	

GROUP 3

White elm.	Black gum.
Red gum.	Black ash.
Sycamore.	Tupelo.
Pumpkin ash.	Maple—soft or silver.

GROUP 4

Hard maple.	Birch.
Beech.	Rock elm.
Oak.	Hickory.
Hackberry.	White ash.

§ 78.171-10 Width of pieces.

(a) At least 2 1/2".

§ 78.171-11 Width of cleats.

(a) Twice the prescribed thickness plus 3/4".

§ 78.171-12 Thickness of lumber.

(a) Nailed boxes not cleated (Style 1): Authorized gross weight not over 100 pounds, see Note 1. Sides as in Table 1; top and bottom as in Table 1A; ends as in Table 5.

(b) Glued-lock-corner boxes (Style 6): Authorized gross weight not over 150 pounds. Sides as in Table 3; top and bottom as in Table 1A; ends as in Table 3A. Or, sides as in Table 2; top and bottom as in Table 1A; ends as in Table 4.

(c) Single-cleated boxes (Style 4 or 5): Authorized gross weight not over 200 pounds for boxes with vertical cleats nor over 400 pounds for boxes with horizontal cleats. Sides as in Table 1; top and bottom as in Table 1A; ends and cleats as in Table 3A.

(d) Double-cleated boxes (Style 2, 2 1/2, or 3): Authorized gross weight not over 500 pounds. Sides as in Table 1; top and bottom as in Table 1A; ends and cleats as

in Table 2A. Or, sides as in Table 1; top and bottom as in Table 1A, cleats as in Table 3B; ends not thinner than thinnest side or top.

Exception: For containers consisting of an inner wooden crate of at least 1/2" thickness throughout, with or without top, and an outside double cleated box without the openings permitted by § 78.171-2, the thickness of all parts of the outside box may be reduced to not less than 3/4".

(e) Tables are as follows (dimensions of materials finished or resawed):

TABLE 1

Table with columns: Depth of box (inches), Authorized gross weight (pounds), and Minimum thickness of part. Rows range from 15 to 500 inches depth.

TABLE 1A

Table with columns: Width of box (inches), Authorized gross weight (pounds), and Minimum thickness of part. Rows range from 15 to 500 inches width.

TABLE 2

Table with columns: Depth of box (inches), Authorized gross weight (pounds), and Minimum thickness of part. Rows range from 15 to 35 inches depth.

TABLE 2-Continued

Table with columns: Depth of box (inches), Authorized gross weight (pounds), and Minimum thickness of part. Rows range from 45 to 500 inches depth.

TABLE 2A

Table with columns: Smallest dimension of end, Authorized gross weight (pounds), and Minimum thickness of part. Rows range from 15 to 500 inches end dimension.

TABLE 3

Table with columns: Depth of box (inches), Authorized gross weight (pounds), and Minimum thickness of part. Rows range from 15 to 500 inches depth.

TABLE 3A

Table with columns: Smallest dimension of end, Authorized gross weight (pounds), and Minimum thickness of part. Rows range from 15 to 500 inches end dimension.

TABLE 3B

Table with columns: Smallest dimension of end, Authorized gross weight (pounds), and Minimum thickness of part. Rows range from 15 to 500 inches end dimension.

TABLE 4

Table with columns: Smallest dimension of end, Authorized gross weight (pounds), and Minimum thickness of part. Rows range from 15 to 180 inches end dimension.

RULES AND REGULATIONS

TABLE 5

Smallest dimension of end	Not over 8"	Not over 9"	Not over 10"	Not over 12"	Not over 14"	Over 14"	Minimum thickness of part					
							Inch	Inch	Inch	Inch	Inch	Inch
15	3/4	7/8	1	1 1/8	1 1/4	1 1/2	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	
25	3/4	7/8	1	1 1/8	1 1/4	1 1/2	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	
35	3/4	7/8	1	1 1/8	1 1/4	1 1/2	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	
45	3/4	7/8	1	1 1/8	1 1/4	1 1/2	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	
55	3/4	7/8	1	1 1/8	1 1/4	1 1/2	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	
65	3/4	7/8	1	1 1/8	1 1/4	1 1/2	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	
75	3/4	7/8	1	1 1/8	1 1/4	1 1/2	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	
85	3/4	7/8	1	1 1/8	1 1/4	1 1/2	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	
100	1	1 1/8	1 1/4	1 1/2	1 3/4	2	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	

§ 78.171-13 Reduced thicknesses.

(a) Reduction in thicknesses is authorized as in paragraphs (a) to (d) of this section except that reduced thicknesses must be not less than:

(1) Sides, top, and bottom: Minimum 5/16" for boxes up to 35 pounds authorized gross weight and 3/8" above that weight.

(2) Ends or cleats: Minimum 7/16".

(b) Sides of one-piece or equivalent: 12 1/2 percent. In battery boxes reinforced with separate pieces in the form of extension handles, not extension of side boards or cleats, having cross section at least equal to cleats required for single-cleated boxes of corresponding size and gross weight, 20 percent in sides or ends so reinforced.

(c) Any part or cleat of Group 3 or 4 wood: 20 percent.

(d) Sides, top, and bottom when to be strapped as per § 78.171-18 (b): 20 per-

cent for 1 strap; 35 percent for 2 straps.

CONVERSION TABLE

Specified thickness (inches)	Reduced thickness corresponding to percent reduction		
	12 1/2	20	35
3/4	3/4	3/4	3/4
7/8	7/8	7/8	7/8
1	1	1	1
1 1/8	1 1/8	1 1/8	1 1/8
1 1/4	1 1/4	1 1/4	1 1/4
1 1/2	1 1/2	1 1/2	1 1/2
1 3/4	1 3/4	1 3/4	1 3/4
2	2	2	2
2 1/8	2 1/8	2 1/8	2 1/8
2 1/4	2 1/4	2 1/4	2 1/4
2 1/2	2 1/2	2 1/2	2 1/2
2 3/4	2 3/4	2 3/4	2 3/4
3	3	3	3
3 1/8	3 1/8	3 1/8	3 1/8
3 1/4	3 1/4	3 1/4	3 1/4
3 1/2	3 1/2	3 1/2	3 1/2
3 3/4	3 3/4	3 3/4	3 3/4
4	4	4	4

§ 78.171-14 Nails and nailing.

(a) Cement coated nails of size and with spacing detailed in §§ 78.171-15 and 78.171-16.

(b) At cleated edges drive at least 40 percent of nails into cleats.

(c) Nails fastening cleats to be staggered and clinch 1/8"; uncoated nails authorized.

(d) Nailing tops and bottoms to sides permitted but not required.

§ 78.171-15 Nails; kind of dimensions.

(a) Cement¹ coated of gauge and length as for "sinkers" and "coolers" as generally known to the trade; size² in "penny" as follows:

Species of wood holding points of nails	Thickness of material holding points of nails (inches)										
	3/4 or less	3/4	1/2	3/8	5/16	1/4	3/16	5/32	1/8	3/16	1/4 or more
Group 1	4	5	5	6	7	7	8	8	8	9	10
Group 2	4	4	5	5	6	6	7	7	7	8	9
Group 3	3	4	4	5	5	6	6	7	7	7	8
Group 4	3	3	4	4	4	5	5	6	6	7	7

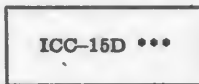
§ 78.171-16 Nail spacing.³

(a) Nail spacing as follows:

Nails (size)	Maximum spacing when driven into end and cleats	
	Side grain	End grains
	Inches	Inches
Threepenny	1 1/4	1
Fourpenny	1 1/2	1 1/4
Fivepenny	1 3/4	1 1/2
Sixpenny	2	1 3/4
Sevenpenny	2 1/4	2
Eightpenny	2 1/2	2 1/4
Ninepenny	2 3/4	2 1/2
Tenpenny	3	2 3/4

§ 78.171-17 Marking.

(a) Marking on each box with letters and figures at least 1/2" high in rectangle as follows:



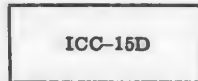
(1) The stars must be replaced by authorized gross weight (for example, ICC-15D125, etc.) This mark shall be under-

³To determine number of nails, divide length of nailing edge by spacing; fractions greater than 1/2 are considered as whole numbers.

stood to certify that box complies with all specification requirements.

(b) The words "ONE STRAP", or "TWO STRAPS", etc., when straps are required (see § 78.171-13 (d)); this to be placed above or below the rectangle.

(c) Marks may also be applied as follows:



NO STRAP XXX LBS.
ONE STRAP XXX LBS.
TWO STRAPS XXX LBS.

(1) The "X's" must be replaced by authorized gross weights as authorized for the strapping conditions.

§ 78.171-18 Closing for shipment.

(a) Box to be securely closed. Nails, if used, to be as prescribed in §§ 78.171-15 and 78.171-16.

¹Uncoated nails authorized when increased 25 percent in number.

²Nails 1-penny smaller authorized when spaced as for 2-penny smaller. Nails 2-penny smaller authorized, but not less than 3-penny, when thickness of material nailed through does not exceed 1/2 of thickness of material holding points of nails.

(b) Metal straps, as specified by marks on box, must encircle sides, top, and bottom as follows:

(1) One nailless strap: At center of box.

(2) Two or more nailless straps: Outer two about 1/3 of box length from ends and other equally spaced between.

(3) Nailed straps: At ends of sides, top, and bottom; use same size nails as for closing and space not over twice as far apart.

(4) Size of flat straps must be as follows:

Authorized gross weight (pounds)	Cross-section size when number of straps is—		
	2		3
	Inch	Inch	Inch
50	3/4 x 0.020	3/4 x 0.015	3/4 x 0.018
100	3/4 x 0.020	3/4 x 0.018	3/4 x 0.020
200	3/4 x 0.023	3/4 x 0.020	3/4 x 0.018
300	3/4 x 0.023	3/4 x 0.020	3/4 x 0.020
400	3/4 x 0.023	3/4 x 0.020	3/4 x 0.023
500	3/4 x 0.023	3/4 x 0.023	3/4 x 0.023

(5) Wires, Washburn and Moen gauge, authorized as follows:

Authorized gross weight (pounds)	Gauge of wires when number of straps is—		
	1	2	3
50	12	14	
100	11	12	
200	9	11	12
300		10	11
400		10	11
500		9	10

§ 78.171-19 Boxes for shipment of wet electric storage batteries.

(a) Boxes over 500 pounds gross weight are authorized for shipments of wet electric storage batteries when the batteries are contained in a rigid cradle or box, or are securely fastened together so as to form a single unit, and not more than one such cradle, box, or unit is packed in the outside container. Skids required: runners to be at least 2 inches by 4 inches commercial thickness, minimum of three, except that two runners are authorized when width of case does not exceed 24 inches; or two runners may be used, minimum of 4 inches by 4 inches commercial thickness, when case does not exceed 36 inches in width. Runners to be beveled at ends to facilitate use of rollers. Bottom boards, minimum of 1 inch commercial thickness, to be nailed across runners; bracing of parts and thickness of lumber to be sufficient to protect contents in transit.

§ 78.172 Specification 15E; wooden boxes, fiberboard lined.

§ 78.172-1 Compliance.

(a) Required in all details.

§ 78.172-2 Closed box.

(a) Parts and pieces to be in close contact.

§ 78.172-3 Ends.

(a) Butt-joint glued to fiberboard. Plywood not authorized.

§ 78.172-4 Sides, top, and bottom.

(a) Butt-joint or plywood glued to fiberboard.

§ 78.172-5 Lumber.

(a) To be well seasoned, commercially dry, and free from decay, loose knots, knots that would interfere with nailing, and other defects that would materially lessen the strength. Grain of wood in cleats must not cross cleat within 1/2 its length.

(b) Plywood, if used, shall be free of knots, decay, and other visible defects that interfere with the nailing. Plywood used must be of good commercial box or sheathing grade veneer.

§ 78.172-6 Grouping of principal woods.

(a) Grouping as follows:

GROUP 1

White pine.	Balsam fir.
Norway pine.	Yellow poplar.
Aspen (popple).	Chestnut.
Spruce.	Sugar pine.
Western	Cypress.
(yellow) pine.	Basswood.
Cottonwood.	Willow.

GROUP 1—Continued

Noble fir.	Butternut.
Magnolia.	Cucumber.
Buckeye.	Alpine fir.
White fir.	Lodgepole pine.
Cedar.	Jack pine.
Redwood.	

GROUP 2

Southern yellow pine.	North Carolina pine.
Hemlock.	Douglas fir.
	Larch (tamarack).

GROUP 3

White elm.	Black ash.
Red gum.	Tupelo.
Sycamore.	Maple—soft or silver.
Pumpkin ash.	
Black gum.	

GROUP 4

Hard maple.	Oak.
Beech.	Hackberry.
Birch.	Hickory.
Rock elm.	White ash.

§ 78.172-7 Width of pieces.

(a) At least 2 1/2 inches.

§ 78.172-8 Thickness of wood parts.

(a) Thickness as follows:

column of the following table; weights specified in the table are the minimum authorized:

Authorized gross weight of box not over (pounds)	Classified strength ¹ of completed board	Solid fiberboard minimum combined weight of component plies exclusive of adhesives (pounds per 1,000 sq. ft.)	Facings for corrugated fiberboard double-faced minimum combined weight of facings (pounds per 1,000 sq. ft.)
150	200	190	84
250	275	237	138
350	325	237	138
450	350	283	180
550	375	283	180

¹ Mullen or Cady test (minimum).

§ 78.172-14 Solid fiberboard.

(a) To be 3-ply or more; both outer plies water resistant.

§ 78.172-15 Corrugated fiberboard.

(a) Both outer facings water resistant; corrugated sheets must be at least 0.009 inch thick and weigh not less than 26 pounds per 1,000 square feet; all parts must be securely glued together throughout all contact areas.

§ 78.172-16 Test.

(a) Acceptable board must have prescribed strength, Mullen or Cady test, after exposure for at least 3 hours to normal atmospheric conditions (50 to 70 percent relative humidity), under test as follows:

(1) Clamp board firmly in machine and turn wheel thereof at constant speed of approximately 2 revolutions per second.

(2) Six punctures required, 3 from each side; all results but one must show prescribed strength.

(3) Board failing may be retested by making 24 punctures, 12 from each side; when all results but 4 show prescribed strength the board is acceptable.

(4) For corrugated fiberboard, double-pop tests may be disregarded.

§ 78.172-17 Assembly.

(a) The sheet of fiberboard to which are glued the boards forming the sides, top and bottom box sections, shall be properly scored to form a tube. The joint shall be on a side, top or bottom, near the center of the face, and located under one of the wood boards of the face.

(1) A water resistant glue shall be used to attach the fiberboard to the wood. The glue shall be applied in ribbons (lines) at right angles to the scores of the tube. The ribbons of glue shall be not less than 1/4" wide and shall be spaced sufficiently close so that glue will cover not less than 25 percent of the surface of the fiberboard. The ribbons of glue shall be equally spaced on the length of the box with the outside ribbons flush with the ends of the tube. Glue shall be applied to the fiberboard on the ends of the box in like amount as on the tube.

§ 78.172-11 Nails; kind and dimensions.

(a) Cement¹ coated of gauge and length as for "sinks" and "coolers" as generally known to the trade; size in penny as prescribed in § 78.172-8.

§ 78.172-12 Nail spacing.²

(a) Nail spacing as follows:

Nails (size)	Maximum spacing when driven into end and cleats	
	Side grain	End grains
	Inches	Inches
Fourpenny.....	1 1/2	1 1/4
Fivepenny.....	1 3/4	1 1/2
Sixpenny.....	2	1 3/4
Sevenpenny.....	2 1/4	2

§ 78.172-13 Classification of board.

(a) Fiberboard is hereby classified by strength³ of completed board as in first

¹ Uncoated nails authorized when increased 25 percent in number.

² To determine number of nails, divide length of nailing edge by spacing; fractions greater than 1/2 are considered as whole numbers. Each piece of sides, top and bottom shall be nailed to the ends with at least two nails through each end of the piece.

³ Mullen or Cady test (minimum).

Authorized gross weight of box not over (pounds)	Style of box (see Notes 2 and 3)	Minimum thickness (see Note 1) of sides, top and bottom in inches		Minimum thickness of ends and cleats in inches		Minimum width of cleats in inches	Size of nails in ends (penny)	
		Groups 1 and 2	Groups 3 and 4	Groups 1 and 2	Groups 3 and 4		Groups 1 and 2	Groups 3 and 4
250.....	2 1/2, 3 or 4.....	7/32	3/16	5/8	3/16	1 1/2	5	4
350.....	2 1/4 or 3.....	1/4	3/32	3/4	1 1/4	2 1/4	6	5
450.....	2 1/4 or 3.....	3/16	1/4	2 3/4	2 3/4	2 1/4	6	5
550.....	2 1/4 or 3.....	3/8	3/16	1 3/16	1 3/16	2 1/2	7	6

NOTE 1: Plywood or paper covered wood veneer board of equal thickness and efficiency is permitted. Paper covered veneer board shall be of good quality Douglas fir core of at least 1/16 inch thickness, or lumber of equal quality, and free of breaks, gaps, holes, or knots. Paper covering shall be at least Kraft untreated linerboard having a basis weight of 42 pounds per 1,000 square feet and shall be secured to veneer core by adhesive in such manner as to form a satisfactorily laminated board.

NOTE 2: Thickness of ends in style 1 boxes shall be not less than 25/32 inch and load limit shall be not more than 100 pounds.

NOTE 3: Style 4 boxes shall have load limit of 200 pounds.

§ 78.172-9 Assembly.

(a) By nails, screws, staples or other devices of equal efficiency. Nails, screws, and staples must be driven flush.

§ 78.172-10 Nails and nailing.

(a) Cement coated nails of size and with spacing detailed in §§ 78.172-8, 78.172-11 and 78.172-12.

(b) At cleated edges drive at least 40 percent of nails into cleats.

(c) Nails fastening cleats to ends be staggered and clinch 1/8 inch; uncoated nails authorized.

(2) For styles 2, 2½, and 3, all faces of the tube shall extend over the end boards and cleats. For style 4, all faces shall extend over the end boards, but only the side sections shall extend over the cleats.

(3) The boards between score lines, shall butt against each other when placed on the fiberboard, and the combined widths of the boards shall be approximately equal to the inside dimension of the respective box section so that the boards completely cover the fiberboard between the inside edges of adjacent scores.

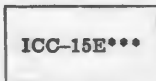
(4) A sheet of fiberboard shall be attached to each end as provided in subparagraph (1) of this paragraph and shall completely cover the inside of the end.

§ 78.172-18 Closing for shipment.

(a) Box shall be securely closed. Nails, if used, shall be as prescribed in §§ 78.172-8, 78.172-10, 78.172-11, and 78.172-12.

§ 78.172-19 Marking.

(a) Marking on each box with letters and figures at least ½" high in rectangle as follows:



(1) The stars must be replaced by authorized gross weight (for example, ICC-15E100, etc.). This mark shall be understood to certify that box complies with all specification requirements.

§ 78.176 Specification 15L; wooden boxes with inside containers for desensitized liquid explosives.

§ 78.176-1 Compliance.

(a) Required in all details.

§ 78.176-2 Size and capacity.

(a) Each outside wooden container shall contain not more than one inside metal container having a capacity not to exceed 10 quarts.

§ 78.176-3 Outside containers.

(a) Wooden boxes cleated as prescribed. Parts must be in close contact and completely enclose inside containers. Lumber must be well seasoned, commercially dry, and free from decay, loose knots, knots that would interfere with assembly, or other defects that materially lessen the strength.

(b) Assembly: Use brass screws throughout. Assemble sides and ends with grain of wood vertical. Fasten bottom securely with edges flush with sides and ends of box. Cleats must extend around entire perimeter of box. Apply top and bottom cleats horizontally. Bottom cleats must be flush with bottom surface of the box. Top cleats must extend above top of box to provide a ¾-inch recess for cover projections (see § 78.176-5). Cover must be flush with outside surface of top cleats and must be cleated on the outside at all edges. Cleats may be mitered but must butt at all corners.

(c) Parts and dimensions as follows:

Minimum dimensions			
Thickness, sides, top, bottom, and ends	Top cleats	Bottom cleats	Cover cleats
¾"	¾" x 3¼"	¾" x 2¾"	¾" x 2"

§ 78.176-4 Inside containers.

(a) Inside containers must be as follows:

(1) *Metal containers.* Double seamed, of copper weighing not less than 16 ounces per square foot, or other non-sparking material of equivalent strength. All seams must be closed by welding, brazing, or soldering so as to be tight against leakage. Handles must be fastened to top of container and be of copper weighing not less than 48 ounces per square foot, or other nonsparking material of equivalent strength. Each side of the container must be strengthened vertically by at least three equally spaced indented crimps. Each container must have two pouring spouts in the top securely closed by rubber stoppers.

(2) *Rubber liners.* Each inside metal container must be inserted in a two-piece rubber liner or boot, consisting of a cover and body, into which it must fit snugly and which in turn shall fit snugly the outside wooden container. This liner must be watertight and of such size as to fully protect the inside container. Sides of liner must be at least ¼ inch in thickness and bottom at least ½ inch in thickness. Top edge of boot must be flanged to fit the recess provided by the top cleats on the outside wooden container and such flange must be at least ¾ inch thick exclusive of any channels or indentations necessary to effect satisfactory closure because of projections on cover. Cover must be not less than ½ inch in thickness including projections for securing rubber stoppers in metal containers, and must have a formed molding around its entire perimeter to match and tightly fit channels or indentations in the body flange.

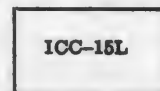
(b) Tests: Each inside metal and rubber container must be adequately tested and inspected during manufacture to insure against leakage.

§ 78.176-5 Closure.

(a) Top of rubber liner must be firmly fastened to wooden cover of outside container so as to fit securely into ¾-inch recess provided by top cleats on box. Top of liner must have projections on the inside which bear directly on rubber stoppers of metal containers to secure them in place. When closure is effected the liner must provide a positive seal against interior leakage. Cover of wooden outside container must be securely fastened to body of container by means of trunk clasps affixed to each face of the box. The trunk clasps must be recessed into cover and top cleats to furnish a smooth bearing surface on all faces of the box.

§ 78.176-6 Marking.

(a) Marking on each box with letters and figures at least ½-inch high in rectangle as follows:



(1) This mark shall be understood to certify that box complies with all specification requirements.

§ 78.177 Specification 15M; wooden boxes, metal lined, with inside containers for desensitized liquid explosives.

§ 78.177-1 Compliance.

(a) Required in all details.

§ 78.177-2 Size and capacity.

(a) Each outside wooden container shall contain not more than 6 inside metal containers having nominal capacity of 10 quarts each.

§ 78.177-3 Outside containers.

(a) Wooden boxes cleated as prescribed. Parts must be in close contact and completely enclose inside containers. Lumber must be well seasoned, commercially dry, and free from decay, loose knots, knots that would interfere with assembly, or other defects that materially lessen the strength.

(1) The box shall be lined with copper or other nonsparking metal having suitable strength. All seams must be soldered, welded, or brazed to produce a liquid-tight container having no openings in the bottom, sides, or ends.

(b) Assembly: Use brass screws throughout, countersunk and with heads covered with suitable wood filling compound. Any screw used to secure a metal attachment shall be soldered, welded, or brazed thereto. Metal parts used in the construction of or attached to the box or cover must be of nonsparking type. Fasten bottom securely with edges flush with sides and ends of box. Cleats must extend around entire perimeter of box. Apply top and bottom cleats horizontally. Bottom cleats must be flush with bottom surface of the box. Top cleats must extend above top of box to provide a ¾-inch recess for cover projections (§ 78.177-5). Cover must be flush with outside surface of top cleats. Cleats may be mitered but must butt at all corners.

(c) Cellular construction: The interior of the box shall be divided into cells by means of removable, nonmetallic, non-sparking dividers, into which the rubber boots or secondary containers fit snugly. The cells shall be of such size as to extend from the bottom to near the top of the rubber boots or secondary containers.

(d) Parts and dimensions as follows:

[Minimum dimensions in inches]

Thickness, sides, top, bottom, and ends	Top cleats	Bottom cleats	Cover cleats
¾"	¾" x 3¼"	¾" x 2¾"	¾" x 2"

§ 78.177-4 Inside containers.

(a) Inside containers must be as follows:

(1) **Metal containers.** The individual inside containers shall be made in a workmanship manner, of copper or other nonsparking material of suitable strength, with all seams soldered, welded, or brazed to be liquid tight. The top shall be fitted with a securely attached carrying handle of copper or other non-sparking material of suitable strength. Each inside container must have a filling and pouring spout in the top, which shall be securely closed with rubber stoppers, paraffin, or oil-treated corks or other nonmetallic, nonsparking closures which are resistant to absorption of the contents and which provide a leakproof seal. The closures shall be secured in such manner as to prevent loosening, displacement, and leakage of contents during transit. Each inside container may have sufficient capacity in excess of 10 quarts to provide for outage requirements. Each side of the container must be strengthened vertically by at least 3 equally spaced indented crimps.

(2) **Rubber boots or secondary containers.** Each inside metal container must be contained in a rubber boot or other similar suitable leakproof, non-metallic, nonabsorbent outer container, which must fit snugly in cellular structure provided in § 78.177-3 (c). The rubber boot or secondary container must be liquid tight and shall be so constructed as to have an inside height approximately that of the inside metal container plus closure and otherwise so constructed that the bottom will provide cushioning for the inner container.

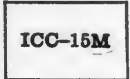
(b) **Tests:** Each inside metal and rubber or secondary container must be adequately tested and inspected during manufacture to insure against leakage.

§ 78.177-5 Closure.

(a) The box cover must be securely fastened to the box in a manner to prevent movement of the insides containers. The inner surface of the box cover must be lined with suitable coating material or sheathed with nonsparking metal to provide a nonabsorbent surface. The cover must be secured to the box by means of nylon, or other suitable straps, and be so positioned to furnish a smooth bearing surface on all faces of the box. There shall be no protruding parts on the box or cover which would result in metal-to-metal contact.

§ 78.177-6 Marking.

(a) Marking on each box with letters and figures at least 1/2 inch high in rectangle as follows:



(1) This mark shall be understood to certify that box complies with all specification requirements.

§ 78.181 Specification 15X; wooden boxes for two five-gallon cans.

§ 78.181-1 Compliance.

(a) Required in all details.

§ 78.181-2 Closed box.

(a) Parts and pieces to be in close contact.

§ 78.181-3 Ends.

(a) To be of group 1, 2, or 3 wood not over 2-piece.

§ 78.181-4 Sides, top and bottom.

(a) To be of Group 1, 2, or 3 wood, not over 3-piece.

§ 78.181-5 Two-piece ends and corrugated fasteners.

(a) *Two-piece ends.* Joints must be fastened with at least 3 corrugated fasteners.

(b) *Corrugated fasteners.*—To be 1" wide and with penetration of 1/2 inch.

§ 78.181-6 Lumber.

(a) To be well seasoned, commercially dry, and free from decay, loose knots, knots that would interfere with nailing, and other defects that would materially lessen the strength.

§ 78.181-7 Groupings of principal woods.

(a) Grouping as follows:

GROUP 1

White pine.	Willow.
Norway pine.	Noble fir.
Aspen (popple).	Magnolia.
Spruce.	Buckeye.
Western (yellow) pine.	White fir.
Cottonwood.	Cedar.
Balsam fir.	Redwood.
Yellow poplar.	Butternut.
Chestnut.	Cucumber.
Sugar pine.	Alpine fir.
Cypress.	Lodgepole pine.
Basswood.	Jackpine.

GROUP 2

Southern yellow pine.	North Carolina pine.
Larch (tamarack).	Douglas fir.
Hemlock.	

GROUP 3

White elm.	Black gum.
Red gum.	Black ash.
Sycamore.	Tupelo.
Pumpkin ash.	Maple, soft or silver.

§ 78.181-8 Width of pieces.

(a) At least 2" for sides, top and bottom if in two pieces, or 2 3/8" for tops and bottoms and at least 4" for sides if in three pieces.

§ 78.181-9 Thickness of lumber.

(a) **Thickness as follows:**
 (1) Ends: Thickness to be not less than 3/4" for Group 1 or 2 lumber and 1 1/8" for Group 3 lumber.
 (2) Sides, top and bottom: Thickness to be not less than 3/8".

§ 78.181-10 Assembly.

(a) By nailing with either bright or cement-coated nails, size and spacing as follows:

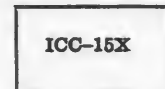
(1) Top to each end: 5 nails (1 1/2" by 12 1/2 gauge).

(2) Bottom to each end: 6 nails (1 3/4" by 12 gauge).

(3) Sides to each end: 6 nails (1 1/2" by 12 1/2 gauge).

§ 78.181-11 Marking.

(a) Marking on each box in letters and figures at least 1/2" high in a rectangle as follows:



(1) This mark shall be understood to certify that box complies with all specification requirements.

§ 78.181-12 Inside can.

(a) **Size:** Approximate dimensions 9 3/8 x 9 3/8 x 13 15/16 inches.

(b) **Approximate capacity:** 1,188 cu. in.

(c) **Top:** Embossed.

Seams: Crimped and soldered.
 Closure: Airtight and leakproof.
 Handles: Wire.

(d) **Bottom:** Embossed.

Seams: Crimped and soldered.

(e) **Body:** Paneled on 4 sides.

Two seams: Clinched and soldered.

(f) **Material:** IC (107 lb.) tin or terne-plate.

(g) **Average weight:** 2 pounds 8 ounces.

(h) **Marking:** No specification marking required.

§ 78.182 Specification 15P; glued plywood, or wooden box for inside containers.

§ 78.182-1 Material requirements.

(a) Lumber or plywood must be well seasoned, commercially dry, and free from decay, loose knots, knots that would interfere with nailing, and other defects that would materially lessen the strength and in accordance with the following:

(1) Lumber must be of good commercial grade.

(2) Plywood sections shall be firmly glued together with waterproof glue. A section of plywood from any part when immersed in water at room temperature for 48 hours shall show no delamination or separation of plies to qualify glue as waterproof.

§ 78.182-2 Construction requirements.

(a) Box shall be constructed of wood or of plywood not less than three-ply fabrication and shall be constructed so as to completely and snugly enclose body of the inside container, and so formed that inside container cannot permanently change position and be of sufficiently strong wood or plywood to withstand prescribed tests without serious rupture of or damage to box that would cause failure or lead to impending failure of inside container.

NOTE 1: Vertical openings not exceeding 3/8 inch in width and extending to within 3 inches of top or bottom on two opposite sides of box are permitted.

(b) Specifications for the outside container must be filed with and approved by the Bureau of Explosives.

§ 78.182-3 Tests.

(a) One sample, taken at random and with inner container filled to marked capacity with water and closed as for use, shall be capable of withstanding prescribed tests without leakage. Tests shall be made of each size by each company starting production. The type tests are as follows:

(1) Complete package must be capable of withstanding two drops from a height of 4 feet onto solid concrete, the first drop to be made diagonally so top corner will strike the concrete; the second drop onto a 2 inch by 6 inch timber resting on the concrete with the 6 inch leg vertical, the drop being made with the box in a horizontal position and at right angles to the timber so that impact is near the center of the box side-wall.

(2) Additional tests as required by inside container specification.

§ 78.182-4 Marking.

(a) Each outside container must be plainly marked with letters and figures at least 3/4 inch high applied by hot branding iron or dark colored printing ink with pressure dies as follows:

(1) ICC-15P. This mark shall be understood to certify that the complete outer package complies with all specification requirements.

(2) Name or symbol (letters) of company setting up the package, or other party assuming responsibility for its compliance with the specification requirements; this must be registered with the Bureau of Explosives and located just above or below the mark specified in paragraph (a) (1) of this section.

§ 78.185 Specification 16A; plywood or wooden boxes, wirebound.

§ 78.185-1 Compliance.

(a) Required in all details. Authorized tolerances. Cleats, battens, and handles, minus 1/32"; single thickness veneer, minus 5 percent; resawn boards, 1/64" below specified thickness for boards up to 3/32" thick and 1/32" below specified thickness for boards 1/4" or more thick.

§ 78.185-2 Lumber or plywood.

(a) Lumber shall be well seasoned and commercially dry; free from decay, objectionable knots, slanting shakes, sharp cross grain, and other defects that materially lessen the strength. Grain of wood in cleats and battens must not cross piece within its length.

(b) Plywood shall be made from veneer which has been rotary cut, sliced, or sawed. Plywood shall be good commercial box or sheathing grade and shall be moisture-resistant; free from decay, objectionable knots that interfere with nailing, splits, gaps, and other defects that materially lessen the strength.

(1) Moisture-resistant plywood shall be fabricated with either synthetic or protein type glue. Specimens for test-

ing shall be not less than 5 in number, measuring 6" x 6", and shall withstand 10 cycles of 4 hours immersion in water at room temperature and drying for 20 hours at a temperature not over 100° F. After 10 cycles, 4 of the 5 samples are to show not more than a sum total of 2-inch delamination on the edges, with depth delamination no greater than 1/2 inch.

§ 78.185-3 Wires.

(a) Of annealed steel, or other metal of equal strength, Washburn and Moen sizes.

§ 78.185-4 Staples.

(a) Wire size, Washburn and Moen.

§ 78.185-5 Grouping of principal woods.

(a) Grouping as follows:

GROUP 1

White pine.	Yellow poplar.
Norway pine.	Balsam fir.
Aspen (popple).	Chestnut.
Spruce.	Sugar pine.
Western yellow pine.	Cypress.
Cottonwood.	Basswood.
Willow.	Noble fir.
Magnolia.	Butternut.
Buckeye.	Alpine fir.
White fir.	Cucumber.
Cedar.	Lodgepole pine.
Redwood.	Jack pine.

GROUP 2

Southern yellow pine.	Douglas fir.
Hemlock.	Larch (tamarack).
North Carolina pine.	

GROUP 3

White elm.	Black gum.
Red gum.	Tupelo.
Sycamore.	Maple—soft or silver.
Pumpkin ash.	
Black ash.	

GROUP 4

Hard maple.	Birch.
Beech.	Rock elm.
Oak.	White ash.
Hackberry.	Hickory.

§ 78.185-6 Closed box.

(a) Parts and pieces with edges in close contact to give completely closed box.

§ 78.185-7 Top, sides, and bottom.

(a) Each cleated at both ends; intermediate rows of cleats authorized.

§ 78.185-8 Cleats.

(a) Ends mitered or with mortise and tenon joints.

(b) Cleats for plywood boxes shall be Group 4 woods.

§ 78.185-9 Ends.

(a) Battened when prescribed. Wired ends authorized provided wires run cross grain and terminate in loops with ends of wire driven through end board and clinched. Grain of wood and outside ply of plywood shall be perpendicular to sides except for wired ends.

(b) As provided by § 73.65 (a) (1), Note 1, of this chapter, wooden boxes, having inside metal containers which are tightly and securely closed, may be equipped with hand holes in each end which must be not more than one inch by four inches and centered laterally not nearer than 1 5/8 inches from top edge of end of box.

§ 78.185-10 Wires.

(a) One wire over each row of cleats; intermediate wires as prescribed.

§ 78.185-11 Stapling.

(a) Staples for wires over cleats driven through boards into cleats and anchored; others through boards and clinched.

§ 78.185-12 Thickness of boards or plywood (sides, tops, bottoms, and ends).

(a) Thickness as follows except that, for thicknesses prescribed as 3/16" or less, resawn boards must be 1/64" thicker for each resawn surface:

Group of wood	Minimum thickness of boards (Inch)						
	1/4 (0.125)	1/2 (0.143)	3/4 (0.167)	7/8 (0.185)	1 (0.219)	1 1/4 (0.250)	1 1/2 (0.313)
	Authorized gross weight, box and contents, not over (pounds)						
1.....	25	35	50	75	100	150	200
2.....	35	50	75	100	150	200	315
3.....	50	75	100	150	200	315	400
4.....	75	100	150	200	315	400	.....

(1) For boxes with 3 or more rows of cleats, boards of the next lower thickness prescribed in the table are acceptable.

(b)

Group of wood	Minimum thickness of plywood (Inch) ¹		
	1/4 (0.125)	3/8 (0.150)	1/2 (0.188)
	Authorized gross weight, box and contents, not over (pounds)		
4.....	150	300	400

¹Minimum tolerance of 5% permitted for specified thicknesses.

§ 78.185-13 Size of cleats.

(a) At least 1 3/16" by 1 3/16" when thickness required for boards exceeds 1/4"; otherwise at least 9/16" by 1 3/16".

§ 78.185-14 Binding wires (sides, top, and bottom).

(a) Spacing not over 8".

Exception: When each binding wire is stapled to a row of cleats, 11" spacing is authorized.

(b) Number and size of binding wires as follows:

Number of wires	Minimum gauge of wires, Washburn and Moen				
	16	15	14	13	12
	Authorized gross weight, box and contents (pounds)				
2	35	50	75	100	180
3	50	75	100	150	200
4	75	100	150	200	315
5	100	150	200	315	400
6		200	315	400	
7			400		

§ 78.185-15 Wires for wired ends.

(a) At least 2 wires on each end, size not less than as specified for binding wires in § 78.185-14, and spaced as follows:

Thickness of end (inch)	Maximum spacing	
	Between wires (inch)	Wires to cleats (inch)
0.125	6	4
.143	6	4
.167	6 1/2	4
.187	6 1/2	4
.210	7	4
.250	7	4
.313	7	4

(b) Ends less than 10 inches deep are authorized with 1 wire provided they are reinforced by 2 strips (liners), at least 1 1/4" wide and as thick as ends, securely stapled along edges of the end parallel to the wires.

§ 78.185-16 Staple spacing (approximate) and minimum size.

(a) Staples into cleats 16 gauge, Washburn and Moen, and:

(1) One and one-fourth inches long with 1 1/2-inch spacing, or 1 3/8 inches long with 1-inch spacing, when boards are over 1/4-inch thick.

(2) One and one-eighth inches long with 1 1/2" spacing, for boards 1/4" thick or less; except that staples 7/8" long with 1 1/2" spacing are authorized when boards are 1/7" thick or less.

(b) Other staples 18 gauge, Washburn and Moen.

§ 78.185-17 End supporting battens.¹

(a) End supporting battens at least 1 1/8" wide and same thickness as cleats; fastened securely across ends parallel to side cleats; required so that unsupported distance between cleats, battens, and between cleats and battens will be not greater than as follows.

¹ Not required for wired ends less than 20 inches long.

Thickness of ends (inch):

Thickness of ends (inch)	Maximum spacing (inches)
0.125	10
0.143	11
0.167	12
0.187	13
0.210	14
0.250	15
0.313	16

§ 78.185-18 Side cleat battens and wired end supports.

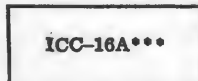
(a) Side cleat battens. At least 1 3/16" by 1 3/16"; fastened securely to ends so as to be adjacent to side cleats when box is set up; required, in addition to any other battens, when authorized gross weight exceeds the following:

Group of wood in cleats:	Authorized gross weight, box and contents, over (pounds)
1	100
2	150
3	200
4	200

(b) Wired end supports. Wired ends, for boxes for authorized gross weight exceeding the foregoing, must be reinforced by 2 strips (liners), at least 1 1/4" wide and as thick as ends, securely stapled along edges of the end parallel to the wires; side cleat battens not required.

§ 78.185-19 Marking.

(a) Marking on each box with letters and figures at least 1/2" high in rectangle as follows:



(1) Stars must be replaced by maximum authorized gross weight (for example, ICC-16A150, etc.). This mark shall be understood to certify that box complies with all specification requirements.

(b) Name of maker located just above, below, or following the mark specified in paragraph (a) of this section; symbol (letters) authorized if registered with the Bureau of Explosives.

§ 78.185-20 Setting up and closing.

(a) Nail or staple unwired ends to side cleats at intervals not over 2 1/2"; fasten wired ends securely by means of loop fasteners.

(b) Twist ends of binding wires or bend loops to give tight closure.

(c) Nail at least 2 nails through side cleats into each side-cleat batten at not over 4" intervals; nail through top and bottom cleats with one 7-penny nail into each end of end-supporting battens.

§ 78.185-22 Special box authorized only when used in conjunction with inside spec. 2U (§ 78.24 of this chapter) polyethylene 5- and 15-gallon cubical containers.

(a) The boxes shall comply with spec. 16A requirements using the table for a gross weight of 200 pounds for construction purposes only, except as follows:

(1) The top section of boxes may have a hole not over 4 1/8 inches in diameter midway between the cleats, and centered not less than 3 1/16 inches from either the back or front edge of boxes.

(2) Five-gallon capacity—ends. Ends may be made from 1/8 inch or thicker

vener and have only one 14-gauge wire across face. One-eighth inch veneer liners, at least 1 1/4 inches wide, must be stapled across the top and bottom of the ends.

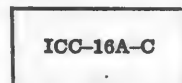
(1) Fifteen-gallon capacity—ends. Ends must be made with same thickness faceboard material as the sides, top, and bottom and must have two liners of the same thickness, at least 3 inches wide, fastened by two rows of staples. Ends may have one 13-gauge wire across face.

(3) Paper overlaid veneer having veneer core of group 3 or 4 wood and completely covered on each side with 42 pound basis weight kraft paper securely adhered thereto by moisture resistant adhesive, is authorized. Total combined thickness of finished board shall be not less than 0.160 inch.

(4) Wire spacing for 5-gallon capacity containers. Binding wires stapled to a row of cleats may be spaced not more than 13 inches apart.

(b) Wirebound wooden or paper overlaid veneer board boxes must be provided with full size double-faced corrugated liners of at least 125-pound test (Mullen or Cady) for bottom and sides. Full area top pad is required for 5-gallon capacity containers and must be a minimum of 200-pound test (Mullen or Cady). Full area top pad is required for the 15-gallon capacity container and must be a minimum of 275-pound test (Mullen or Cady).

(c) Marking required:
(1) Marking on each box with letters and figures at least 1/2 inch high in rectangle as follows:



(2) This mark shall be understood to certify that outer container complies with all construction requirements of the specification.

(3) Name of maker shall be located just above, below, or following the mark specified in subparagraph (1) of this paragraph; symbol (letters) authorized if registered with the Bureau of Explosives.

§ 78.186 Specification 16B; wooden boxes, wirebound.

§ 78.186-1 Compliance.

(a) Required in all details. Authorized tolerances: Cleats, battens, and handles, minus 1/32"; single thickness veneer, minus 5 percent; resawn boards, 1/64" below specified thickness for boards up to 7/32" thick and 1/32" below specified thickness for boards 1/4" or more thick.

§ 78.186-2 Lumber.

(a) Well seasoned and commercially dry; free from decay, objectionable knots, slanting shakes, sharp cross grain, and other defects that materially lessen the strength. Grain of wood in cleats and battens must not cross piece within its length.

§ 78.186-3 Wires.

(a) Of annealed steel, or other metal of equal strength, Washburn and Moen sizes.

§ 78.186-4 Staples.

(a) Wire size, Washburn and Moen.

§ 78.186-5 Grouping of principal woods.

(a) Groupings as follows:

GROUP 1

White pine.	Noble fr.
Norway pine.	Willow.
Aspen (popple).	Magnolia.
Spruce.	Buckeye.
Western yellow pine.	White fr.
Cottonwood.	Cedar.
Yellow poplar.	Redwood.
Balsam fr.	Butternut.
Chestnut.	Alpine fr.
Sugar pine.	Cucumber.
Cypress.	Lodgepole pine.
Basswood.	Jack pine.

GROUP 2

Southern yellow pine.	North Carolina pine.
Hemlock.	Douglas fr.
	Larch (tamarack).

GROUP 3

White elm.	Black ash.
Red gum.	Black gum.
Sycamore.	Tupelo.
Pumpkin ash.	Maple—soft or silver.

GROUP 4

Hard maple.	Birch.
Beech.	Rock elm.
Oak.	White ash.
Hackberry.	Hickory.

§ 78.186-6 Closed box.

(a) Parts and pieces with edges in close contact to give completely closed box except that spaces 1½" are authorized between side boards and between top boards when boards are at least 3½" wide.

(b) Handles: Containers may be provided with suitable handles at discretion of shipper. When used, they must be securely fastened along tops of sides under wires and project 3 inches or be mounted on end cleats; extensions of side boards acceptable; dimensions as follows:

Group of wood	Minimum thickness of boards (inch)						
	¼ (0.125)	½ (0.143)	¾ (0.167)	¾ (0.185)	7/8 (0.219)	¾ (0.250)	¾ (0.313)
	Authorized gross weight, box and contents (pounds)						
1.....	25	35	50	75	100	150	200
2.....	35	50	75	100	150	200	315
3.....	50	75	100	150	200	315	400
4.....	75	100	150	200	315	400	.....

(b) For boxes with 3 or more rows of cleats, boards of the next lower thickness prescribed in the table are acceptable.

§ 78.186-13 Size of cleats.

(a) At least 1¾" by 1¾" when thickness required for boards exceeds ¼"; otherwise at least ¾" by 1¾".

78.186-14 Binding wires (sides, top, and bottom).

(a) Spacing not over 8".

Exception: When each binding wire is stapled to a row of cleats, 11" spacing is authorized.

Authorized gross weight not over (pounds):	Handles ¹ minimum cross section (inches)
150.....	½ x 2½
200.....	5/8 x 2½
315.....	5/8 x 3½
400.....	13/16 x 3½

¹ Also ridge reinforcing battens when prescribed.

§ 78.186-7 Top, sides, and bottom.

(a) Each cleated at both ends; intermediate rows of cleats authorized.

§ 78.186-8 Cleats.

(a) Ends mitered or with mortise and tenon joints.

§ 78.186-9 Ends.

(a) Battened when prescribed. Wired ends authorized provided wires run cross grain and terminate in loops with ends of wire driven through end board and clinched. Grain of wood perpendicular to sides except for wired ends. Ridge-top containers, authorized as follows:

(1) Ends must be at least 2 times as thick as prescribed in § 78.186-12.

(2) Unsupported distance as prescribed in § 78.186-17 must not exceed 10" in any case.

(3) Ridge over 30" long must be reinforced on the outside, from end to end, by 2 battens with abutting edges and of cross section as prescribed for handles.

(4) Vertical grain unwired ends are authorized.

§ 78.186-10 Wires.

(a) One wire over each row of cleats; intermediate wires as prescribed.

§ 78.186-11 Stapling.

(a) Staples for wires over cleats driven through boards into cleats and anchored; others through boards and clinched.

§ 78.186-12 Thickness of boards (sides, tops, bottoms, and ends).

(a) Thickness as follows except that, for thicknesses prescribed as ¾" or less, resawn boards must be ¼" thicker for each resawn surface:

§ 78.186-15 Wires for wired ends.

(a) At least 2 wires on each end, size not less than as specified for binding wires in § 78.186-14, and spaced as follows:

Thickness of end (inch)	Maximum spacing	
	Between wires (inch)	Wires to cleats (inch)
0.125	6	4
.143	6	4
.167	6½	4
.187	6½	4
.219	7	4
.250	7	4
.313	7	4

(b) Ends less than 10 inches deep are authorized with 1 wire provided they are reinforced by 2 strips (liners), at least 1¼" wide and as thick as ends, securely stapled along edges of the end parallel to the wires.

§ 78.186-16 Staple spacing (approximate) and minimum size.

(a) Staples into cleats 16 gauge, Washburn and Moen, and:

(1) One and one-fourth inches long with 1½" spacing, or 1⅝" long with 1" spacing, when boards are over ¼" thick.

(2) One and one-eighth inches long with 1½" spacing, for boards ¼" thick or less; except that staples ⅞" long with 1½" spacing are authorized when boards are ¼" thick or less.

(b) Other staples 18 gauge, Washburn and Moen.

§ 78.186-17 End supporting battens.¹

(a) At least 1⅝" wide and same thickness as cleats; fastened securely across ends parallel to side cleats; required so that unsupported distance between cleats, battens, and between cleats and battens will be not greater than as follows:

Thickness of ends (inch):	Maximum-spacing (inches)
0.125.....	10
0.143.....	11
0.167.....	12
0.187.....	13
0.219.....	14
0.250.....	15
0.313.....	16

§ 78.186-18 Side cleat battens and wired end supports.

(a) Side cleat battens. At least 1¾" by 1¾"; fastened securely to ends so as to be adjacent to side cleats when box is set up; required, in addition to any other battens, when authorized gross weight exceeds the following:

Group of wood in cleats:	Authorized gross weight, box and contents, over (pounds)
1.....	100
2.....	150
3.....	200
4.....	200

(b) Wired end supports. Wired ends, for boxes for authorized gross weight ex-

¹ Not required for wired ends less than 20 inches long.

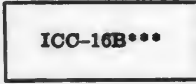
(b) Number and size of binding wires as follows:

Number of wires	Minimum gauge of wires, Washburn and Moen				
	16	15	14	13	12
	Authorized gross weight, box and contents (pounds)				
2.....	35	50	75	100	150
3.....	50	75	100	150	200
4.....	75	100	150	200	315
5.....	100	150	200	315	400
6.....		200	315	400	.....
7.....			400	.....	.....

ceeding the foregoing, must be reinforced by 2 strips (liners), at least 1 1/4" wide and as thick as ends, securely stapled along edges of the end parallel to the wires; side cleat battens not required.

§ 78.186-19 Marking.

(a) Marking on each box with letters and figures at least 1/2" high in rectangle as follows.



(1) Stars must be replaced by maximum authorized gross weight (for example, ICC-16B315, etc.). This mark shall be understood to certify that box complies with all specification requirements.

(b) Name of maker located just above, below, or following the mark specified in paragraph (a) of this section; symbol (letters) authorized if registered with the Bureau of Explosives.

§ 78.186-20 Setting up and closing.

(a) Nail or staple unwired ends to side cleats at intervals not over 2 1/2"; fasten wired ends securely by means of loop fasteners. Provided, That ends at least 1/16" thick may be nailed with cement-coated nails through sides, top, and bottom of box into the ends at 3" intervals.

(b) Twist ends of binding wires or bend loops to give tight closure.

(c) Nail at least 2 nails through side cleats into each side-cleat batten at not over 4" intervals; nail through top and bottom cleats with one 7-penny nail into each end of end-supporting battens.

§ 78.186-21 Special box.

(a) Gross weight not over 500 pounds. Must comply with this specification except as follows: Sides, top, bottom, and ends, to be of group 2 or 3 wood having minimum thickness of 1/4" for boxes not over 315 pounds gross weight, 5/16" for boxes not over 400 pounds gross weight, and 3/8" for boxes not over 500 pounds gross weight. Size of end cleats must be at least 1 3/16" x 7/8" and ends must have horizontal supporting battens at least 1 3/8" x 1 3/16". One batten is required for boxes not over 200 pounds gross weight and three battens for others. Ends must be held in place by one metal strap at least 5/8" x 0.020" completely around the box stapled to the middle end battens. When size of box will not permit the application of all prescribed binding wires during manufacture, the additional binding wires of prescribed number and size, or metal straps of equal number and strength, must be applied after closing. At least three-binding wires must be applied to boxes not over 200 pounds gross weight and at least four to boxes over 200 pounds gross weight by the box manufacturer. Binding wires for boxes over 400 pounds gross weight must be of size and number prescribed

for boxes not over 400 pounds gross weight.

§ 78.187 Specification 16D; wooden wirebound overwrap for inside containers.

§ 78.187-1 Material requirements.

(a) Lumber shall be as follows:
 (1) Lumber shall be well seasoned and commercially dry; free from decay, objectionable knots, slanting shakes, sharp cross grain, and other defects that materially lessen the strength. Grain of wood in cleats and battens must not cross piece within its length.

(2) Authorized tolerances; cleats, battens and handles, minus 1/32 inch; single thickness veneer, minus 5 percent; resawn boards, 1/64 inch below specified thickness for boards up to 7/32 inch thick and 1/32 inch below specified thickness for boards 1/4 inch or more thick.

(3) Woods authorized are in the following groups:

GROUP 2	
Southern yellow pine.	North Carolina pine.
Hemlock.	Douglas fir.
	Larch (tamarack).
GROUP 3	
White elm.	Black gum.
Red gum.	Tupelo.
Sycamore.	Maple—soft or silver.
Pumpkin ash.	
Black ash.	
GROUP 4	
Hard maple.	Birch.
Beech.	Rock elm.
Oak.	White ash.
Hackberry.	Hickory.

(b) Binding wires and staples shall be as follows:

(1) Of annealed steel or other material of equal strength, Washburn and Moen sizes.

§ 78.187-2 Construction requirements.

(a) Wirebound overwrap for drum-type inside container shall be constructed in accordance with the following:

Wirebound containers	Marked capacity of inside containers			
	Not over 5 gallons	Not over 15 gallons	Not over 30 gallons	Not over 55 gallons
<i>Faceboard thickness (sides only)</i>				
Group 2 woods.....	1/4" veneer.....	3/4" resawn.....	3/4" resawn.....	3/4" resawn.
Group 3 or 4 woods.....	do.....	do.....	3/4" resawn.....	Do.
<i>Cleats, mitered</i>				
Outside cleats. Group 2, 3, or 4 woods.	1 3/16" x 7/8".....	1 3/16" x 7/8".....	1 3/16" x 7/8".....	1 3/16" x 7/8".
<i>Binding wires</i>				
Number and gauge over outside cleats.	2-14 gauge.....	2-12 gauge.....	2-11 gauge.....	2-11 gauge.
Number and gauge intermediate wires.	1-14 gauge.....	3-12 gauge.....	4-12 gauge.....	3-12 gauge. 2-11 gauge.
<i>Staples (length, gauge and spacing)</i>				
In outside cleats.....	1 1/2"-16 gauge.....	1 1/2"-16 gauge.....	1 1/2"-16 gauge.....	1 1/2"-16 gauge.
Over intermediate wires.....	3/4"-18 gauge.....	3/4"-18 gauge.....	3/4"-18 gauge.....	3/4"-18 gauge.
Maximum space between staples	1 3/4".....	1 3/4".....	1 3/4".....	1 3/4".
<i>Tops and bases (group 2, 3, or 4 woods)</i>				
Faceboard thickness.....	1/4" resawn.....	3/8" resawn.....	3/8".....	1 3/16".
Battens (2 required).....	1 3/8" x 7/8".....	1 3/8" x 7/8".....	1 3/8" x 7/8".....	1 3/8" x 7/8".
Staples or cement coated nails.....	1 3/16"-18 gauge.....	1 1/4"-16 gauge.....	22-4d nails.....	1 3/8"-14 gauge.

(1) Staples for wires over cleats driven through boards into cleats and anchored; others through boards and clinched.

(2) Container shall be closed with threaded loop fastener with "Z" clinch for all capacities except 5 gallons for which regular clinch is authorized.

(3) Where binding wire closure clinches contact inner container, 1 1/2

inches wide water-resistant fabric cloth with plastic coated backing and pressure-sensitive adhesive or other suitable means shall be applied in a single strip across clinches, or other equally efficient methods may be used.

(b) Wirebound overwrap for bottle-type inside container shall be constructed in accordance with the following:

Wirebound containers	Marked capacity of inside containers		
	Not over 6 1/2 gallons (rectangular overwrap)	Not over 13 gallons (rectangular overwrap)	Not over 13 gallons (cylindrical overwrap)
<i>Faceboard thickness (sides only)</i>			
Group 2 woods.....	3/4".....	3/4".....	3/4".
Group 3 woods.....	1/4" resawn.....	3/8".....	3/8".
Group 4 woods.....	do.....	do.....	Do.
<i>Cleats</i>			
Outside and interrupted cleats.....	1 3/16" x 7/8".....	1 3/16" x 7/8".....	1 3/16" x 5/8".
Intermediate cleats.....	5/2" x 3/8".....	5/2" x 3/8".....	Outside cleats only
<i>Binding wires</i>			
Number and gauge over outside cleats.....	2-13 gauge.....	2-12 gauge.....	2-12 gauge.
Number and gauge over intermediate cleats or intermediate wires.	2-14 gauge (not over 6 gallons). 4-14 gauge (not over 6 1/2 gallons).	4-13 gauge.....	Do.

Wirebound containers	Marked capacity of inside containers		
	Not over 6½ gallons (rectangular overwrap)	Not over 13 gallons (rectangular overwrap)	Not over 13 gallons (cylindrical overwrap)
Staples			
In outside and interrupted cleats.....	1½"-16 gauge.....	1½"-16 gauge.....	1½"-16 gauge.....
In intermediate cleats.....	¾"-16 gauge.....	¾"-16 gauge.....	None.
Over intermediate wires.....	¾"-18 gauge.....	¾"-18 gauge.....	No 2" gap in staples required.
Note: A 2" gap between staples must be provided in the center of each line of staples over the intermediate cleats.			
Top 11			
Face material thickness.....	¾"	1¾"	¾"
Battens.....	1¾" x ¾"	1¾" x 1¾"	¾" x 1¾"
Base			
Face material thickness.....	¾"	¾"	¾"
Edge strips.....	1¼" x ¾"	3¼" x ¾"	¾" x 1¾"
Center strips.....	3¼" x ¾"	do	(Battens.)

¹ A hole of suitable type may be left in top of box to provide for protruding neck of inner container.
² Exterior grade plywood ½" thick with no battens is authorized.

(1) Containers shall be closed with threaded loop fasteners using a regular clinch.

§ 78.187-3 Assembly.

(a) Overwrap shall be constructed to provide a snug fit for the inside container.

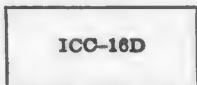
(b) Overwrap inside surfaces shall be reasonably smooth and free from projections which would damage inside container.

§ 78.187-4 Tests.

(a) Wirebound overwrap; when assembled as for use, shall withstand the tests prescribed for specified inside containers. The completed package must withstand these tests without serious rupture of the overwrap and without producing a condition of the overwrap that could result in potential damage to the inside container.

§ 78.187-5 Marking authorized.

(a) Marking on each overwrap with letters and figures at least ½ inch high in rectangle as follows:



(b) This mark shall be understood to certify that outer container complies with all construction requirements of the specification.

(c) Name of maker shall be located just above, below, or following the mark specified in paragraph (a) of this section; symbol (letters) authorized if registered with the Bureau of Explosives.

§ 78.190 Specification 19A; wooden boxes, glued plywood cleated.

§ 78.190-1 Compliance.

(a) Required in all details.

§ 78.190-2 Three-way corners.

(a) Three-way corners (when specified in §§ 78.190-3 to 78.190-13) shall be of type so nailing will be into edge grain of cleats, unless otherwise specified.

§ 78.190-3 Lumber.

(a) Well seasoned and commercially dry; free from decay, loose knots, knots that would interfere with nailing, and other defects that would materially lessen the strength. Cleats to be free from knots and grain of wood must not cross cleat in less than one-half its length.

(b) To be at least 3-ply, except for cleats; each ply glued in place with grain at right angles to the one next.

§ 78.190-4 Nails.

(a) Cement coated and of size specified for "sinkers", "coolers", and "3-ply-veneer nails" as generally known to the trade.

§ 78.190-5 Grouping of principal woods.

(a) Grouping as follows:

- GROUP 1**
- White pine. Chestnut.
- Norway pine. Sugar pine.
- Aspen (popple). Cypress.
- Spruce. Basswood.
- Western (yellow) pine. Willow.
- Cottonwood. Noble fr.
- Yellow poplar. Magnolia.
- Balsam fr. Buckeye.
- Cedar. White fr.
- Redwood. Alpine fr.
- Butternut. Lodgepole pine.
- Cucumber. Jack pine.
- GROUP 2**
- Southern yellow pine. Douglas fr.
- Hemlock. Larch (tamarack).
- North Carolina pine.
- GROUP 3**
- White elm. Black ash.
- Red gum. Black gum.
- Sycamore. Tupelo.
- Pumpkin ash. Maple—soft or silver.
- GROUP 4**
- Hard maple. Birch.
- Beech. Rock elm.
- Oak. White ash.
- Hackberry. Hickory.

§ 78.190-6 Three-way corners.

(a) Three-way corners required; except for authorized gross weight not over 75 pounds.

§ 78.190-7 Cleats required.

(a) Two on each face at opposite edges; others as necessary so that cleats are not over 12" apart. These to extend full length of face.

(b) Others, if necessary, to provide nailing surface at each box edge.

§ 78.190-8 Parts and dimensions.

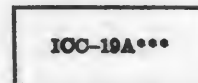
(a) Parts and dimensions as follows:

Authorized gross weight	Ply-wood minimum thickness ¹	Cleats of group 1 or 2 woods ¹		Cleats of group 3 or 4 woods ¹	
		Minimum thickness	Minimum width	Minimum thickness	Minimum width
Pounds	Inch	Inch	Inches	Inch	Inches
50.....	¾	½	1½	½	1½
75.....	¾	¾	1½	½	1½
100.....	¾	¾	1¾	½	1½
150.....	¾	¾	2¼	½	1½
200.....	¾	¾	2¼	¾	1½
300.....	¾	¾	2¼	¾	1¾
400.....	¾	¾	2½	¾	2¼

¹ Variation authorized of ¼ prescribed thickness of any part not to exceed 10 percent of its area. Cleats at least ½" thick, of cross section equivalent to prescribed cleats are authorized.

§ 78.190-9 Marking.

(a) Marking on each container with letters and figures at least ½" high in rectangle as follows:



(1) The stars must be replaced by authorized gross weight (for example, ICC-19A200). This mark shall be understood to certify that box complies with all specification requirements.

(2) Name of maker located just above, below, or following the mark specified in this paragraph; symbol (letters) authorized if registered with the Bureau of Explosives.

§ 78.190-10 Setting up and closing all boxes.

(a) Each edge of each plywood section secured with 3-ply-veneer cement coated nails, or staples, at 3" intervals as follows:

(1) To face of cleat; clinching required; cement coating optional.

(2) To edge of cleat; except when nailing through a cleat in which case nail as in § 78.190-13.

§ 78.190-11 Boxes with 3-way corners.

(a) Each cleat forming 3-way corner to be nailed with 2 nails at each end into edge of adjoining cleat.

§ 78.190-12 Boxes without 3-way corners.

(a) Each edge cleat to be nailed to cleat on adjoining face.

§ 78.190-13 Nails and nailing under §§ 78.190-11 and 78.190-12.

(a) To be cement coated and as follows:

Cleats—thickness (inch)	Nails—cement coated			
	Group 1 or 2 woods		Group 3 or 4 woods	
	Size (penny)	Spacing (inches)	Size (penny)	Spacing (inches)
1/2	5	1 3/4	4	1 1/2
3/4	6	2	5	1 3/4
1	6	2	5	1 3/4
1 1/4	7	2 1/4	6	2
3/4	7	2 1/4	6	2
1 3/4	8	2 1/2	7	2 1/4
1	9	2 3/4	8	2 1/2

§ 78.191 Specification 19B; wooden boxes, glued plywood, nailed.

§ 78.191-1 Compliance.

(a) Required in all details.

§ 78.191-2 Authorized gross weight.

(a) Authorized gross weight not to exceed 150 pounds.

§ 78.191-3 Plywood.

(a) Plywood shall be made from veneer which has been rotary cut, sliced or sawed. It shall be well seasoned and commercially dry; free from decay, objectionable knots, that interfere with nailing, splits, gaps, and other defects that materially lessen the strength. Plywood shall be of good commercial box or sheathing grade.

(b) Plywood shall be at least 5 ply; each ply alternately glued with the grain at right angles to the one next.

§ 78.191-4 Nails.

(a) Cement coated and of size specified for "sinkers" or "coolers" as generally known to the trade.

(b) Nail spacing as follows:

Nail (size) in penny	Maximum spacing when driven into end and corner posts	
	Side grain	End grains
	Inches	Inches
Threepenny	1 1/4	1
Fourpenny	1 1/2	1 1/4
Fivepenny	1 3/4	1 1/2
Sixpenny	2	1 3/4
Sevenpenny	2 1/4	2
Eightpenny	2 1/2	2 1/4
Ninepenny	2 3/4	2 1/2
Tenpenny	3	2 3/4

§ 78.191-5 Corner construction.

(a) Boxes exceeding 35 pounds gross weight must have 4 vertical corner posts, or other equally suitable devices or fasteners; nailed lap-joint permitted for others.

§ 78.191-6 Assembly.

(a) Assemble with grain of outer plywood face in the direction of the longest faces of the box and securely nail or fasten to corner posts or ends as provided in §§ 78.191-4 and 78.191-5.

§ 78.191-7 Special tests.

(a) Samples of each type and size manufactured, taken at random, and filled with dummy contents the shape and size of expected contents, or with sand or sawdust, to the gross weight at which container is marked, closed as for

use, must be capable of withstanding the following tests without serious rupture or exposure of contents:

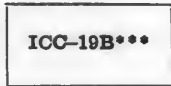
(1) 8 drops from height of 1 foot, one on each corner, onto solid concrete.

§ 78.191-8 Closing for shipment.

(a) Box to be securely closed. Nails, if used, must be as prescribed in § 78.191-3; hinges and hasps or other equally efficient device authorized.

§ 78.191-9 Marking.

(a) Marking on each container with letters and figures at least 1/2" high in rectangle as follows:



(1) The stars must be replaced by authorized gross weight (for example ICC-19B150). This mark shall be understood to certify that box complies with all specification requirements.

(2) Name of maker located just above below, or following the mark specified in this section; symbol (letters) authorized if registered with the Bureau of Explosives.

§ 78.193 Specification 18B; wooden kits.

§ 78.193-1 Compliance.

(a) Required in all details.

§ 78.193-2 Tops and bottoms.

(a) Pieces to be glued together.

§ 78.193-3 Parts required and dimensions.

(a) Parts required and dimensions as follows:

Authorized gross weight (pounds)	Thickness (minimum)		Hoops (minimum)		
	Top and bottom (inch)	Staves (inch)	Number	Width (inch)	Gauge ¹
25	1/2	3/8	3	3/4	23
40	3/4	1/2	3	3/4	23

¹ Birmingham wire gauge (number).

§ 78.193-4 Middle hoop.

(a) Middle hoop of No. 11 gauge wire authorized.

§ 78.193-5 Type test.

(a) Sample, filled with dry, finely powdered material to authorized gross weight and closed as for use, shall withstand, without leaking, a drop from height of 4 feet onto solid concrete so as to strike diagonally on top chime.

§ 78.193-6 Marking.

(a) Marking on each container plainly as follows:

(1) ICC-18B; followed by the authorized gross weight (for example, ICC-18B25). This mark shall be understood to certify that the container complies with all specification requirements.

(2) Name or symbol (letters) of maker; this must be registered with the Bureau of Explosives and located just above, below, or following the mark specified in subparagraph (1) of this paragraph.

§ 78.193-7 Size of mark.

(a) Size of mark (minimum). 1/2" high.

§ 78.196 Specification 22A; wooden drums, glued plywood.

§ 78.196-1 Compliance.

(a) Required in all details.

§ 78.196-2 Lumber.

(a) To be well seasoned, commercially dry, and free from decay, loose knots, knots that would interfere with nailing, and other defects that would materially lessen the strength.

§ 78.196-3 Woods required for plywood.

(a) As follows:

GROUP 3

- White elm.
- Red gum.
- Sycamore.
- Pumpkin ash.
- Black ash.
- Black gum.
- Tupelo.
- Maple—soft or silver.

GROUP 4

- Hard maple.
- Beech.
- Oak.
- Hackberry.
- Birch.
- Rock elm.
- White ash.
- Hickory.

§ 78.196-4 Plywood.

(a) At least 2-ply for body and 3-ply for heads; all plies glued together cross grain.

§ 78.196-5 Hoops and battens.

(a) Grain of wood must not cross piece within 1/2 of its length. Hoops to be of elm.

Exception: Plywood hoops 0.28" thick are authorized.

§ 78.196-6 Parts and dimensions.

(a) Parts and dimensions as follows:

Maximum net weights authorized	Thickness (minimum)		Size of hoops (minimum)		Head liners (minimum)
	Body	Heads	Wooden	Metal ²	
	Pounds	Inch	Inch	Inch	Inch	Inch
33	0.16	3/4	1/4 x 2	0.023 x 1 1/4	1/4 x 3/4
56	.18	3/4	1/4 x 2	.015 x 2 3/4 .023 x 1 1/4	1/4 x 3/4
115	.20	3/4	1/4 x 2 1/4	.015 x 2 3/4 .023 x 1 1/4	1/4 x 3/4
200	.28	0.43	1/4 x 3	.015 x 2 3/4 .028 x 1 1/4	1/4 x 3/4

¹ Authorized only when metal hoop is between body of drum and wooden hoop as described in § 78.196-8.

² On drums of not over 10 1/4 gallons capacity having authorized maximum net weights not over 115 pounds, additional outside headliners may be used in lieu of metal hoops provided containers will pass prescribed tests. (See § 78.196-14.)

§ 78.196-7 Body joints.

(a) To be made by steel strip 0.015" x 1 1/2" secured by staples, clinched, at 1 1/8" centers, or by other method giving equivalent strength; also to be made siftproof by 2 thicknesses of 3" paper tape 60-pound strength, Mullen or Cady test, or other equivalent protection.

NOTE 1: Because of the present emergency and until further order of the Commission, tape 2 1/2" may be used.

§ 78.196-8 Hoops.

(a) One wooden and 1 metal required at each chime; wooden hoops secured by staples, clinched, at 3" centers; metal

hoops to be outside wooden hoops and secured by punching, or other equivalent method, at 6" centers.

§ 78.196-9 Head battens.

(a) Required for heads over 15" diameter; 3/4" x 3", minimum; ends rounded to fit chime.

§ 78.196-10 Head liners.

(a) Required inside and outside for full circumference of heads. To be securely fastened by staples or nails, clinched.

§ 78.196-11 Head lining paper.

(a) Required for each head; 1 1/2" larger than head diameter; of No. 1 Kraft paper 90 pounds per ream (480 sheets 24" x 36") or equivalent.

NOTE 1: Because of the present emergency and until further order of the Commission, a ream may consist of 500 sheets.

§ 78.196-12 Bung openings.

(a) Bung and bunghole authorized provided head lining paper is glued around hole.

§ 78.196-13 Insertion of head.

(a) As in § 78.196-16.

§ 78.196-14 Tests.

(a) Samples of each type and size taken at random, filled with dry, fine powder to the authorized net weight and closed as for use, must be capable of withstanding, without leakage, 2 drops diagonally on either end chime onto solid concrete from height of 4 feet.

§ 78.196-15 Marking.

(a) Marking on each container by marks 3/4" high, as follows:

(1) ICC-22A, followed by authorized gross weight (authorized net weight plus approximate tare weight, for example, ICC-22A115). This mark shall be understood to certify that the container complies with all specification requirements.

(2) Name or symbol (letters) of maker; this must be registered with the Bureau of Explosives and located just above, below, or following the mark specified in subparagraph (1) of this paragraph.

§ 78.196-16 Closing for shipment.

(a) Closing heads. Insert head lining paper, head, and head liner; nail with 15 gauge nails, clinched, at 2" centers through head liner, body and wooden hoop; equivalent stapling authorized. Nail through steel hoop with two 7-penny nails into each end of head batten, if any.

§ 78.196-17 Bung closures.

(a) Bung closures (if any) must be well driven and secured sufficiently to prevent leakage in transit.

§ 78.197 Specification 22B; wooden drums, glued plywood.

§ 78.197-1 Compliance.

(a) Required in all details.

§ 78.197-2 Lumber.

(a) To be well seasoned, commercially dry, and free from decay, loose knots, knots that would interfere with nailing,

and other defects that would materially lessen the strength.

§ 78.197-3 Woods required for plywood.

(a) Woods required as follows:

GROUP 3	
White elm.	Black ash.
Red gum.	Black gum.
Sycamore.	Tupelo.
Pumpkin ash.	Maple—soft or silver.
GROUP 4	
Hard maple.	Birch.
Beech.	Rock elm.
Oak.	White ash.
Hackberry.	Hickory.

§ 78.197-4 Plywood.

(a) At least 2-ply for body and 3-ply for heads; all plies glued together cross grain.

§ 78.197-5 Hoops and battens.

(a) Grain of wood must not cross piece within 1/2 of its length. Hoops to be of elm. Exception: Plywood hoops 0.28" thick are authorized.

§ 78.197-6 Parts and dimensions.

(a) Parts and dimensions as follows:

Maximum net weights authorized	Thickness (minimum)		Size of hoops (minimum)		Head liners (minimum)
	Body	Heads	Wooden		
			Wooden	Metal ¹	
Pounds	Inch	Inch	Inch	Inch	Inch
33.....	0.16	3/4	1/4 x 2	0.023 x 1 1/4 .015 x 2 3/4	1/4 x 3/4
56.....	.18	3/4	1/4 x 2	.023 x 1 1/4 .015 x 2 3/4	1/4 x 3/4
115.....	.20	3/4	1/4 x 2 1/4	.023 x 1 1/4 .015 x 2 3/4	1/4 x 3/4
200.....	.28	0.43	1/4 x 3	.028 x 1 1/4	1/4 x 3/4

¹ Authorized only when metal hoop is between body of drum and wooden hoop as described in § 78.197-8.

² On drums of not over 10 1/2 gallons capacity having authorized maximum net weights not over 115 pounds, additional outside headliners may be used in lieu of metal hoops provided containers will pass prescribed tests. (See § 78.197-13.)

§ 78.197-7 Body joint.

(a) Joint to be made by steel strip 0.015" x 1 1/2" secured by staples, clinched, at 1 1/8" centers, or by other method giving equivalent strength.

§ 78.197-8 Hoops.

(a) One wooden and 1 metal required at each chime; wooden hoops secured by staples, clinched, at 3" centers; metal hoops to be outside wooden hoops and secured by punching, or other equivalent method, at 6" centers.

§ 78.197-9 Head battens.

(a) Required for heads over 15" diameter, 3/4" x 3", minimum; ends rounded to fit chime.

§ 78.197-10 Head liners.

(a) Required inside and outside for full circumference of heads. To be securely fastened by staples or nails, clinched. Inside head liners not required when close fitting inside metal drum or strong container is used.

§ 78.197-11 Bung or other openings in head.

(a) Bung and bunghole authorized provided head lining paper is glued around hole. Holes are permitted in heads to provide for closing devices of

inside metal drums or other strong inside containers when plywood drum is so equipped.

§ 78.197-12 Insertion of head.

(a) As in § 78.197-15.

§ 78.197-13 Tests.

(a) Samples of each type and size taken at random, filled with dry, fine powder to the authorized net weight and closed as for use, must be capable of withstanding, without leakage, 2 drops diagonally on either end chime onto solid concrete from height of 4 feet.

§ 78.197-14 Marking.

(a) Marking on each container by marks 3/4" high, as follows:

(1) ICC-22B, followed by authorized gross weight (authorized net weight plus approximate tare weight, for example, ICC-22B235). This mark shall be understood to certify that the container complies with all specification requirements.

(2) Name or symbol (letters) of maker; this must be registered with the Bureau of Explosives and located just above, below, or following the mark specified in subparagraph (1) of this paragraph.

§ 78.197-15 Closing for shipment.

(a) Closing heads. Insert head lining paper, head, and head liner; nail with 15 gauge nails, clinched, at 2" centers through head liner, body and wooden hoop; equivalent stapling authorized. Nail through steel hoop with two 7-penny nails into each end of head batten, if any.

§ 78.197-16 Bung closures.

(a) Bung closures (if any) must be well driven and secured sufficiently to prevent leakage in transit.

§ 78.198 Specification 22C; plywood drum for plastic inside container.

§ 78.198-1 Material requirements.

(a) Plywood shall be as follows:
(1) Plywood for body and heads shall be of good commercial or sheathing grade hardwood veneer. Veneer plies shall be firmly glued together with waterproof glue. A section of plywood from any part when immersed in water at room temperature for 48 hours shall show no delamination or separation of plies to qualify glue as waterproof.

(2) Plywood shall be well seasoned, commercially dry, and free from decay, loose knots that interfere with assembly, and other defects that would materially lessen the strength.

§ 78.198-2 Construction requirements.

(a) Plywood drum shall completely and snugly enclose body of inside container, or shall completely and snugly enclose body and neck of inside container. Top head of drum may have a hole of suitable size to provide for protruding neck of plastic container; bottom head may have drainage holes of suitable size. The following are required:

(1) Body shall be constructed of 2 shells, (see Note 1), butt-jointed, telescoped one within the other; outer shell shall be fastened on the outside with wire staples of not less than 17-gauge metal

driven through a metal strip not less than 28-gauge by 1½ inches width and each side of body joint. Staples shall be spaced not more than 1½ inches apart and clinched on the inside. The grain of outside ply shall be paralleled and the grain of inner ply shall be vertical to plane of the heads.

NOTE 1: Each shell shall be of two-ply construction having minimum wall thickness of ¼ inch for inside container not over 6½ gallons marked capacity and ⅜ inch for inside container not over 14 gallons marked capacity.

(2) Body heads shall be of at least three-ply construction with grain of alternate plies at right angles, circled to fit snugly within the body shell. Each head shall have a minimum thickness of ⅜ inch for inside container not over 6½ gallons marked capacity and ⅞ inch for inside container not over 14 gallons marked capacity. As an alternate, ½ inch thick pine bottom heads are authorized.

(3) Hoops shall be of at least three-ply construction with grain of alternate plies at right angles. Hoops shall be fastened to body shell so that ends butt or slightly gap by driving wire staples of at least 17-gauge metal through hoop and body and be clinched on the inside; staples spaced on not less than 3 inches centers. Each hoop shall be not less than ⅝ inch thickness by 2½ inches width for inside container not over 14 gallons marked capacity, and not less than ¼ inch thickness by 3 inches width for inside container not over 6½ gallons marked capacity.

(4) Head retaining rings shall be of hardwood veneer not less than ½ inch thickness by ⅝ inch width for inside container not over 6½ gallons marked capacity, and not less than ⅜ inch thickness by ¾ inch width for inside container not over 14 gallons marked capacity. The head retaining rings shall be fastened to the body shell with wire staples clinched on the inside of not less than 17-gauge metal spaced on 3 inch centers, except that bottom ring may be fastened by 14-gauge wire staples spaced on 4 inch centers.

(b) Plywood drum for plastic inside container not over 5 gallons marked capacity shall comply with requirements of § 78.198-1(a) (1) and (2) and paragraph (a) of this section.

(1) Body shells shall be of two-ply construction having a minimum thickness of ⅜ inch and with grain of outside ply parallel and grain of inner ply vertical to plane of the heads. Body shall be butt-jointed and fastened on the outside with wire staples of not less than 17-gauge metal driven through a metal strip not less than 28-gauge by 1½ inches width and each side of body joint. Staples shall be spaced not more than 1½ inches apart and clinched on the inside.

(2) Body heads shall be of at least three-ply construction with grain of alternate plies at right angles circled to fit snugly within the body shell. Each head shall have a minimum thickness of ⅜ inch.

(3) Hoops shall be of hardwood veneer, not less than 2¼ inches wide by ¼

inch thick. Hoops shall be fastened to the body by 17-gauge staples on not less than three-inch centers and shall be overlapped not less than 3 inches.

(4) Head retaining rings shall be of hardwood veneer of ½ inch thickness by ¾ inch width except bottom rings may be two thicknesses, each ⅜ inch thickness by 1¾ inches width. Rings shall be fastened to body shell with wire staples of 17-gauge metal on not less than 3-inch centers and clinched on inner surface.

§ 78.198-3 Tests.

(a) Samples taken at random with inner plastic container filled to marked capacity with water and closed as for use, shall be capable of withstanding prescribed tests without leakage from inside container or breakage of outside container that would be of such a nature as to contribute to potential failure of inner container. Tests shall be made of each size by each company starting production. The type test is as follows:

(1) One 4-foot drop onto solid concrete so as to strike diagonally on either chime.

(2) Additional tests as required by inside container specification.

§ 78.198-4 Marking on outside container.

(a) Each outside container must be plainly marked with letters and figures at least ¼ inch high applied by hot branding iron or dark colored printing ink with high pressure dies as follows:

(1) ICC-22C. This mark shall be understood to certify that the complete package complies with all specification requirements.

(2) Name or symbol (letters) of company setting up the package, or other party assuming responsibility for its compliance with the specification requirements; this must be registered with the Bureau of Explosives and located just above or below the mark specified in subparagraph (1) of this paragraph.

Subpart F—Specifications for Fiberboard Boxes, Drums, and Mailing Tubes

§ 78.205 Specification 12B; fiberboard boxes.

§ 78.205-1 Compliance.

(a) Required in all details.

§ 78.205-2 Definitions.

(a) Terms such as "200-pound test" mean minimum strength, Mullen or Cady test.

(b) "Joints" are where edges of parts of box, except recessed flanged heads, are connected together in setting up the box. Generally done by box maker.

(c) "Seams" are where edges of parts of box are visible, except joints, when box is closed.

§ 78.205-3 Classification of board.

(a) Fiberboard is hereby classified by strength¹ of completed board as in first column of the following table; weights specified in the table are the minimums authorized.

Classified strength ¹ of completed board	Solid fiberboard—Minimum combined weight of component plies exclusive of adhesives (pounds per 1,000 sq. ft.)	Facings for corrugated fiberboard	
		Double-faced—Minimum combined weight of facings (pounds per 1,000 sq. ft.)	Double-wall—Minimum combined weight of facings including center liner (pounds per 1,000 sq. ft.)
175-----	140	75	92
200-----	190	84	110
275-----	237	138	110
325-----	237	138	110
350-----	283	180	126
375-----	283	180	180
400-----	283	180	180
450-----	283	180	180

¹ Mullen or Cady test (minimum).

§ 78.205-4 Solid fiberboard.

(a) To be 3-ply or more; both outer plies water resistant.

§ 78.205-5 Corrugated fiberboard.

(a) Both outer facings water resistant; corrugated sheets must be at least 0.009 inch thick and weigh not less than 26 pounds per 1000 square feet; all parts must be securely glued together throughout all contact areas.

§ 78.205-6 Stitching staples.

(a) Of steel wire at least ⅜ x 0.019 inch, or equal cross section, formed into staples about ⅞ inch wide. Staples of metal other than steel are authorized provided their efficiency is equal to that of steel wire staples specified in this section.

§ 78.205-7 Tape.

(a) Coated with glue at least equal to No. 1¾ Peter Cooper standard. Cloth tape of strength, across the wool, at least 70 units, Elmendorf test. Sisal tape of 2 sheets of No. 1 Kraft paper, total weight 80 pounds per ream (500 sheets, 24" x 36"); sheets to be combined with asphalt and reinforced by unspun sisal fibers completely embedded in the asphalt and extending across the tape, except as provided in § 78.205-11(d). Other tapes of equal strength and efficiency are authorized.

(b) Tape for closure of slotted containers complying with the following requirements is authorized when applied as prescribed in § 78.205-17 (a) (3):

(1) Tape must be not less than 3 inches wide and shall be made of two sheets of 100 percent sulfate Kraft each not less than 30 pounds basis weight, reinforced with glass, sisal, or rayon fiber, combined with a laminant of asphalt or other material not affected by temperature extremes any more than would standard 180° to 200° softening point asphalt.

(2) Tape must be reinforced by lengthwise fibers spaced not more than an average of ½ inch apart, and by crosswise fibers spaced not less than an average of 2 per inch except that when a diamond pattern is employed for crosswise reinforcement, the spacing between the parallel sides of the diamond measured in the machine direction must be not more than 1 inch.

(3) Glass or sisal reinforced tape must have a minimum tensile strength in the machine direction of 75 pounds per inch of width and a minimum tensile strength in the cross direction of 45 pounds per inch of width; rayon reinforced tape must have a minimum tensile strength in the machine direction of 57 pounds per inch of width and a minimum tensile strength in the cross direction of 27 pounds per inch of width with elongation not exceeding 15 percent. Tensile tests on the finished product shall be made on a 3-inch width sample.

§ 78.205-8 Test.

(a) Acceptable board must have prescribed strength, Mullen or Cady test, after exposure for at least 3 hours to normal atmospheric conditions (50 to 70 percent relative humidity), under test as follows:

(1) Clamp board firmly in machine and turn wheel thereof at constant speed of approximately 2 revolutions per second.

(2) Six punctures required, 3 from each side; all results but one must show prescribed strength.

(3) Board failing may be retested by making 24 punctures, 12 from each side; when all results but 4 show prescribed strength the board is acceptable.

(4) For corrugated fiberboard, double-pot tests may be disregarded.

§ 78.205-9 Types authorized.

(a) To be of solid or corrugated fiberboard of the following types, or as specifically provided for in § 78.205-19 to § 78.205-37:

(1) Slotted box; three-piece box without recessed ends; three-piece box of solid fiberboard with recessed ends; double-slide box; triple-slide box; telescope box, with sections of equal depth, or with covers, top or bottom or both, with 3 inches overlap. (See § 78.205-14 (d) for boxes with single-flap closures).

§ 78.205-10 Forming.

(a) Parts must be cut true to size and so creased and slotted as to fit closely into position without cracking, surface breaks, separation of parts outside of crease, or undue binding.

§ 78.205-11 Joints.

(a) For solid and corrugated fiberboard slotted containers: Lapped $1\frac{1}{2}$ inches from center of scoreline except as in § 78.205-12; stitched at $2\frac{1}{2}$ inch intervals and within 1 inch of each end of joint; body joint must be double-stitched (2 parallel stitches) at each end of joint over 18 inches long.

(b) For corrugated fiberboard slotted containers only: One butt joint taped (See § 78.205-7) is authorized; 3 inch tape required for boxes over 30 pounds authorized gross weight and 2 inch tape for others.

(c) For triple and double slide boxes: Joints of all slides must be taped (see § 78.205-7) or stitched; 3-inch tape required for boxes over 30 pounds authorized gross weight and 2-inch for others.

(d) For corrugated fiberboard only: One butt joint taped inside and outside with strips of one thickness of sulphate paper not less than 2 inches wide ex-

tending entire length of joint and firmly glued to box. For boxes not exceeding 65 pounds gross weight, outside strip of sulphate paper to be of basis weight not less than 60 pounds and inside strip of sulphate paper to be of basis weight not less than 40 pounds testing not less than 40 pounds. For boxes exceeding 65 pounds gross weight, outside and inside with strips of sulphate paper which must each be of basis weight not less than 90 pounds testing not less than 90 pounds. Basis weight of paper shown is for 500 sheets, 24 x 36 inches.

(1) For glued lap joint, the sides of box forming joint must lap not less than $1\frac{1}{4}$ " and be firmly glued throughout entire area of contact with a glue or adhesive which cannot be dissolved in water after the film application has dried.

§ 78.205-12 Flanged heads.

(a) Must have 4 flanges, at least 1" long above fillet, on each head. Recessed flanged heads not authorized for boxes of corrugated fiberboard.

§ 78.205-13 Seams which are to be stitched.

(a) Overlap, if any, required to be at least $1\frac{1}{2}$ inches from center of scoreline except as in § 78.205-12.

§ 78.205-14 Flap closures.

(a) Fill-in pieces, of the same type fiberboard as used in construction of the container, are required where it is necessary to prevent an opening between the inner flaps, unless otherwise provided by Part 73 of this chapter.

(b) If to be closed by adhesive, each inner flap must cover at least one-third of face; inner flaps must butt or have full overlap, or fill-in pieces must be used, unless otherwise provided by Part 73 of this chapter, except that fill-in pieces are not required when outer flaps have full overlap. Outer flaps must butt or have full overlap.

(c) In lieu of fill-in pieces between inner flaps which do not butt, the following is authorized when linings are not prescribed in § 78.205-16;

(1) Top and bottom pads the same dimensions as interior of container of solid or corrugated fiberboard at least 125 pound test (Mullen or Cady).

(2) Minimum combined weight of facings for corrugated fiberboard pads must be at least 52 pounds per thousand square feet.

(3) Minimum combined weight of component plies for solid fiberboard pads must be at least 114 pounds per thousand square feet, exclusive of adhesives.

(4) Complete inner box or boxes.

(d) Single-flap closures are authorized for boxes with one dimension not over 2"; each flap must be scored and form one of the small faces of the box and lap at least 5" on one of the largest faces.

§ 78.205-15 Linings (when prescribed).

(a) Of 1-piece to extend around 4 faces with joint at center of 1 face and with 4 flanges, at least $1\frac{1}{2}$ " long, on each end (corners may be mitered) to bend over the other 2 faces; also 2 pads to

cover the other 2 faces. Pads may be omitted if closing flaps afford 3 thicknesses throughout face. For boxes with 1 dimension not over 3", one of the widest flanges may be lengthened to cover entire face and lap 6" on the adjoining face and the other flanges and the pads may then be omitted.

§ 78.205-16 Authorized gross weight and parts required.

(a) Authorized gross weight (when packed) and parts required as follows:

Authorized gross weight (pounds)	Strength of fiberboard (minimum) Mullen or Cady test						
	Solid board			Double-faced corrugated		Double-wall corrugated	
	Box	Lining ²	Heads ¹	Box	Lining ²	Box	Lining ²
15.....	175		(³) 275	175		200	
30.....	200		275	200		200	
40.....	275		350	275	175	200	
55.....	325		(³)	325		275	
65 ⁴	375		(³)	375		275	
	275	175	350	275	175	275	
				200	200		

¹ For recessed heads when used. In other cases same as for box.

² As prescribed in § 78.205-16. A complete box is acceptable in place of the lining.

³ Recessed heads not authorized in any case.

⁴ Except as otherwise authorized herein or by Part 73 of this chapter.

(b) Triple slide boxes authorized for gross weights as follows: Of board at least 175-pound test for 40 pounds; of board at least 200-pound test for 65 pounds.

§ 78.205-17 Closing for shipment.

(a) Slotted container, by coating with adhesive the entire contact surfaces of closing flaps and fill-in pieces where required or as prescribed in subparagraph (1), (2), or (3) of this paragraph.

(1) By stitching with staples as prescribed by § 78.205-6 at $2\frac{1}{2}$ -inch intervals along all seams (one 5-inch space allowed when necessary to permit use of stitching device); or with staples made of flat wire of hardness not less than equivalent of Rockwell B90, and not less than 0.037 inch thick and not less than 0.074 inch wide, with not less than $1\frac{1}{4}$ inch crown, may be spaced not more than 5 inches apart. Such staples may be used across center seam where outside flaps meet in lieu of on both sides of center seam but need only be used where outside flaps overlay inner flaps; or staples made of arcuate wire of hardness not less than equivalent of Rockwell B90, and not less than 0.027 inch thick and not less than 0.095 inch wide, with not less than 1 inch crown, may be spaced not more than 5 inches apart. Such stitches when spaced not more than $2\frac{1}{2}$ inches apart may be used across center seam where outside flaps meet in lieu of on both sides of center seam but need only be used where outside flaps overlay inner flaps.

(2) For fiberboard boxes containing not more than 1 inside metal can not exceeding 1 gallon nominal capacity, and as otherwise authorized by Part 73 of this chapter, by application of 2 strips of pressure-sensitive tape not less than $\frac{1}{2}$ inch in width, 1 strip to be placed ap-

proximately equal distance over the seam of abutting outer flaps, the other at a right angle to the first and spaced approximately equal distance on the closure face; strips must be of sufficient length to extend not less than 1 inch beyond score lines on side and end panels. Tape shall have a minimum tensile strength of 160 pounds per inch of width; minimum adhesion value of 18 ounces per inch of width; and minimum elongation of 12 percent at break, or having a minimum longitudinal tensile strength of not less than 240 pounds per inch of width; minimum adhesion value of 18 ounces per inch of width and a minimum elongation of 3 percent at break.

(3) For slotted containers only, reinforced tape complying with the requirements of § 78.205-7 (b) is authorized for application over the center seam only. Tape must extend over the ends of box not less than 2½ inches.

(b) Double slide boxes or triple slide boxes, by coating the inner slides with adhesive, or by closing with reinforced tape capable of withstanding test prescribed by subparagraph (1) of this paragraph; for single-flap closures as authorized for boxes with one dimension not over 2 inches, the flaps must be fastened to the body with adhesive.

(1) Boxes selected at random, containing dummy contents similar to that to be shipped and packed to authorized gross weight, closed with reinforced tape across the ends and onto opposite side panels at least 2 inches, must be capable of withstanding a drop on each end from a height of 4 feet onto solid concrete without closure failure.

(c) Fiberboard boxes with covers extending over sides but not to bottom, covers resting on walls of box, or telescope boxes of equal depth section, covers extending to bottom, must be secured by one of the following methods:

(1) By not less than three metal straps, one lengthwise and others at right angles thereto.

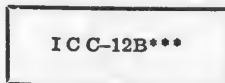
(2) When cover extends not less than 3 inches over the walls of the box, by coating with adhesive the entire contact area of the cover.

(3) Telescope boxes having equal depth sections may be closed by application of reinforced water activated tape or pressure sensitive tape under conditions and for commodities as prescribed in Part 73 of this chapter.

(d) When metal straps are specified, boxes must be strapped with the required number; size at least ¾ inch x 0.015 inch.

§ 78.205-18 Marking.

(a) On each container. Symbol in rectangle as follows:



(1) Stars to be replaced by authorized gross weight (for example, ICC-12B40, etc.). This mark shall be understood to certify that the container complies with all specification requirements.

(2) Name and address of plant making the container; symbol (letters) author-

ized if recorded with the Bureau of Explosives. This mark to be located just above or below the mark specified in this paragraph.

(3) When metal straps are prescribed, boxes must be marked "----- (number) METAL STRAPS REQUIRED" just above or below the mark specified in this paragraph.

(4) Size of markings: Specification markings prescribed in subparagraph (1) of this paragraph must be at least ½ inch high; other markings must be legible.

§ 78.205-19 Special box; authorized only for contents in 1-gallon rectangular metal cans or cylindrical metal cans of 26 gauge material.

(a) Must comply with this specification except as follows: Must be 1-piece type, of double-wall corrugated fiberboard at least 400-pound test with all three facings at least 135-pound test; to be marked "FOR 1-GAL. CYLINDRICAL OR RECTANGULAR CANS ONLY" near the I.C.C. specification mark; authorized gross weight 84 pounds.

§ 78.205-20 Special box; authorized only for pyroxylin in sheets, rods, or tubes.

(a) Must comply with this specification except as follows: Must be of board at least 275-pound test with lining at least 200-pound test, all being double-faced corrugated fiberboard; 3 metal straps required (see §§ 78.205-17 and 78.205-18); authorized gross weight 90 pounds.

§ 78.205-21 Special box; authorized only for pyroxylin in sheets, rods, or tubes.

(a) Must comply with this specification except as follows: Must be telescope type with wooden frame between the parts that telescope; authorized gross weight 90 pounds.

(b) Frame of group 3 or 4 wood ½" thick with lock corners glued.

GROUP 3

White elm.	Black gum.
Red gum.	Black ash.
Sycamore.	Tupelo.
Pumpkin ash.	Maple—soft or silver.

GROUP 4

Hard maple.	Birch.
Beech.	Rock elm.
Oak.	Hickory.
Hackberry.	White ash.

(c) Telescoping parts of double-faced corrugated fiberboard at least 400-pound test with facings at least 180 pounds per thousand square feet; each part of same depth as frame; outer part to have corners overlapped and securely fastened.

(d) Four metal straps required. Glued or stitched closure not required. (See §§ 78.205-17 and 78.205-18.)

§ 78.205-22 Special box; authorized only for motion-picture film in metal cans or strong cardboard or fiberboard boxes each containing not over 2,000 feet (approx.) of film.

(a) Must comply with this specification except as follows:

(1) For one inside container. Must be of board at least 275-pound test for a 2,000-foot film and of board at least

200-pound test for a 1,000-foot film; lining and pads not required; closure by taping with strong paper tape authorized.

(2) For more than one inside container. Must be of 1-piece type; authorized gross weight 55 pounds when made of 325-pound test board, 65 pounds when made of 375-pound test board, and 75 pounds when made of 450-pound test board; interior packing required, of fiberboard at least 175-pound test, adequate to support inside containers in center of outside container; lining and top and bottom pads not required.

§ 78.205-23 Special box; authorized only for poisonous solids, class B, in 1-gallon metal cans.

(a) Must comply with this specification except as follows: Must be 1-piece type, of double-wall corrugated fiberboard at least 400-pound test with all three facings at least 135-pound test; authorized gross weight 84 pounds.

§ 78.205-24 Special box; authorized only for railway fuses.

(a) Must comply with this specification except as follows: Must be double-faced corrugated fiberboard at least 400-pound test, or solid fiberboard of same strength; lining and pads not required; authorized gross weight 75 pounds. For fuses equipped with spikes, protection as required in § 73.108(b)(2) of this chapter must be provided.

§ 78.205-25 Special box; authorized only for wet electric storage batteries of the glass cell type or synthetic resin (plastic) type.

(a) Must comply with this specification except as follows: Must be one-piece type of double wall corrugated fiberboard at least 275-pound test; must have linings to extend around four faces with joint in center of or at end of one face but at no time may joint of box and joint of liner coincide; lining to be of sufficient height to support vertical scorings of box; lining to be made of double wall corrugated board with minimum test of 275 pounds, top of battery or batteries to be protected by trays or scored sheets of corrugated fiberboard having minimum test of 200 pounds; bottom of batteries to be protected by minimum of one excelsior pad or one double wall corrugated fiberboard pad; when one or more batteries are packed in same carton, batteries must be separated by a minimum of one thickness of double wall corrugated fiberboard having minimum test of 275 pounds; authorized gross weight 95 pounds.

§ 78.205-26 Special box; authorized only for one 5-gallon rectangular metal can, spec. 2F (§ 78.25 of this part); gross weight not to exceed 65 pounds.

(a) Must comply with this specification except as follows: Must be 1-piece type of double-wall corrugated fiberboard at least 350-pound test; must have top and bottom pads of double-wall corrugated fiberboard at least 350-pound test, pads to be double-flanged with flanges extending down the inside of carton at least four inches.

§ 78.205-27 **Special box; authorized only for not more than two square inside metal cans each containing not over 200 feet (approx.) motion-picture film; gross weight not to exceed 15 pounds.**

(a) Must comply with this specification except as follows: Must be double-slide type, both slides of double-faced corrugated fiberboard at least 200-pound test; closure by taping with strong paper tape authorized.

§ 78.205-28 **Special box; authorized only for wet electric storage batteries of aluminum-case type, asphaltum composition, impregnated rubber, synthetic resin (plastic), or wooden-battery-box type, having a net weight greater than 75 pounds.**

(a) Must comply with this specification except as follows: Must be one-piece type of double wall corrugated fiberboard at least 400-pound test, or solid fiberboard testing at least 400 pounds; boxes may or may not have hand holes provided for in ends of box providing same will not materially weaken box, top of battery to be protected by wood frame, corrugated trays or scored sheets of corrugated fiberboard having minimum test of 200 pounds, top protection must bear evenly on connectors of battery to facilitate stacking of batteries; bottom of batteries to be protected by minimum of one excelsior pad or double wall corrugated fiberboard pad; sides and ends to be cushioned between batteries and walls of box; combined thickness of cushioning material and walls of box must be not less than $\frac{1}{2}$ "', cushioning to be of excelsior pads, corrugated fiberboard or other suitable cushioning material; no more than one battery to be packed per box, authorized gross weight 190 pounds.

§ 78.205-29 **Special box; authorized only for ship distress signals in inside metal containers of not less than 24 gauge metal.**

(a) Must comply with this specification except as follows: Must be one-piece type of double faced corrugated board at least 350-pound test, with top and bottom pads of the same material. Gross weight not to exceed 95 pounds.

§ 78.205-30 **Special box; authorized only for toy torpedoes.**

(a) Must comply with this specification and the following: Must be one-piece type fabricated of double-wall corrugated fiberboard having minimum strength of 350 pounds per square inch, Mullen or Cady test. Box shall be provided with double-face lining on all sides and top and bottom pads. Gross weight not to exceed 25 pounds.

§ 78.205-31 **Special box; authorized only for commodities where spec. 12B is prescribed in Part 73 of this chapter.**

(a) Box shall have not more than 1 inside glass container having screw cap closure or metal container not exceeding 32 ounces or 2 pounds net weight, which must fit snugly or be adequately cushioned to prevent movement. Box shall comply with this specification and be of one-piece folder type, so designed as to

form double thickness of corrugated board on top, bottom, and ends. Fiberboard used in construction of the box shall have a minimum strength of 200 pounds per square inch, but for gross weight exceeding 8 pounds, the box must be constructed of at least 275-pound per square inch test fiberboard (Mullen or Cady). Closure must be equal in efficiency to that prescribed in § 78.205-17.

§ 78.205-32 **Special box; authorized only for electrolyte (acid), corrosive battery fluid, hydrochloric acid mixtures of not over 28 percent strength, or cleaning compounds, liquid, containing not over 28 percent hydrochloric (muriatic) acid.**

(a) Box shall have not more than 12 inside glass bottles, with acid-proof closures, of not over 32 ounces capacity each. Box shall comply with this specification and be constructed of at least 275-pound test (Mullen or Cady) double-wall corrugated fiberboard and be equipped with at least 125-pound test (Mullen or Cady) double-faced corrugated fiberboard scored sheets so designed as to provide two thicknesses of corrugated fiberboard between each bottle and one thickness between bottles and sides and ends of box. Top and bottom pads of the same size as the top and bottom area of the box and of at least 125-pound test (Mullen or Cady) double-faced corrugated board are required or box shall comply with this specification and be constructed of at least 325-pound test (Mullen or Cady) double-faced corrugated board and be equipped with at least 200-pound test (Mullen or Cady) corrugated fiberboard $\frac{1}{2}$ inch extended cell slotted partitions so designed as to provide a void space between the ends and sides of outside box and the inside cell partition and shall be provided with top and bottom pads, of the same area as the box, of at least 200-pound test (Mullen or Cady) double-faced corrugated fiberboard.

§ 78.205-33 **Special box; authorized only for electrolyte (acid) and alkaline corrosive battery fluid packed with storage batteries.**

(a) Box shall be constructed of corrugated fiberboard having strength of not less than 200 pounds per square inch, Mullen or Cady test for maximum authorized gross weight not over 65 pounds. Top and bottom pads and fill-in pieces are not required when inner flaps do not meet. Box must otherwise comply with this specification. (See § 73.258(a) (3) of this chapter.)

§ 78.205-34 **Special box; authorized only for a polyethylene, or other suitable plastic, tight-fitting inside container having a minimum wall thickness of 0.015 inch and so designed as to maintain its configuration when standing empty and open.**

(a) Box shall comply with this specification except that top of box shall be closed by means of slotted flaps so arranged as to provide protection for the neck of the inside container and be fitted with fill-in pieces as necessary; equally efficient closures and container neck protectors are authorized. Complete package, closed as for shipment with inside container filled to rated

capacity with water, must be capable of withstanding 2 drops from a height of 4 feet onto solid concrete without leakage or serious rupture of box. Authorized gross weight not over 65 pounds.

§ 78.205-35 **Special box; authorized only for aircraft type wet electric storage batteries.**

(a) Box shall comply with this specification and shall be constructed of at least 275-pound test double-faced corrugated fiberboard. Inside corrugated fiberboard cushioning shall be provided as necessary to prevent short-circuits, breakage under normal conditions of transportation, and superimposed weights on links, covers, or other parts weaker than the battery case. Not more than one wet electric storage battery shall be packed in a box and gross weight shall not exceed 85 pounds.

§ 78.205-36 **Special box; authorized only for an inside polyethylene container, spec. ICC-2U (§ 73.24 of this chapter), not over 5 gallons capacity.**

(a) Box shall comply with this specification except as provided herein, and shall have glued closure flaps only. Inner and outer top closure flaps may have suitably sized holes for access to the closure of the polyethylene container. The diameter of these holes must be less than the diameter of a metal plate inserted between the flaps to which polyethylene closure shall be attached.

§ 78.205-37 **Special box; with inside polyethylene or other suitable plastic bags for packaging of electrolyte (acid) or alkaline corrosive battery fluid only.**

(a) Box shall comply with this specification, except as follows: Box must be of one-piece construction of regular slotted style and be constructed of at least 275-pound test double-faced corrugated fiberboard with complete corrugated fiberboard liner, a scored and flanged bottom pad, and a scored and flanged top tray pad, reinforced, all of same material as box. Box may have die-cut areas of minimum size to provide access to inside closure part.

(b) Box must have 2 polyethylene or other suitable plastic bags, one within the other, with closure adequate to prevent leakage under conditions incident to transportation; maximum volumetric capacity not over 5 gallons. Bags shall be formed of tubing of virgin plastic material not less than 0.004 inch thick, with joints heat sealed.

(c) Representative samples of completely assembled boxes, with all parts closed as for shipment, must be capable of withstanding the following tests without leakage or serious damage to boxes. No one box shall be expected to withstand more than one of the following tests:

(1) Box with inside container filled with 5 gallons of a liquid of the same specific gravity as expected contents for shipment must be dropped twice from a height of 4 feet onto concrete, one drop to be made with the box positioned so as to strike flat on the box bottom, the other drop to be made so box will strike flat on the largest face.

(2) Box with inside container filled with 5 gallons of a solution which is compatible with the plastic bags, and remains liquid at 0° F. or lower shall be dropped once from a height of 4 feet onto concrete, when container and contents are at or below 0° F. Box shall be positioned so as to strike flat on the box bottom.

(3) Box with inside container filled as prescribed in subparagraph (1) of this paragraph shall be capable of withstanding a vibration test by placing the container on the vibration table anchored in such manner that all horizontal motion shall be restricted and only vertical motion allowed. The test shall be performed for one hour using an amplitude of one inch at a frequency that causes the test container to be raised from the floor of the table to such a degree that a piece of paper or flat steel strap or tape can be passed between the table and the container.

(d) Tests to be conducted by or for each plant assembling and filling boxes at the initial start of production and must be repeated at intervals of four months thereafter; initial tests must be witnessed by a representative of the Bureau of Explosives. Samples last tested must be dated with date of test and must be retained until subsequent tests are conducted. Empty boxes with liners may be shipped to a central point for assembling, filling and testing in which case the Bureau of Explosives must be advised of test location.

§ 78.206 Specification 12C; fiberboard boxes.

§ 78.206-1 Compliance.

(a) Required in all details.

§ 78.206-2 Definitions.

(a) Terms such as "200-pound test" mean minimum strength, Mullen or Cady test.

(b) "Joints" are where edges of parts of box, except recessed flanged heads, are connected together in setting up the box. Generally done by box maker.

(c) "Seams" are where edges of parts of box are visible, except joints, when box is closed.

§ 78.206-3 Classification of board.

(a) Fiberboard is hereby classified by strength of completed board as in first column of the following table; weights specified in the table are the minimums authorized.

Classified strength ¹ of completed board	Solid fiberboard—Minimum combined weight of component plies exclusive of adhesives (pounds per 1,000 sq. ft.)	Facings for corrugated fiberboard	
		Double-faced—Minimum combined weight of facings (pounds per 1,000 sq. ft.)	Double-wall—Minimum combined weight of facings including center liner (pounds per 1,000 sq. ft.)
175	149	75	
200	190	84	92
275	237	138	110
350	283	180	126

¹ Mullen or Cady test (minimum).

§ 78.206-4 Solid fiberboard.

(a) To be 3-ply or more; both outer plies water resistant.

§ 78.206-5 Corrugated fiberboard.

(a) Both outer facings water resistant; corrugated sheets must be at least 0.009 inch thick and weight not less than 26 pounds per 1000 square feet; all parts must be securely glued together throughout all contact areas.

§ 78.206-6 Stitching staples.

(a) Of steel wire at least 3/32 x 0.019 inch, or equal cross section, formed into staples about 7/16 inch wide. Staples of metal other than steel are authorized provided their efficiency is equal to that of steel wire staples specified in this section.

§ 78.206-7 Tape.

(a) Coated with glue at least equal to No. 1 3/4 Peter Cooper standard. Cloth tape of strength, across woof, at least 70 units, Elmendorf test. Sisal tape of 2 sheets of No. 1 Kraft paper, total weight 80 pounds per ream (500 sheets, 24 x 36 inches); sheets to be combined with asphalt and reinforced by unspun sisal fibers completely embedded in the asphalt and extending across the tape, except as provided in § 78.206-11(d).

(b) Tape for closure of slotted containers complying with the following requirements is authorized when applied as prescribed in § 78.206-17 (a) (3):

(1) Tape must be not less than 3 inches wide and shall be made of two sheets of 100 percent sulfate Kraft each not less than 30 pounds basis weight, reinforced with glass; sisal, or rayon fiber, combined with a laminant of asphalt or other material not affected by temperature extremes any more than would standard 180° to 200° softening point asphalt.

(2) Tape must be reinforced by lengthwise fibers spaced not more than an average of 1/2 inch apart, and by crosswise fibers spaced not less than an average of 2 per inch except that when a diamond pattern is employed for crosswise reinforcement, the spacing between the parallel sides of the diamond measured in the machine direction must be not more than 1 inch.

(3) Glass or sisal reinforced tape must have a minimum tensile strength in the machine direction of 75 pounds per inch of width and a minimum tensile strength in the cross direction of 45 pounds per inch of width; rayon reinforced tape must have a minimum tensile strength in the machine direction of 57 pounds per inch of width and a minimum tensile strength in the cross direction of 27 pounds per inch of width with elongation not exceeding 15 percent. Tensile tests on the finished product shall be made on a 3-inch width sample.

§ 78.206-8 Test.

(a) Acceptable board must have prescribed strength, Mullen or Cady test, after exposure for at least 3 hours to normal atmospheric conditions (50 to 70 percent relative humidity), under test as follows:

(1) Clamp board firmly in machine and turn wheel thereof at constant speed

of approximately 2 revolutions per second.

(2) Six punctures required, 3 from each side; all results but one must show prescribed strength.

(3) Board failing may be retested by making 24 punctures, 12 from each side; when all results but 4 show prescribed strength the board is acceptable.

(4) For corrugated fiberboard, double-pop tests may be disregarded.

§ 78.206-9 Types authorized.

(a) To be of solid or corrugated fiberboard of the following types:

(1) Slotted box; three-piece box without recessed ends; three-piece box of solid fiberboard with recessed ends; double-slide box; triple-slide box; telescope box, with sections of equal depth, or with covers, top or bottom or both, with 3-inch overlap. (See § 78.206-14 (d) for boxes with single-flap closures.)

§ 78.206-10 Forming.

(a) Parts must be cut true to size and so creased and slotted as to fit closely into position without cracking, surface breaks, separation of parts outside of crease, or undue binding.

§ 78.206-11 Joints.

(a) For solid and corrugated fiberboard slotted containers: Lapped 1 1/2 inches from center of scoreline except as in § 78.206-12; stitched at 2 1/2 inch intervals and within 1 inch of each end of joint; body joint must be double-stitched (2 parallel stitches) at each end of joint over 18 inches long.

(b) For corrugated fiberboard slotted containers only: One butt joint taped. (See § 78.206-7) is authorized; 3 inch tape required for boxes over 30 pounds authorized gross weight and 2 inch tape for others.

(c) For triple and double slide boxes: Joints of all slides must be taped (See § 78.206-7) or stitched.

(d) For corrugated fiberboard only: One butt joint taped inside and outside with strips of one thickness of sulphate paper not less than 2 inches wide extending entire length of joint and firmly glued to box. For boxes not exceeding 65 pounds gross weight, outside strip of sulphate paper to be of basis weight not less than 60 pounds testing not less than 60 pounds and inside strip of sulphate paper to be of basis weight not less than 40 pounds testing not less than 40 pounds. For boxes exceeding 65 pounds gross weight, outside and inside with strips of sulphate paper which must each be of basis weight not less than 90 pounds testing not less than 90 pounds. Basis weight of paper shown is 500 sheets, 24 x 36 inches.

(1) For glued lap joint, the sides of box forming joint must lap not less than 1 1/4" and be firmly glued throughout entire area of contact with a glue or adhesive which cannot be dissolved in water after the film application has dried.

§ 78.206-12 Flanged heads.

(a) Must have 4 flanges, at least 1" long above fillet, on each head. Recessed flanged heads not authorized for boxes of corrugated fiberboard.

§ 178.206-13 Seams which are to be stitched.

(a) Overlap, if any, required to be at least 1½ inches from center of scoreline except as in § 78.206-12.

§ 78.206-14 Flap closures.

(a) Fill-in pieces, of the same type fiberboard as used in construction of the container, are required where it is necessary to prevent an opening between the inner flaps, unless otherwise provided by Part 73 of this chapter.

(b) If to be closed by adhesive, each inner flap must cover at least one-third of face; inner flaps must butt or have full overlap, or fill-in pieces must be used, unless otherwise provided by Part 73 of this chapter, except that fill-in pieces are not required when outer flaps have full overlap. Outer flaps must be reasonably close together at the center seam or have full overlap.

(c) In lieu of fill-in pieces between inner flaps which do not butt, the following is authorized when linings are not prescribed in § 78.206-15:

(1) Top and bottom pads the same dimensions as interior of container of solid or corrugated fiberboard at least 125 pound test (Mullen or Cady).

(2) Minimum combined weight of facings for corrugated fiberboard pads must be at least 52 pounds per thousand square feet.

(3) Minimum combined weight of component plies for solid fiberboard pads must be at least 114 pounds per thousand square feet, exclusive of adhesives.

(4) Complete inner box or boxes.

(d) Single-flap closures are authorized for boxes with one dimension not over 2"; each flap must be scored and form one of the small faces of the box and lap at least 5" on one of the largest faces.

§ 78.206-15 Linings (when prescribed).

(a) Of 1-piece to extend around 4 faces with joint at center of 1 face and with 4 flanges, at least 1½" long, on each end (corners may be mitered) to bend over the other 2 faces; also 2 pads to cover the other 2 faces. Pads may be omitted if closing flaps afford 3 thicknesses throughout face. For boxes with 1 dimension not over 3", one of the widest flanges may be lengthened to cover entire face and lap 6" on the adjoining face and the other flanges and the pads may then be omitted.

§ 78.206-16 Authorized gross weight and parts required.

(a) Authorized gross weight (when packed) and parts required as follows:

Authorized gross weight (pounds)	Strength of fiberboard (minimum) Mullen or Cady Test						
	Solid board			Double-faced corrugated		Double-wall corrugated	
	Box	Lining ¹	Heads ¹	Box	Lining ²	Box	Lining ³
30.....	175	-----	200	175	-----	200	-----
40.....	200	-----	275	200	-----	200	-----
65.....	275	-----	350	{ 275 200	{ ----- 175	} 275	-----

¹ For recessed heads when used. In other cases same as for box.

² As prescribed in § 78.206-15. A complete box is acceptable in place of the lining.

³ Facings at least 133 pounds per thousand square feet or inner facing at least 42 pounds and outer facing at least 90 pounds per thousand square feet.

⁴ Except as otherwise authorized by Part 73 of this chapter.

(b) Triple slide boxes of double-faced corrugated fiberboard of at least 175-pound test are also authorized for 65 pounds gross weight.

§ 78.206-17 Closing for shipment.

(a) Slotted container, by coating with adhesive the entire contact surfaces of closing flaps and fill-in pieces where required or as prescribed in subparagraph (1), (2), or (3) of this paragraph.

(1) By stitching with staples as prescribed by § 78.206-6 at 2½-inch intervals along all seams (one 5-inch space allowed when necessary to permit use of stitching device); or with staples made of flat wire of hardness not less than equivalent of Rockwell B90, and not less than 0.037 inch thick and not less than 0.074 inch wide, with not less than 1¼-inch crown, may be spaced not more than 5 inches apart. Such staples may be used across center seam where outside flaps meet in lieu of on both sides of center seam but need only be used where outside flaps overlay inner flaps; or staples made of arcuate wire of hardness not less than equivalent of Rockwell B90, and not less than 0.027 inch thick and not less than 0.095 inch wide, with not less than 1 inch crown, may be spaced not more than 5 inches apart. Such stitches when spaced not more than 2½ inches apart may be used across center seam where outside flaps meet in lieu of on both sides of center seam but need only be used where outside flaps overlap inner flaps.

(2) For fiberboard boxes containing not more than 1 inside metal can not exceeding 1 gallon nominal capacity, by application of 2 strips of pressure-sensitive tape not less than ½ inch in width, 1 strip to be placed approximately equal distance over the seam of abutting outer

flaps, the other at a right angle to the first and spaced approximately equal distance on the closure face; strips must be of sufficient length to extend not less than 1 inch beyond score lines on side and end panels. Tape shall have a minimum tensile strength of 160 pounds per inch of width; minimum adhesion value of 18 ounces per inch of width; and minimum elongation of 12 percent at break, or having a minimum longitudinal tensile strength of not less than 240 pounds per inch of width; minimum adhesion value of 18 ounces per inch of width and a minimum elongation of 3 percent at break.

(3) For slotted containers only, reinforced tape complying with the requirements of § 78.206-7 (b) is authorized for application over the center seam only. Tape must extend over the ends of box not less than 2½ inches.

(b) Double slide boxes or triple slide boxes, by coating with adhesive the inner slides; for single-flap closures as authorized for boxes with one dimension not over 2 inches, the flaps must be fastened to the body with adhesive.

(c) Fiberboard boxes with covers extending over sides but not to bottom, covers resting on walls of box, or telescope boxes of equal depth section, covers extending to bottom, must be secured by one of the following methods:

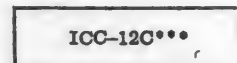
(1) By not less than three metal straps, one lengthwise and others at right angles thereto.

(2) When cover extends not less than 3 inches over the walls of the box, by coating with adhesive the entire contact area of the cover.

(d) When metal straps are specified, boxes must be strapped with the required number; size at least ½ inch x 0.015 inch.

§ 78.206-18 Marking.

(a) On each container. Symbol in rectangle as follows:



(1) Stars to be replaced by authorized gross weight (for example, ICC-12C65, etc.). This mark shall be understood to certify that the container complies with all specification requirements.

(2) Name and address of plant making the container; symbol (letters) authorized if recorded with the Bureau of Explosives. This mark to be located just above or below the mark specified in this paragraph.

(3) When metal straps are prescribed, boxes must be marked "----- (number) METAL STRAPS REQUIRED" just above or below the mark specified in this paragraph.

(4) Size of markings: Specification markings prescribed in subparagraph (1) of this paragraph must be at least 1/2 inch high; other markings must be legible.

§ 78.206-19 Special box; authorized only for polyethylene, or other suitable plastic, tight-fitting inside containers having minimum wall thickness of 0.015 inch and so designed as to maintain their configuration when standing empty and open.

(a) Box shall comply with this specification except that top of box shall be closed by means of slotted flaps so arranged as to provide protection for the neck of the inside container and be fitted with fill-in pieces as necessary. Top may have die-cut area of suitable size to provide for easy opening. Complete package, closed as for shipment, with inside container filled to rated capacity with water, must be capable of withstanding 2 drops from a height of 4 feet onto solid concrete without leakage or serious rupture of box. Authorized gross weight not over 65 pounds. (See § 73.257(a) (6) of this chapter.)

§ 78.207 Specification 12D; fiberboard boxes.

§ 78.207-1 Compliance.

(a) Required in all details.

§ 78.207-2 Definitions.

(a) Terms such as "200-pound test" mean minimum strength, Mullen or Cady test.

(b) "Joints" are where edges of parts of box are connected together in setting up the box. Generally done by box maker.

(c) "Seams" are where edges of parts of box are visible, except joints, when box is closed.

§ 78.207-3 Classification of board.

(a) Fiberboard is hereby classified by strength of completed board as in first column of the following table; weights specified in the table are the minimums authorized.

Classified strength ¹ of completed board	Facings for double-wall corrugated fiberboard—Minimum combined weight of facings including center liner (pounds per 1,000 sq. ft.)
275.....	110
350.....	126

¹ Mullen or Cady test (minimum).

§ 78.207-4 Corrugated fiberboard.

(a) Both outer facings water resistant; corrugated sheets at least 0.009" thick and weigh not less than 26 pounds per 1000 square feet; all parts securely glued together throughout all contact areas.

§ 78.207-5 Stitching staples.

(a) Of steel wire at least 3/32" x 0.019", or equal cross section, formed

into staples about 1/16" wide. Staples of metal other than steel are authorized provided their efficiency is equal to that of steel wire staples specified in this section.

§ 78.207-6 Tape.

(a) Coated with glue at least equal to No. 1 3/4 Peter Cooper standard. Cloth tape of strength, across the woof, at least 70 units, Elmendorf test. Sisal tape of 2 sheets of No. 1 Kraft paper, total weight 80 pounds per ream (500 sheets, 24" x 36"); sheets to be combined with asphalt and reinforced by unspun sisal fibers completely embedded in the asphalt and extending across the tape, except as provided in § 78.207-10(d).

(b) Tape for closure of slotted containers complying with the following requirements is authorized when applied as prescribed in § 78.207-17 (a) (3):

(1) Tape must be not less than 3 inches wide and shall be made of two sheets of 100 percent sulfate Kraft each not less than 30 pounds basis weight, reinforced with glass, sisal, or rayon fiber, combined with a laminant of asphalt or other material not affected by temperature extremes any more than would standard 180° to 200° softening point asphalt.

(2) Tape must be reinforced by lengthwise fibers spaced not more than an average of 1/2 inch apart, and by crosswise fibers spaced not less than an average of 2 per inch except that when a diamond pattern is employed for crosswise reinforcement, the spacing between the parallel sides of the diamond measured in the machine direction must be not more than 1 inch.

(3) Glass or sisal reinforced tape must have a minimum tensile strength in the machine direction of 75 pounds per inch of width and a minimum tensile strength in the cross direction of 45 pounds per inch of width; rayon reinforced tape must have a minimum tensile strength in the machine direction of 57 pounds per inch of width and a minimum tensile strength in the cross direction of 27 pounds per inch of width with elongation not exceeding 15 percent. Tensile tests on the finished product shall be made on a 3-inch width sample.

§ 78.207-7 Test.

(a) Acceptable board must have prescribed strength, Mullen or Cady test, after exposure for at least 3 hours to normal atmospheric conditions (50 to 70 percent relative humidity), under test as follows:

(1) Clamp board firmly in machine and turn wheel thereof at constant speed of approximately 2 revolutions per second.

(2) Six punctures required, 3 from each side; all results but one must show prescribed strength.

(3) Board failing may be retested by making 24 punctures, 12 from each side, when all results but 4 show prescribed strength the board is acceptable.

(4) Double-pop tests may be disregarded.

§ 78.207-8 Types authorized.

(a) To be of double-wall corrugated fiberboard of the following types:

(1) Slotted box; three piece box without recessed ends; double-slide box; triple-slide box; telescope box, with sections of equal depth, or with covers, top or bottom or both, with 3 inch overlap.

§ 78.207-9 Forming.

(a) Parts must be cut true to size and so creased and slotted as to fit closely into position without cracking, surface breaks, separation of parts outside of crease, or undue binding.

§ 78.207-10 Joints.

(a) For slotted containers: Lapped 1 1/2 inches from center of scoreline except as in § 78.207-11; stitched at 2 1/2-inch intervals and within 1 inch of each end of joint; body joint must be double-stitched (2 parallel stitches) at each end of joint over 18 inches long.

(b) For slotted containers only: One butt joint taped (See § 78.207-6) is authorized; 3 inch tape required.

(c) For triple and double slide boxes: Joints of all slides must be taped (See § 78.207-6) or stitched.

(d) One butt joint taped inside and outside with strips of one thickness of sulphate paper not less than 2 inches wide extending entire length of joint and firmly glued to box. For boxes not exceeding 65 pounds gross weight, outside strip of sulphate paper to be of basis weight not less than 60 pounds testing not less than 60 pounds and inside strip of sulphate paper to be of basis weight not less than 40 pounds testing not less than 40 pounds. For boxes exceeding 65 pounds gross weight, outside and inside with strips of sulphate paper which must each be of basis weight not less than 90 pounds testing not less than 90 pounds. Basis weight of paper shown is for 500 sheets, 24 x 36 inches.

(1) For glued lap joint, the sides of box forming joint must lap not less than 1 1/4" and be firmly glued throughout entire area of contact with a glue or adhesive which cannot be dissolved in water after the film application has dried.

§ 78.207-11 Flanged heads.

(a) Must have 4 flanges, at least 1" long above fillet, on each head. Recessed flanged heads not authorized.

§ 78.207-12 Seams which are to be stitched.

(a) Overlap, if any, required to be at least 1 1/2 inches from center of scoreline except as in § 78.207-11.

§ 78.207-13 Flap closures.

(a) Fill-in pieces, of the same type fiberboard as used in construction of the container, are required where it is necessary to prevent an opening between the inner flaps.

(b) If to be closed by adhesive, each inner flap must cover at least 1/2 of face; inner flaps must butt or have full overlap, or fill-in pieces must be used; except that fill-in pieces are not required when outer flaps have full overlap. Outer flaps must butt or have full overlap.

§ 78.207-14 Linings (when prescribed).

(a) Of 1 piece to extend around 4 faces with joint at center of 1 face and with 4 flanges, at least 1½" long, on each end (corners may be mitered) to bend over the other 2 faces; also 2 pads to cover the other 2 faces. Pads may be omitted if closing flaps afford 3 thicknesses throughout face. For boxes with 1 dimension not over 3", one of the widest flanges may be lengthened to cover entire face and lap 6" on the adjoining face and the other flanges and the pads may then be omitted.

§ 78.207-15 Authorized gross weight and parts required.

(a) Authorized gross weight (when packed) and parts required as follows:

(1) For authorized gross weight not over 25 pounds, box must be constructed of at least 275-pound test double-wall corrugated fiberboard with liners and top and bottom pads, or a complete inner box, of same material.

(2) For authorized gross weight over 25 pounds but not exceeding 75 pounds, inside containers must be packed in boxes of at least 275-pound test double-wall corrugated fiberboard and these packages packed in an outside box of at least 350-pound test double-wall corrugated fiberboard.

§ 78.207-16 Test for completed package.

(a) The completed packages closed as for shipment must be capable of withstanding a drop of 4 feet to solid concrete without breakage of the inside containers.

§ 78.207-17 Closing for shipment.

(a) Slotted container, by coating with adhesive the entire contact surfaces of closing flaps and fill-in pieces, or as prescribed in subparagraphs (1), (2), or (3) of this paragraph.

(1) By stitching at 2½-inch intervals along all seams (one 5-inch space allowed when necessary to permit use of stitching device).

(2) For fiberboard boxes containing not more than 1 inside metal can not exceeding 1 gallon nominal capacity, by application of 2 strips of pressure-sensitive tape not less than ½ inch in width, 1 strip to be placed approximately equal distance over the seam of abutting outer flaps, the other at a right angle to the first and spaced approximately equal distance on the closure face; strips must be of sufficient length to extend not less than 1 inch beyond score lines on side and end panels. Tape shall have a minimum tensile strength of 160 pounds per inch of width; minimum adhesion value of 18 ounces per inch of width; and minimum elongation of 12 percent at break, or having a minimum longitudinal tensile strength of not less than 240 pounds per inch of width; minimum adhesion value of 18 ounces per inch of width and a minimum elongation of 3 percent at break.

(3) For slotted containers only, reinforced tape complying with the requirements of § 78.207-6 (b) is authorized for application over the center seam only.

Tape must extend over the ends of box not less than 2½ inches.

(b) Double slide boxes or triple slide boxes, by coating with adhesive the inner slides; for single-flap closures as authorized for boxes with one dimension not over 2 inches, the flaps must be fastened to the body with adhesive.

(c) Fiberboard boxes with covers extending over sides but not to bottom, covers resting on walls of box, or telescope boxes of equal depth section, covers extending to bottom, must be secured by one of the following methods:

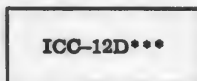
(1) By not less than three metal straps, one lengthwise and others at right angles thereto.

(2) When cover extends not less than 3 inches over the walls of the box, by coating with adhesive the entire contact area of the cover.

(d) When metal straps are specified, boxes must be strapped with the required number; size at least ⅝ inch by 0.015 inch.

§ 78.207-18 Marking.

(a) On each container. Symbol in rectangle as follows:



(1) Stars to be replaced by authorized gross weight (for example, ICC-12D65, etc.). This mark shall be understood to certify that the container complies with all specification requirements.

(2) Name and address of plant making the container; symbol (letters) authorized if recorded with the Bureau of Explosives. This mark to be located just above or below the mark specified in this paragraph.

(3) When metal straps are prescribed, boxes must be marked "----- (number) METAL STRAPS REQUIRED" just above or below the mark specified in this paragraph.

(4) Size of markings: Specification markings prescribed in subparagraph (1) of this paragraph must be at least ½ inch high; other markings must be legible.

§ 78.208 Specification 12E; fiberboard boxes.

§ 78.208-1 Compliance.

(a) Required in all details.

§ 78.208-2 Definitions.

(a) Terms such as "200-pound test" mean minimum strength, Mullen or Cady test.

(b) "Joints" are where edges of parts of box, except recessed flanged heads, are connected together in setting up the box. Generally done by box maker.

(c) "Seams" are where edges of parts of box are visible, except joints, when box is closed.

§ 78.208-3 Corrugated fiberboard.

(a) Both outer facings water resistant; corrugated sheets must be at least 0.009 inch thick and weigh not less than 26 pounds per 1000 square feet; all parts must be securely glued together throughout all contact areas.

§ 78.208-4 Tape.

(a) Coated with glue at least equal to No. 1¾ Peter Cooper standard. Cloth tape of strength, across wool, at least 70 units, Elmendorf test. Sisal tape of 2 sheets of No. 1 Kraft paper, total weight 80 pounds per ream (500 sheets, 24 x 36 inches); sheets to be combined with asphalt and reinforced by unspun sisal fibers completely embedded in the asphalt and extending across the tape.

§ 78.208-5 Test.

(a) Acceptable board must have prescribed strength, Mullen or Cady test, after exposure for at least 3 hours to normal atmospheric conditions (50 to 70 percent relative humidity), under test as follows:

(1) Clamp board firmly in machine and turn wheel thereof at constant speed of approximately 2 revolutions per second.

(2) Six punctures required, 3 from each side; all results but one must show prescribed strength.

(3) Board failing may be retested by making 24 punctures, 12 from each side; when all results but 4 show prescribed strength the board is acceptable.

(4) Double-pop tests may be disregarded.

§ 78.208-6 Type authorized.

(a) Corrugated fiberboard with one-piece body with separate flanged heads. Box is authorized only for 1 or 2 rectangular metal inside containers of not over 5 gallons capacity each.

§ 78.208-7 Forming.

(a) Parts must be cut true to size and so creased and slotted as to fit closely into position without cracking, surface breaks, separation of parts outside of crease, or undue binding.

§ 78.208-8 Joints.

(a) *Body.* Each end of body must have four flanges, creased to bend over outside of body, at least 2½" long beyond crease.

(b) *Butt joint.* One butt joint taped is authorized; 3-inch tape required.

§ 78.208-9 Flanged heads.

(a) Each head must have four flanges, one on each edge, creased to bend over outside body of the box and then under the body flanges, of length at least 5 inches exclusive of creases.

§ 78.208-10 Authorized gross weight (when packed) and parts required.

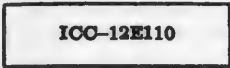
(a) Board for outside container must be corrugated fiberboard at least 400-pound test; minimum combined weight of component plies, exclusive of adhesives, 180 pounds per 1000 square feet; body must be double-wall board; heads may be double-faced board. Authorized gross weight 110 pounds.

§ 78.208-11 Closing for shipment.

(a) Boxes must be closed by applying heads with head-flanges tucked under body-flanges and then fastening each head in place with a flat steel strap, at least ⅜" x 0.015", extending around the 4 sides of the body and securely sealed.

§ 78.208-12 Marking.

(a) On each container. Symbol in rectangle as follows:



(1) This mark shall be understood to certify that the container complies with all specification requirements.

(2) Name and address of plant making the container; symbol (letters) authorized if recorded with the Bureau of Explosives. This mark to be located just above or below the mark specified in this paragraph.

(3) When metal straps are prescribed, boxes must be marked "_____" (number) METAL STRAPS REQUIRED" just above or below the mark specified in this paragraph.

(4) Size of markings: Specification markings prescribed in subparagraph (1) of this paragraph must be at least 1/2 inch high; other markings must be legible.

§ 78.209 Specification 12H; fiberboard boxes.

§ 78.209-1 Compliance.

(a) Required in all details.

§ 78.209-2 Definitions.

(a) Terms such as "200-pound test" mean minimum strength, Mullen or Cady test.

(b) "Joints" are where edges of parts of box are connected together in setting up the box. Generally done by box maker.

(c) "Seams" are where edges of parts of box are visible, except joints, when box is closed.

§ 78.209-3 Classification of board.

(a) Fiberboard is hereby classified by strength of completed board as in first column of the following table; weights specified in the table are the minimum authorized.

Classified strength ¹ of completed board	Facings for corrugated fiberboard	
	Double-faced-minimum combined weight of facings (pounds per 1,000 sq. ft.)	Double-wall-minimum combined weight of facings including center liner (pounds per 1,000 sq. ft.)
275	133	110
325	133	110
350	180	126
375	180	180
400	180	180
450	180	180

¹ Mullen or Cady test (minimum).

§ 78.209-4 Corrugated fiberboard.

(a) Both outer facings water resistant; corrugated sheets must be at least 0.009 inch thick and weigh not less than 26 pounds per 1000 square feet; all parts must be securely glued together throughout all contact areas.

§ 78.209-5 Stitching staples.

(a) Of steel wire, copper-coated or equivalent in nonsparking quality, at

least 3/32" x 0.019", or equal cross section, formed into staples about 1/16" wide.

§ 78.209-6 Tape.

(a) Used for manufacturers' joints must be coated with glue at least equal to No. 1 3/4 Peter Cooper standard. Cloth tape of strength, across the woof, at least 70 units, Elmendorf test. Sisal tape of 2 sheets of No. 1 Kraft paper, total weight 80 pounds per ream (500 sheets, 24" x 36"); sheets to be combined with asphalt and reinforced by unspun sisal fibers completely embedded in the asphalt and extending across the tape.

§ 78.209-7 Test.

(a) Acceptable board must have prescribed strength, Mullen or Cady test, after exposure for at least 3 hours to normal atmospheric conditions (50 to 70 percent relative humidity), under test as follows:

(1) Clamp board firmly in machine and turn wheel thereof at constant speed of approximately 2 revolutions per second.

(2) Six punctures required, 3 from each side; all results but one must show prescribed strength.

(3) Board failing may be retested by making 24 punctures, 12 from each side; when all results but 4 show prescribed strength, the board is acceptable.

(4) For corrugated fiberboard, double-pop tests may be disregarded.

§ 78.209-8 Type authorized.

(a) Shall be corrugated fiberboard, telescoping type, 1-piece, 2-piece or 3-piece construction without recessed heads, as follows:

(1) Box to consist of top and bottom sections divided equally or unequally and inner lining tube. The lining tube must be staple stitched to the lower section of the box to give in effect a 2-piece box. (See § 78.209-11.)

(2) Box to consist of full depth top and bottom sections completely telescoping. No inner lining tube required. Three variations are authorized: one with bottom slotted on ends and cover on sides; second, with both cover and bottom slotted on sides; and third, with sides and ends (both covers and bottom) not slotted, manufacturer's joint a side lap glued or stapled to end, closing flaps to form top and bottom of box with side closing flaps out and overlapping.

NOTE 1: Hand-holes oval in shape, not more than 1 inch in width; by 3 inches in length, and horizontal with top score line, are authorized in ends of top section of boxes.

(3) Box to consist of 1-piece, 2-piece, or 3-piece, without recessed heads, fitted with lining tube as prescribed in § 78.209-11, except that lining tube is not required for boxes used for shipment of electric blasting caps packed in accordance with § 78.66(g) (1) of this chapter. When outer flaps butt, inner flaps must also butt, except 1-piece with tube or 2-piece fully telescoping 1/2 slotted style may have outer flaps that overlap a minimum of 2 inches to and including full overlap, and inner flaps may be of same length as outer flaps.

(4) Three-piece box without recessed ends. Outer flap may be full lap style

with a 3-inch tuck. With the full lap style, the inner end flaps must have a minimum length of 4 inches with or without hand holes.

§ 78.209-9 Forming.

(a) Parts must be cut true to size and so creased and slotted as to fit closely into position without cracking, surface breaks, separation of parts outside of crease, or undue binding.

§ 78.209-10 Joints.

(a) Lapped 1 1/2" and stitched at 2 1/2" intervals and within 1" of each end of joint; except for full depth telescope style boxes, body joints must be double-stitched (two parallel rows of stitches).

(b) For glued lap joint, the sides of box forming joint must lap not less than 1 1/4" and be firmly glued throughout entire area of contact with a glue or adhesive which cannot be dissolved in water after the film application has dried.

(c) For lining tubes only, one butt joint taped (see § 78.209-6) tape not less than 3" wide is authorized.

§ 78.209-11 Authorized gross weight and parts required.

(a) Box shall be corrugated fiberboard at least 275 pound test. Tubes, when required, shall be of solid fiberboard at least 200-pound test, or of corrugated fiberboard of at least 275-pound test, with adjoining edges stitched, taped, or glued.

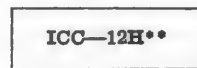
(b) Authorized gross weight: 65 pounds.

§ 78.209-12 Closing for shipment.

(a) By any method capable of withstanding tests prescribed by § 78.209-16 without failure.

§ 78.209-13 Marking.

(a) On each container. Symbol in rectangle as follows:



(1) Stars to be replaced by authorized gross weight (for example ICC-12H65). This mark shall be understood to certify that the container complies with all specification requirements.

(2) Name and address of plant making the container; symbol (letters) authorized if recorded with the Bureau of Explosives. This mark to be located just above or below the mark specified in paragraph (a) of this section.

(3) Size of markings: Specification markings prescribed in subparagraph (1) of this paragraph must be at least 1/2 inch high; other markings must be legible.

§ 78.209-14 Special tests.

(a) By whom and when. By or for each plant making the boxes; at beginning of manufacture and at six-month intervals thereafter; on largest size, by weight. Smaller sizes need not be tested if they have the same or equivalent construction. Report of results, with all pertinent data, to be maintained on file for one year; copy to be filed with the Bureau of Explosives.

§ 78.209-15 Material.

(a) Box material must comply with requirements of §§ 78.209-3, 78.209-4, 78.209-7, 78.209-11, and the following:

(b) Box material must also have 275 pound test strength and moisture content not over 30 percent as follows:

(1) Box material must test at least 200 pounds per square inch immediately after exposure for 3 days to 90 percent relative humidity of not less than 70° nor more than 75° F.

(2) Box material must test at least 100 pounds per square inch immediately after it has been in contact with water for 3 hours under 3" head at not less than 70° nor more than 75° F.

NOTE: The test shall be conducted on a sample no greater than 6 inches in diameter when exposed to water. The sample shall be rigidly fastened to a water column device so constructed as to provide at least a 3-inch head of water on the outer surface of the fiberboard sample. The water column device must be suspended in such manner that free circulation of air on the inner surface of fiberboard sample which is not exposed to water is permitted. After contact with water for 3 hours under conditions specified, the water column device shall be emptied, the sample blotted, and immediately subjected to Mullen or Cady test. (A 6-inch diameter pipe having a welded flange to which the sample is secured by a bolted ring flange is acceptable.)

§ 78.209-16 Completed container.

(a) Samples must pass the following immediately after exposure for 2 weeks to 90 percent relative humidity at not less than 70° nor more than 75° F.; loaded containers shall contain dummy contents of shape and weight of the expected contents, and shall be closed in the same manner as for shipment:

(1) Three loaded samples to be tested. Each must withstand 200 drops in standard 7-foot revolving test drum with pointed hazard in place, without spilling any contents.

(2) Three loaded samples to be tested. Each must withstand end to end pressure of at least 500 pounds without deflection of over 1½".

(3) Three empty samples to be tested. Each must withstand top to bottom pressure of at least 500 pounds without deflection of over ½ inch.

(b) As an alternate to the drum test specified in paragraph (a), 3 loaded samples must pass the drop test specified below:

(1) Box shall be dropped from height of 2 feet.

(2) Identification of face, edge, and corners. Facing one end (with the manufacturer's joint on the observer's right), the top of the box is designated as 1, the right side as 2, the bottom as 3, and the left side as 4. The near end is designated as 5 and the far end as 6. The edges are identified by the number of the two faces which make that edge, as for example, 1-2 identifies the edge where the top and right side meet and 2-5 the edge having the manufacturer's joint. The corners are identified by the number of the three faces which meet to form that corner, as for example, 1-2-5 identifies the corner where the top, the right side, and the near end meet.

(c) Drop sequence as follows:

(1) A corner drop on 1-2-5.

(2) An edge drop on the shortest edge radiating from that corner (usually 2-5).

(3) An edge drop on the next shortest edge radiating from that corner (usually 1-5).

(4) An edge drop on the longest edge radiating from that corner (usually 1-2).

(5) A flatwise drop on one of the smallest faces (usually end 5 or 6).

(6) A flatwise drop on the opposite smallest face.

(7) A flatwise drop on one of the medium faces (usually side 2 or 4).

(8) A flatwise drop on the opposite medium face.

(9) A flatwise drop on one of the largest faces (usually top 1 or bottom 3).

(10) A flatwise drop on the opposite large face.

This completes one cycle of ten drops. Commence the next cycle, with a drop on the corner diagonally opposite through the box to the corner on which the first drop was made, on corner 3-4-6. Commence the third cycle of ten drops with corner 1-4-5. Each loaded container must withstand 3 cycles without spilling or sifting of contents.

§ 78.210 Specification 12A; fiberboard boxes.

Nonreuseable containers.

§ 78.210-1 Compliance.

(a) Required in all details.

§ 78.210-2 Definitions.

(a) Terms such as "200-pound test" mean minimum strength. Mullen or Cady test.

(b) "Joints" are where edges of parts of box, except recessed flanged heads, are connected together in setting up the box. Generally done by box maker.

§ 78.210-3 Classification of board.

(a) Fiberboard is hereby classified by strength¹ of completed board as in first column of the following table; weights specified in the table are the minimums authorized.

Classified strength of completed board	Facings for corrugated fiberboard	
	Double-faced-minimum combined weight of facings (pounds per 1,000 sq. ft.)	Double-wall-minimum combined weight of facings including center liner (pounds per 1,000 sq. ft.)
200.....	84	92
275.....	138	110

§ 78.210-4 Corrugated fiberboard.

(a) Both outer facings water resistant; corrugated sheets must be at least 0.009 inch thick and weigh not less than 26 pounds per 1000 square feet; all parts must be securely glued together throughout all contact areas.

§ 78.210-5 Tests.

(a) Acceptable board must have prescribed strength, Mullen or Cady test,

¹ Mullen or Cady test (minimum)

after exposure for at least 3 hours to normal atmospheric conditions (50 to 70 percent relative humidity), under test as follows:

(1) Clamp board firmly in machine and turn wheel thereof at constant speed of approximately 2 revolutions per second.

(2) Six punctures required, 3 from each side; all results but one must show prescribed strength.

(3) Board failing may be retested by making 24 punctures, 12 from each side, when all results but 4 show prescribed strength the board is acceptable.

(4) Double-pop tests may be disregarded.

§ 78.210-6 Boxes authorized.

(a) Corrugated fiberboard boxes having gross weight not over 80 pounds of the following strengths are authorized:

Gross weight not over (pounds)	Corrugated fiberboard strength (Mullen or Cady test) minimum	
	Double-faced	Double-wall
20.....	200	200
50.....	275	200
80.....		275

§ 78.210-7 Forming.

(a) Parts must be cut true to size and so creased and slotted as to fit closely into position without cracking, surface breaks, separation of parts outside of crease, or undue binding.

§ 78.210-8 Joints.

(a) For slotted containers: Lapped 1½ inches from center of scoreline except as in § 78.210-8(b)(2); stitched at 2½-inch intervals and within 1 inch of each end of joint; body joint must be double-stitched (2 parallel stitches) at each end of joint over 18 inches long.

(b) Joints as provided for by the following are authorized provided resulting joint is capable of withstanding the tests prescribed by § 78.210-10:

(1) For slotted containers only; one butt joint, taped, is authorized.

(2) For glued lap joint, the sides of box forming joint must lap not less than 1¼ inches and be firmly glued throughout entire area of contact with a glue or adhesive which cannot be dissolved in water after the film application has dried.

(3) For triple and double slide boxes; joints of all slides must be taped or stitched.

§ 78.210-9 Inside cushioning.

(a) Sufficient inside cushioning shall be required for protection of inside containers so that completed packages as offered for shipment shall be capable of withstanding test prescribed by § 78.210-10.

§ 78.210-10 Test for completed package.

(a) A minimum of 4 boxes with inside containers filled with water, and box closed as for shipment, shall be capable of withstanding the following drop tests from the prescribed heights onto solid concrete without leakage from or

breakage of any inside container or rupture of the outside fiberboard box; each box shall be subjected to not more than one of the series of tests:

- (1) Box No. 1. Flat drop on bottom from height of 4 feet.
- (2) Box No. 2. Flat drop on side from height of 4 feet.
- (3) Box No. 3. Flat drop on end from height of 4 feet.
- (4) Box No. 4. Flat drop on top from height of 2 feet.

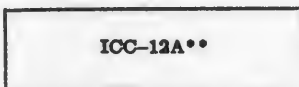
(b) Tests prescribed by paragraph (a) of this section must be conducted prior to initial use of the package and shall be repeated on the change of any components of the package.

§ 78.210-11 Closing for shipment.

(a) By any method capable of withstanding tests prescribed by § 78.210-10.

§ 78.210-12 Marking.

(a) On each container. Symbol in rectangle as follows:



(1) Stars to be replaced by authorized gross weight (for example, ICC-12A75). The letters NRC, located just above or below the ICC mark, to indicate a non-reusable container. These marks shall be understood to certify that the outer container complies with all the construction requirements of the specification.

Classified strength of completed board ¹	Solid fiberboard—minimum combined weight of component plies exclusive of adhesives (pounds per 1,000 sq. ft.)	Single-wall—minimum combined weight of facings (pounds per 1,000 sq. ft.)	Double-wall—minimum combined weight of facings including center facings (pounds per 1,000 sq. ft.)
175	149	75	92
200	190	84	110
275	237	138	110
325	237	138	110
350	283	180	126
375	283	180	180
400	283	180	180
450	283	180	180
500	330	180	222

¹ Mullen or Cady Test (minimum).

(2) Tests of acceptable completed board must have prescribed strength, Mullen or Cady test, after exposure for at least 3 hours to normal atmospheric conditions (50 to 70 percent relative humidity) under test, as follows:

(i) Clamp board firmly in machine and turn wheel at constant speed of approximately 2 revolutions per second.

(ii) Six bursts required, 3 from each side; all results but one must show prescribed strength.

(iii) Board failing may be retested by making 24 bursts, 12 from each side; when all results but 4 show prescribed strength the board is acceptable.

(iv) For corrugated fiberboard, double-pop tests may be disregarded.

§ 78.211-2 Construction requirements.

(a) Corrugated or solid fiberboard boxes of any type capable of withstanding tests prescribed by § 78.211-5 authorized when constructed in accordance with requirements of this section.

(2) Name and address of plant making the container; symbol (letters) authorized if recorded with the Bureau of Explosives. This mark to be located just above or below the mark specified in (a) of this section.

(3) Size of markings: Specification markings prescribed in subparagraph (1) of this paragraph must be at least 1/2 inch high; other markings must be legible.

§ 78.211 Specification 12P; fiberboard boxes. Nonreusable containers for one inside plastic container greater than 1-gallon capacity, as prescribed in Part 73 of this chapter.

§ 78.211-1 Material requirements.

(a) Boxes shall be of corrugated fiberboard, except as otherwise authorized in this specification, having both outer facings water resistant; corrugating medium shall be at least 0.009 inch thick and weigh not less than 26 pounds per 1,000 square feet; all parts shall be securely glued together throughout all contact areas.

(b) Solid fiberboard is authorized when of strength equal to corrugated fiberboard and in conformance with paragraph (c) of this section.

(c) Fiberboard required and tests as follows:

(1) Fiberboard is hereby classified by strength¹ of completed board as in first column of the following table; weights specified in the table are the minimums authorized.

(b) Corrugated or solid fiberboard boxes in accordance with the following table are authorized.

Gross weight not over (pounds)	Strength of fiberboard (minimum) Mullen or Cady test		
	Solid board	Single-wall corrugated	Double-wall corrugated
20.....	200	200	200
60.....	350	350	275
80.....	500	450	350

(c) All parts must be cut true to size and so creased and slotted as to fit closely into position without cracking, surface breaks, separation of parts outside of crease, or undue binding. Box must provide snug fit for inside plastic container.

(d) Joints (manufacturer's). The joint is defined as that part of the box

¹ Mullen or Cady Test (minimum).

where the ends of the sheet are joined together by taping, stitching or gluing.

(1) For glued or stitched lap joint, the sides of box forming joint must lap not less than 1/4 inches. Glued joints must be firmly glued throughout entire area of contact with a glue or adhesive which cannot be dissolved in water after film application has dried.

(2) Butt-joints, taped, are authorized providing resulting joints are capable of withstanding tests prescribed by § 78.211-5.

§ 78.211-3 Design limitations.

(a) Design limitations are as follows:

(1) Permitted when perforated or die-cut areas remain intact following tests prescribed for box by § 78.211-5.

(i) Outer closing flaps may have perforated areas of no greater size than is necessary to provide access to closure of plastic container; inner flaps may have die-cut areas of similar type.

(ii) Die-cut holes in outer and inner closing flaps when closure for plastic container is attached to a metal plate inserted between the inner and outer flaps or when closure area is protected by means of a plug-in or screw cap or similar device. The diameter of these holes shall be less than the diameter of the metal plate.

(iii) Inside facing of fiberboard closure flaps may be cut or perforated for opening. A tear strip may be incorporated in the body wall of fiberboard boxes provided it is above the shoulder area of the plastic container and this may be accompanied by a nominal thumb-notch in the manufacturer's joint or in a side panel of the box.

(iv) Handholes, by perforation or other means, in any part of the box providing the face having the handhole is backed up by a fiberboard sheet of equal strength of box in full height and width of that face or that handholes are above the neck area of the plastic container. No more than one handhole in any face nor more than two per box.

(2) Not permitted:

(i) Stitched manufacturer's joint or stitched closures when any such stitch (staple) is in direct contact with the inside plastic container.

§ 78.211-4 Closure.

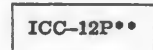
(a) Closure of any type is authorized provided representative boxes are capable of withstanding tests prescribed by § 78.211-5.

§ 78.211-5 Tests.

(a) Representative samples of the completed composite container assembled, filled and closed as for use must be capable of withstanding tests prescribed in the specification for the inside plastic container without rupture of the fiberboard boxes that produces a condition of the box that could result in potential damage to the inside container.

§ 78.211-6 Marking.

(a) On each container. Symbol in rectangle as follows:



(1) Stars to be replaced by authorized gross weight for which box was constructed (for example, ICC-12P80). The letters NRC, located just above or below the ICC mark, to indicate a non-reusable container. These marks shall be understood to certify that the outer container complies with all the construction requirements of the specification.

(2) Name and address of plant making the container; symbol (letters) authorized if recorded with the Bureau of Explosives. This mark to be located just above or below the mark specified in (a) of this section.

(3) Size of markings: Specification as prescribed in paragraph (a) (1) of this section must be at least $\frac{1}{2}$ inch high; other markings must be legible.

§ 78.214 Specification 23F; fiberboard boxes.

§ 78.214-1 Compliance.

(a) Required in all details.

§ 78.214-2 Definitions.

(a) Terms such as "200-pound test" mean minimum strength, Mullen or Cady test.

(b) "Joints" are where edges of parts of box are connected together in setting up the box. Generally done by box maker.

(c) "Seams" are where edges of parts of box are visible, except joints, when box is closed.

§ 78.214-3 Solid fiberboard.

(a) To be 3-ply or more; both outer plies waterproofed.

§ 78.214-4 Corrugated fiberboard.

(a) Both outer facings water resistant; corrugated sheets at least 0.009" thick; all parts securely glued together throughout all contact areas; minimum combined weight of facings not less than 84 pounds per 1,000 square feet, except when only one lining tube is used as provided by § 78.214-15 (b), minimum combined weight of facings must be not less than 138 pounds per 1,000 square feet.

§ 78.214-5 Stitching staples.

(a) Of steel wire, copper-coated or equivalent in nonsparking quality, at least $\frac{3}{32}$ " x 0.019", or equal cross section, formed into staples about $\frac{7}{16}$ " wide.

§ 78.214-6 Tape.

(a) Coated with glue at least equal to No. 1 $\frac{3}{4}$ Peter Cooper standard. Cloth tape of strength, across the wool, at least 70 units, Elmendorf test. Sisal tape of 2 sheets of No. 1 Kraft paper, total weight 80 pounds per ream (500 sheets, 24" x 36"); sheets to be combined with asphalt and reinforced by unspun sisal fibers completely embedded in the asphalt and extending across the tape.

§ 78.214-7 Test.

(a) Acceptable board must have prescribed strength, Mullen or Cady test, under test as follows:

(1) Clamp board firmly in machine and turn wheel thereof at constant speed of approximately 2 revolutions per second.

(2) Six punctures required, 3 from each side; all results but one must show prescribed strength.

(3) Board failing may be retested by making 24 punctures, 12 from each side; when all results but 4 show prescribed strength the board is acceptable.

(4) For corrugated fiberboard, double-pop tests may be disregarded.

§ 78.214-8 Type authorized.

(a) Of solid fiberboard; 1-piece, or 3-piece without recessed heads, fitted with lining tube or lining tubes as prescribed in § 78.214-15, except that lining tubes are not required for boxes used for shipments of high explosives packed in accordance with § 73.63(a) (3) of this chapter or electric blasting caps packed in accordance with § 73.66(g) (1) of this chapter, or when box is constructed of 1-piece of not less than 600-pound test board weighing not less than 300 pounds per 1,000 square feet. Boxes having handholes are authorized when approved by the Bureau of Explosives.

§ 78.214-9 Inside packing and size limits.

(a) As prescribed in § 78.214-15.

§ 78.214-10 Forming.

(a) Parts must be cut true to size and so creased and slotted as to fit closely into position without cracking, surface breaks, separation of parts outside of crease, or undue binding.

§ 78.214-11 Joints.

(a) Lapped $\frac{1}{2}$ inches from center of scoreline except as in § 78.214-12; stitched at $2\frac{1}{2}$ -inch intervals and within 1 inch of each end of joint; double-stitched (2 parallel stitches) at each end of joint over 18 inches long; or lapped not less than $1\frac{1}{4}$ inches and firmly glued throughout entire area of contact with a glue or adhesive which cannot be dissolved in water after the film application has dried.

§ 78.214-12 Flanged heads.

(a) Must have 4 flanges, at least 1" long above fillet, on each head. Recessed flanged heads not authorized.

§ 78.214-13 Seams which are to be stitched.

(a) Overlap, if any, required to be at least $1\frac{1}{2}$ inches from center of scoreline except as in § 78.214-12.

§ 78.214-14 Flap closures.

(a) Flaps must butt or have full overlap excepting that inner flaps may overlap $\frac{1}{2}$ inch.

§ 78.214-15 Authorized gross weight (when packed) and parts required.

(a) Box to be of solid fiberboard, special waterproofed, at least 300-pound test, and weighing at least 250 pounds per thousand square feet. Tubes to be of solid or corrugated fiberboard at least 200-pound test and of 1-piece, or as provided in subparagraph (1) of this paragraph, with adjoining edges stitched, taped, or glued. Glued or stitched lap not less than $1\frac{1}{4}$ ". Lap must be firmly glued throughout entire area of contact with glue or adhesive which cannot be

dissolved in water after the film application has dried.

(1) Or, box shall have one tube liner of solid fiberboard weighing at least 283 pounds per 1,000 square feet with joint or joints either stitched or glued as prescribed in paragraph (a) of this section. One end of the tube may have a handhole approximately $\frac{3}{4}$ " deep located at the center of the top and a perforation with a minimum of $\frac{1}{8}$ " cuts and $\frac{1}{8}$ " webs extending from the handhole to the bottom.

(b) Authorized gross weight; 65 pounds when 2 or more lining tubes are used to divide the box into 2 or more compartments; 65 pounds when 1 or more lining tubes are used and contents will consist of 1 cartridge only or of black powder in bags; 65 pounds when boxes without lining tubes are used for shipments of high explosives packed in accordance with § 73.63(a) (3) of this chapter or electric blasting caps packed in accordance with § 73.66(g) (1) of this chapter; 35 pounds in all other cases except that boxes having a single solid fiberboard lining tube, the fiberboard weighing at least 283 pounds per 1,000 square feet, or corrugated fiberboard lining tube as prescribed in § 78.214-4(a), are authorized for 65 pounds gross weight.

§ 78.214-16 Closing for shipment.

(a) By any method capable of withstanding tests prescribed by § 78.214-20 without failure.

§ 78.214-17 Marking.

(a) On each container. Symbol in rectangle as follows:

ICC-23F***

(1) Stars to be replaced by authorized gross weight (for example, ICC-23F35 or ICC-23F65). This mark shall be understood to certify that the container complies with all specification requirements.

(2) Name and address of plant making the container; symbol (letters) authorized if recorded with the Bureau of Explosives. This mark to be located just above or below the mark specified in this paragraph.

(3) Size of markings: Specification markings prescribed in subparagraph (1) of this paragraph must be at least $\frac{1}{2}$ inch high; other markings must be legible.

§ 78.214-18 Special tests.

(a) *By whom and when.* By or for each plant making the boxes; at beginning of manufacture and at six-month intervals thereafter; on largest size, by weight. Smaller sizes need not be tested if they have the same or equivalent construction. Report of results, with all pertinent data, to be maintained on file for one year; copy to be filed with the Bureau of Explosives.

§ 78.214-19 Material.

(a) Box material (special waterproofed board) must be 300-pound test board and weigh at least 250 pounds per thousand square feet when commercially dry.

(b) Box material must also have 200-pound test strength and moisture content not over 30 percent as follows:

(1) Immediately after exposure for 3 days to 90 percent humidity at 75° F.

(2) Immediately after it has been in contact with water for 3 hours under 3" head at 75° F.

NOTE: The test shall be conducted on a sample no greater than 6 inches in diameter when exposed to water. The sample shall be rigidly fastened to a water column device so constructed as to provide at least a 3-inch head of water on the outer surface of the fiberboard sample. The water column device must be suspended in such manner that free circulation of air on the inner surface of fiberboard sample which is not exposed to water is permitted. After contact with water for 3 hours under conditions specified, the water column device shall be emptied, the sample blotted, and immediately subjected to Mullen or Cady test. (A 6-inch diameter pipe having a welded flange to which the sample is secured by a bolted ring flange is acceptable.)

§ 78.214-20 Completed containers.

(a) Samples must pass the following immediately after exposure for 2 weeks to 90 percent humidity at 75° F.; loaded containers shall contain dummy contents of shape and weight of the expected contents, and shall be closed in same manner as for shipment:

(1) Three loaded samples to be tested. Each must withstand 200 drops in standard 7-foot revolving test drum with pointed hazard in place, without spilling any contents.

(2) Three loaded samples to be tested. Each must withstand end to end pressure of at least 500 pounds without deflection of over 1½".

(3) Three empty samples to be tested. Each must withstand top to bottom pressure of at least 500 pounds without deflection of over ½ inch.

(b) As an alternate to the drum test specified in paragraph (a), 3 loaded samples must pass the drop test specified below:

(1) Box shall be dropped from height of 2 feet.

(2) Identification of face, edge, and corners. Facing one end (with the manufacturer's joint on the observer's right), the top of the box is designated as 1, the right side as 2, the bottom as 3, and the left side as 4. The near end is designated as 5 and the far end as 6. The edges are identified by the number of the two faces which make that edge, as for example, 1-2 identifies the edge where the top and right side meet and 2-5 the edge having the manufacturer's joint. The corners are identified by the number of the three faces which meet to form that corner, as for example, 1-2-5 identifies the corner where the top, the right side, and the near end meet.

(c) Drop sequence as follows:

(1) A corner drop on 1-2-5.

(2) An edge drop on the shortest edge radiating from that corner (usually 2-5).

(3) An edge drop on the next shortest edge radiating from that corner (usually 1-5).

(4) An edge drop on the longest edge radiating from that corner (usually 1-2).

(5) A flatwise drop on one of the smallest faces (usually end 5 or 6).

(6) A flatwise drop on the opposite smallest face.

(7) A flatwise drop on one of the medium faces (usually side 2 or 4).

(8) A flatwise drop on the opposite medium face.

(9) A flatwise drop on one of the largest faces (usually top 1 or bottom 3).

(10) A flatwise drop on the opposite large face.

This completes one cycle of ten drops. Commence the next cycle with a drop on the corner diagonally opposite through the box to the corner on which the first drop was made, on corner 3-4-6. Commence the third cycle of ten drops with corner 1-4-5. Each loaded container must withstand 3 cycles without spilling or sifting of contents.

§ 78.218 Specification 23G; special cylindrical fiberboard box for high explosives.

§ 78.218-1 Compliance.

(a) Required in all details.

§ 78.218-2 Definition.

(a) Terms such as "200-pound test" mean minimum strength, Mullen or Cady test.

§ 78.218-3 Side walls, ends, and interior.

(a) Side walls. To be not less than four-ply of continuous fiber sheets convolutely or spirally wound; combined strength to be not less than 300 pounds, dry; combined thickness to be not less than 0.050" for containers not exceeding 10 pounds gross weight and not less than 0.060" for containers over 10 pounds gross weight.

(b) Ends. To be of one or more plies of fiberboard sufficiently strong to withstand prescribed tests. Wax or plastic material with fiberboard inserts authorized provided the completed container will withstand the prescribed tests at temperatures from zero to one hundred thirty degrees F.

(c) Interior. Interior of the container must be lined or so treated as to prevent penetration by the commodity with which the container is filled for shipping.

§ 78.218-4 Stitching staples.

(a) If used, shall be of steel wire, copper-coated or equivalent in nonsparking quality, at least ½" by 0.019" or equivalent cross section formed into staples approximately ⅞" wide.

§ 78.218-5 Tape.

(a) Coated with animal glue at least equal to No. 1¾ Peter Cooper standard or other adhesive equivalent in tensile properties and resistance to deterioration. Cloth tape of strength, across the width, at least 70 units, Elmendorf test. Sisal tape of 2 sheets of No. 1 Kraft paper, total weight 80 pounds per ream (480 sheets, 24" x 36"); sheets to be combined with asphalt and reinforced by unspun sisal fibers completely em-

bedded in the asphalt and extending across the tape.

§ 78.218-6 Test of board.

(a) Acceptable board must have prescribed strength, Mullen or Cady test, under test as follows:

(1) Clamp board firmly in machine and turn wheel thereof at constant speed of approximately 2 revolutions per second.

(2) Six punctures required, 3 from each side; all results but one must show prescribed strength.

(3) Board failing may be retested by making 24 punctures, 12 from each side; when all results but 4 show prescribed strength the board is acceptable.

§ 78.218-7 Type of container authorized.

(a) One cylindrical tube or;

(b) Two cylindrical tubes butted together and taped or glued completely around circumference at joints to make positive closure.

(c) Open ends to be closed in such a manner as to give complete closure which will withstand prescribed tests.

§ 78.218-8 Approval of specification required.

(a) Specification for each type of container manufactured (under the specification) must be filed with and approved by the Bureau of Explosives. Changes in construction (container and closure) differing from specification thus filed must be approved before authorized for use.

§ 78.218-9 Authorized size and weight limit.

(a) Maximum authorized outside diameter of container is 12".

(b) Maximum authorized gross weight of container is 65 pounds.

§ 78.218-10 Marking.

(a) On each container by symbol as follows:

ICC-23G • • •

(1) Stars to be replaced by *authorized gross weight* (for example, ICC-23G40, ICC-23G65, etc.). This mark shall be understood to certify that the container complies with all specification requirements.

(2) Name or symbol (letters) of maker; this must be registered with the Bureau of Explosives and located just above, below, or following the mark specified in this paragraph.

(3) Size of markings: Specification markings prescribed in subparagraph (1) of this paragraph must be at least ½ inch high; other markings must be legible.

§ 78.218-11 Special tests.

(a) *By whom and when.* By or for each plant making the boxes; at beginning of manufacture and at 6-month intervals thereafter; on largest size, by weight. Smaller sizes need not be tested if they have the same or equivalent construction. Report of results, with all pertinent data, to be maintained on file for one year; copy to be filed with the Bureau of Explosives.

§ 78.218-12 Material.

(a) Box material must be not less than 300 pound test board when commercially dry.

(b) Box material must also have 200-pound test strength, moisture content not over 30 percent and puncture strength not less than 200 units, as determined by General Electric Puncture Tester using an average obtained from a series of five tests, as follows:

(c) Immediately after exposure for 3 days under either of the following conditions:

- (1) 70 percent humidity at 100° F.
- (2) 90 percent humidity at 75° F.

§ 78.218-13 Completed containers.

(a) Samples must pass the following tests immediately after exposure for 2 weeks to 90 percent humidity at 75° F. or 70 percent humidity at 100° F.; loaded containers shall contain dummy contents of shape and weight same as expected contents.

(1) Three loaded samples to be tested. Each must withstand end to end pressure of at least 500 pounds without deflection of over 1½"; speed of compression tester to be ½" per minute plus ¼" minus ¼" per minute.

(2) Three loaded samples to be tested. Each must withstand side to side pressure of at least 500 pounds without deflection of over ½"; except that for boxes with fluted crimped ends the deflection shall not exceed ¾"; speed of compression tester to be ½" per minute plus ¼" minus ¼" per minute.

(3) Three loaded samples to be tested. Each must withstand, without rupture, four 4-foot drops diagonally on the end more likely to cause rupture on impact.

(4) Three loaded samples to be tested. Each must be dropped once, flat on its side, across another similar package lying flat upon the ground with its longitudinal axis at right angles to container dropped. Drops must be made from a height four feet above the topmost point of the container on the ground.

(b) As an alternate to compression test requirements of paragraph (a) (1) and (2) of this section, samples must pass the following tests immediately after exposure for 2 weeks to 90 percent humidity at 75° F. or 70 percent humidity at 100° F.; loaded containers shall contain dummy contents of shape and weight same as expected contents. Static loading tests as specified herein must be conducted with the prescribed weight in place for at least 60 minutes, with deflection of container not in excess of the following:

(1) Three loaded samples to be tested. Each container must be capable of withstanding end-to-end pressure of at least 375 pounds without deflection over 1½ inches.

(2) Three loaded samples to be tested. Each container must be capable of withstanding side-to-side pressure of at least 350 pounds without deflection over ½ inch.

§ 78.219 Specification 23H; fiberboard boxes.

§ 78.219-1 Compliance.

(a) Required in all details.

§ 78.219-2 Definitions.

(a) Terms such as "200-pound test" mean minimum strength, Mullen or Cady test.

(b) "Joints" are where edges of parts of box are connected together in setting up box.

(c) "Seams" are where edges of parts of box are visible, except joints, when box is closed.

§ 78.219-3 Solid fiberboard.

(a) To be 3-ply or more; both outer plies waterproofed.

§ 78.219-4 Stitching staples.

(a) Of steel wire, copper-coated or equivalent in nonsparking quality, at least ½" x 0.019", or equal cross section, formed into staples about ⅞" wide.

§ 78.219-5 Tape.

(a) Coated with glue at least equal to No. 1¾ Peter Cooper standard. Cloth tape of strength, across the wool, at least 70 units, Elmendorf test. Sisal tape of 2 sheets of No. 1 kraft paper, total weight 80 pounds per ream (500 sheets, 24" x 36"); sheets to be combined with asphalt and reinforced by unspun sisal fibers completely embedded in the asphalt and extending across the tape.

§ 78.219-6 Test.

(a) Acceptable board must have prescribed strength, Mullen or Cady test, under test as follows:

(1) Clamp board firmly in machine and turn wheel thereof at constant speed of approximately 2 revolutions per second.

(2) Six punctures required, 3 from each side; all results but one must show prescribed strength.

(3) Board failing may be retested by making 24 punctures, 12 from each side; when all results but 4 show prescribed strength the board is acceptable.

§ 78.219-7 Type authorized.

(a) Of solid fiberboard, telescoping type construction without recessed heads. Box to consist of top and bottom sections, divided equally or unequally, and inner lining tube or full depth cover 2-piece telescope type in which case the lining tube may be omitted. The lining tube, when required, must be staple stitched to the lower section of the box to give in effect a 2-piece box.

(b) Hand-holes oval in shape, not more than 1 inch in width by 3 inches in length and horizontal with top score line, are authorized in ends of top section of full depth cover telescope type boxes.

§ 78.219-8 Inside packing and size limits.

(a) As prescribed in § 78.219-11.

§ 78.219-9 Forming.

(a) Parts must be cut true to size and so creased and slotted as to fit closely into position without cracking, surface breaks, separation of parts outside of crease, or undue binding.

§ 78.219-10 Joints.

(a) Lapped at least 1½ inches from center of scoreline; staple stitched at 2½-inch intervals and within 1 inch of

each end of joint; 2 banks of staple stitches in each joint.

§ 78.219-11 Authorized gross weight (when packed) and parts required.

(a) Box to be of solid fiberboard, special waterproofed at least 300-pound test, and weighing at least 250 pounds per thousand square feet. Tubes to be of solid fiberboard at least 200-pound test and of 1 piece with adjoining edges staple stitched or taped.

(b) Authorized gross weight: 65 pounds when 2 or more lining tubes are used to divide the box into 2 or more compartments; 65 pounds when 1 or more lining tubes are used and contents will consist of 1 cartridge only or of black powder in bags; 35 pounds in all other cases except that boxes having a single solid fiberboard lining tube, the fiberboard weighing at least 283 pounds per 1,000 square feet, are authorized for 65 pounds gross weight. Boxes of 2-piece telescope type having full depth cover are authorized for 65 pounds gross weight.

§ 78.219-12 Closing for shipment.

(a) By any method capable of withstanding tests prescribed by § 78.219-16 without failure.

§ 78.219-13 Marking.

(a) On each container. Symbol in rectangle as follows:

ICC-23H***

(1) Stars to be replaced by authorized gross weight (for example ICC-23H35 or ICC-23H65). This mark shall be understood to certify that the container complies with all specification requirements.

(2) Name and address of plant making the container; symbol (letters) authorized if recorded with the Bureau of Explosives. This mark to be located just above or below the mark specified in paragraph (a) of this section.

(3) Size of markings: Specification markings prescribed in subparagraph (1) of this paragraph must be at least ½ inch high; other markings must be legible.

§ 78.219-14 Special tests.

(a) *By whom and when.* By or for each plant making the boxes; at beginning of manufacture and at six-month intervals thereafter; on largest size, by weight. Smaller sizes need not be tested if they have the same or equivalent construction. Report of results, with all pertinent data, to be maintained on file for one year; copy to be filed with the Bureau of Explosives.

§ 78.219-15 Material.

(a) Box material (special waterproofed board) must be 300-pound test board and weigh at least 250 pounds per thousand square feet when commercially dry.

(b) Box material must also have 200-pound test strength and moisture content not over 30 percent as follows:

(1) Immediately after exposure for 3 days to 90 percent humidity at 75° F.

(2) Immediately after it has been in contact with water for 3 hours under 3" head at 75° F.

NOTE: The test shall be conducted on a sample no greater than 6 inches in diameter when exposed to water. The sample shall be rigidly fastened to a water column device so constructed as to provide at least a 3-inch head of water on the outer surface of the fiberboard sample. The water column device must be suspended in such manner that free circulation of air on the inner surface of fiberboard sample which is not exposed to water is permitted. After contact with water for 3 hours under conditions specified, the water column device shall be emptied, the sample blotted, and immediately subjected to Mullen or Cady test. (A 6-inch diameter pipe having a welded flange to which the sample is secured by a bolted ring flange is acceptable.)

§ 78.219-16 Completed containers.

(a) Samples must pass the following immediately after exposure for 2 weeks to 90 percent humidity at 75° F.; loaded containers shall contain dummy contents of shape and weight of the expected contents, and shall be closed in same manner as for shipment:

(1) *Three loaded samples to be tested.* Each must withstand 200 drops in standard 7-foot revolving test drum with pointed hazard in place, without spilling any contents.

(2) *Three loaded samples to be tested.* Each must withstand end to end pressure of at least 500 pounds without deflection of over 1½".

(3) *Three empty samples to be tested.* Each must withstand top to bottom pressure of at least 500 pounds without deflection of over ½ inch.

(b) As an alternate to the drum test specified in paragraph (a), 3 loaded samples must pass the drop test specified below:

(1) Box shall be dropped from height of 2 feet.

(2) Identification of face, edge, and corners. Facing one end (with the manufacturer's joint on the observer's right), the top of the box is designated as 1, the right side as 2, the bottom as 3,

and the left side as 4. The near end is designated as 5 and the far end as 6. The edges are identified by the number of the two faces which make that edge, as for example, 1-2 identifies the edge where the top and right side meet and 2-5 the edge having the manufacturer's joint. The corners are identified by the number of the three faces which meet to form that corner, as for example, 1-2-5 identifies the corner where the top, the right side, and the near end meet.

(c) Drop sequence as follows:
 (1) A corner drop on 1-2-5.
 (2) An edge drop on the shortest edge radiating from that corner (usually 2-5).

(3) An edge drop on the next shortest edge radiating from that corner (usually 1-5).

(4) An edge drop on the longest edge radiating from that corner (usually 1-2).

(5) A flatwise drop on one of the smallest faces (usually end 5 or 6).

(6) A flatwise drop on the opposite smallest face.

(7) A flatwise drop on one of the medium faces (usually side 2 or 4).

(8) A flatwise drop on the opposite medium face.

(9) A flatwise drop on one of the largest faces (usually top 1 or bottom 3).

(10) A flatwise drop on the opposite large face.

This completes one cycle of ten drops. Commence the next cycle with a drop on the corner diagonally opposite through the box to the corner on which the first drop was made, on corner 3-4-6. Commence the third cycle of ten drops with corner 1-4-5. Each loaded container must withstand 3 cycles without spilling or sifting of contents.

§ 78.224 Specification 21C; fiber drum.

§ 78.224-1 Construction requirements.

(a) Parts and dimensions as follows:

(1) Drums for dry products; minimum requirements unless otherwise stated:

(2) Drums for liquids contained in inside plastic containers as prescribed in Part 73 of this chapter, specifications for which are detailed in this part, shall comply with the construction requirements for drums for dry products and as follows:

Marked rated capacity of inside plastic container (gallons) (not over)	Minimum construction requirement for dry products (pounds)	Authorized maximum net weight of liquid contents (pounds) (not over)
6½	60	105
15	115	245
30	225	450
55	400	550

NOTE 1: See § 78.224-2 for test requirements; § 78.224-4 for marking requirements.

NOTE 2: Drums must provide snug fit for inside plastic container.

NOTE 3: Top head of drums may have holes of suitable size to provide for closure parts of inside container; bottom head may have not more than three holes not over ¾ inch in diameter each for drainage.

§ 78.224-2 Type tests.

(a) *Conditioning:* Prior to testing, drums shall be conditioned at 50 percent relative humidity plus or minus 2 percent and 75° F. plus or minus 3° F. for at least 48 hours.

(b) *Drop tests:* Samples taken at random filled with dry finely powdered material to authorized net weight and closed as for use must withstand the following four foot drop tests on the part specified without leakage or serious rupture. No single drum shall be subjected to more than one of the following tests. Drums with wood heads shall be dropped with grain of wood in cover parallel to concrete surface.

(1) Top chime, diagonally onto solid concrete.

(2) Bottom chime, diagonally onto solid concrete.

(3) Sidewall, over a 2-inch x 6-inch timber resting on solid concrete with 6-inch leg vertical; drop to be made with drum in horizontal position at right angles to the timber.

(4) The closure or on any other part which may be considered weaker onto solid concrete.

(c) *Compression test:* An empty drum shall withstand either of the following compression tests, in accordance with the following table, without buckling of the sidewalls sufficient to cause damage to its expected contents; but in no case shall the maximum deflection be more than one inch.

Maximum net weight	Maximum capacity (gallons)	Maximum inside diameter (inches)	Compression (pounds)	
			Static ¹	Dynamic ²
60	5	11¼	1200	1600
60	20	18½	1200	1600
115	20	18½	1200	1600
115	55	23	1500	2000
225	55	23	1800	2400
400	75	23	2100	2800

¹ *Static Test.* Compression as specified must be applied to full area of top cover of drum for period of 48 hours.

² *Dynamic Test.* Compression as specified must be applied end to end. Speed of compression tester to be one-half inch plus or minus one-fourth inch per minute.

Net weight of contents (pounds) (not over)	Capacity, maximum (gallons) (not over)	Diameter, inside, maximum, (inches)	Sidewall strength (pounds) ¹	Tops and bottoms				
				Fiber ²		Steel (U.S. gauge)	Wood (thickness, inches)	
				Thickness (inches)	Strength ¹		Solid ³	Plywood, at least 3-ply construction
60	5	11¼	500	0.090	600	28	1½	¾
60	20	18½	600	.120	800	28	1½	¾
115	20	18½	700	.120	800	26	1½	¾
115	55	23	800	.160	1100	26	1½	¾
250	55	23	900	.200	1200	24	1½	¾
400	75	23	1000	.220	1300	24	1½	¾

¹ *Mullen or Cady Test.* Either of the following test methods may be used. When more than single ply, test shall be determined from the summation of the tests of individual plies; or, when test is made on a complete drum, the punctures shall be made from the exterior to the interior surface, in which case the values for sidewall shall be not less than 80 percent of the value in the above table and the values for fiber tops and bottoms shall be not less than the value in the above table. There shall be a minimum of six tests and the average shall be not less than the prescribed minimum requirements.

² *Sidewalls.* Sidewalls to be convolutely wound of fiberboard at least 0.012 inch thick, the plies being secured together with adhesives; or may consist of an outer shell and an inner tube each convolutely wound with each fiberboard ply not less than 0.012 inch thick and secured together with adhesive. Drums may contain barrier or lining materials.

³ When made of 2 or more discs, the discs must be fastened together with adhesive.

⁴ Joints in head must be Linderman joints, glued, except as specified in footnote 5.

⁵ Wooden heads at least one-half inch thick having kraft paper glued on both sides at all contact areas with water-resistant adhesive are authorized provided tests prescribed in § 78.224-2 are successful. Joints of any type are authorized.

⁶ Minimum thickness may be reduced to ¾ inch for lumber dressed two sides.

(d) Drums for inside plastic containers for liquids shall be constructed and tested as prescribed in § 78.224-1(a) (2) and paragraphs (a), (b), (c), and (e) of this section. When combined with inside plastic container authorized in Part 73 of this chapter, the composite container must be tested in accordance with requirements detailed in specifications for the inside plastic container and shall develop no condition that would be of such nature as to contribute to potential failure of inner container.

(e) The tests described above must be made by any company starting production, for each plant location of manufacture, on samples taken at random of each type and diameter of container and must be repeated every four months or less during production. Samples last tested must be retained until further tests are made. The tests and procedure described may be conducted at one central laboratory when testing facilities are not available at all plants, in which case the Bureau of Explosives shall be advised of the location where the tests are conducted.

§ 78.224-3 Registration of drum specification.

(a) Specification for each type of drum manufactured (under this specification) shall be filed with the Bureau of Explosives. Changes in construction (drum and closure) differing from specification thus filed must be approved by the Bureau of Explosives before authorized for use.

§ 78.224-4 Marking.

(a) On each container as follows:

(1) Drums for dry products must be marked ICC-21C followed by the authorized net weight to which drum was constructed, for example, ICC-21C115.

(2) Drums for inside plastic containers for liquids must be marked ICC-21CP followed by the authorized net weight for dry products and the authorized net weight for liquid products to which the drum was constructed, for example, ICC-21CP115/245.

(3) Marks specified in paragraph (a) (1) and (2) of this section shall be understood to certify that the fiber drum complies with all specification requirements.

(4) Name or symbol (letters) of maker; this must be registered with the Bureau of Explosives and be located just above, below, or following the mark specified in paragraph (a) (1) or (2) of this section.

§ 78.226 Specification 29; mailing tubes.

§ 78.226-1 Compliance.

(a) Required in all details.

§ 78.226-2 Cushioning.

(a) Inside containers, if any, must fit closely in tube or be properly cushioned.

§ 78.226-3 Construction.

(a) Of fiber at least $\frac{1}{8}$ " thick; metal bottom and metal screw-cap top, or telescope type with fixed metal ends.

§ 78.226-4 Marking.

(a) On each container by letters and figures as follows: ICC-29; this mark

shall be understood to certify that the container complies with all specification requirements.

Subpart G—Specifications for Bags, Cloth, Burlap or Paper

§ 78.230 Specification 36A; lined cloth bags (triplex).

§ 78.230-1 Compliance.

(a) Required in all details.

§ 78.230-2 Capacity.

(a) Not over 100 pounds, net.

§ 78.230-3 Cloth.

(a) Osnaburg cotton cloth at least $8\frac{1}{2}$ ounces per square yard.

NOTE 1: Because of the present emergency and until further order of the Commission, cloth of 40-inch width, 2.11 yards per pound, may be used, provided creped paper is of two-way stretch construction.

§ 78.230-4 Paper.

(a) Shipping sack Kraft, creped. A "ream" as used herein means 500 sheets 24 inches by 36 inches before creping.

§ 78.230-5 Assembly.

(a) Either of the following:

(1) *Single bag.* Cloth-lined with 2 sheets of creped paper, each at least 35 pounds per ream, cemented together and to cloth. Combined tensile strength at least 100 pounds, warp and fill.

(2) *Triple bag.* Outer of cloth; intermediate of 2 thicknesses of creped paper, each at least 30 pounds per ream, cemented together with asphalt so as to weigh 90 pounds per ream; inner of creped paper at least 45 pounds per ream.

§ 78.230-6 Seams.

(a) To be dust-tight.

§ 78.230-7 Test.

(a) The finished container, filled and closed as for shipment, must be capable of withstanding drop test of 4 feet without sifting.

§ 78.230-8 Marking.

(a) Marking on each container by marks at least 1" high as follows:

(1) ICC-36A; this mark shall be understood to certify that the container complies with all specification requirements.

(2) Name and address of maker; located above or below the mark specified in subparagraph (1) of this paragraph; symbol (letters) authorized if registered with the Bureau of Explosives.

§ 78.230-9 Closing for shipment.

(a) By double tying with steel wires at least No. 16 Birmingham wire gauge; inner bags, if any, to have edges rolled in before outer bag is tied.

§ 78.233 Specification 36B; burlap bags, lined.

§ 78.233-1 Compliance.

(a) Required in all details.

§ 78.233-2 Capacity.

(a) Not over 100 pounds, net.

§ 78.233-3 Burlap.

(a) At least equal in quality and strength to 10-oz., 40" (10/40), Cal-

cutta A and/or B mill grade. Thread count at least 11 per 37/40", porter, and 12 per inch, shot; this to be an average of 6 counts.

§ 78.233-4 Paper.

(a) Shipping sack Kraft, creped; at least 25 pounds per ream (500 sheets 24" x 36") before creping.

§ 78.233-5 Assembly.

(a) Burlap to be lined with 2 sheets of creped paper cemented together and to burlap.

(b) Adhesive between paper sheets to be asphalt, melting point 150° F., at minimum rate of 110 pounds per ream.

(c) Adhesive between paper and burlap to be either:

(1) Curing rubber latex at minimum rate of 40 pounds, dry weight, per ream.

(2) Asphalt, any desirable type, at minimum rate of 110 pounds per ream.

§ 78.233-6 Stretch of paper lining.

(a) At least equal to that of burlap in direction of warp and fill and equal to 10 percent in diagonal direction.

§ 78.233-7 Seams.

(a) By cementing or taping to give seam strength at least equal to that of bag material and prevent sifting.

§ 78.233-8 Test.

(a) The finished container, filled and closed as for shipment, must be capable of withstanding drop test of 4 feet on the butt without sifting or rupture of burlap or liners.

§ 78.233-9 Marking.

(a) Marking on each container by marks at least 1" high as follows:

(1) ICC-36B; this mark shall be understood to certify that the container complies with all specification requirements.

(2) Name and address of maker; located above or below the mark specified in subparagraph (1) of this paragraph; symbol (letters) authorized if registered with the Bureau of Explosives.

§ 78.233-10 Closing for shipment.

(a) As specified for seams, § 78.233-7; or, by tying with 2 steel wires of at least No. 16 Birmingham wire gauge.

§ 78.234 Specification 36C; burlap bags, paper lined.

§ 78.234-1 Compliance.

(a) Required in all details.

§ 78.234-2 Capacity.

(a) Not over 100 pounds, net.

§ 78.234-3 Burlap.

(a) At least equal in quality and strength to $7\frac{1}{2}$ ounce, 40 inch ($7\frac{1}{2}/40$) Calcutta A and/or B mill grade. Thread count at least 9 per $\frac{3}{4}$ inch, porter, and 9 per inch, shot; this to be an average of 6 counts.

§ 78.234-4 Paper.

(a) Shipping sack Kraft, creped; at least 30 pounds per ream (500 sheets 24" x 36") before creping.

§ 78.234-5 Assembly.

(a) Burlap to be lined with 1 sheet of creped paper cemented to burlap.

(b) Adhesive between paper and burlap to be asphalt, any desirable type, at a minimum rate of 110 pounds per ream.

§ 78.234-6 Stretch of paper lining.

(a) At least equal to that of burlap in direction of warp and fill and equal to 10 percent in diagonal direction.

§ 78.234-7 Seams.

(a) By cementing or taping to give seam strength at least equal to that of bag material and prevent sifting.

§ 78.234-8 Test.

(a) The finished container, filled and closed as for shipment, must be capable of withstanding drop test of 4 feet on the butt without sifting or rupture of burlap liners.

§ 78.234-9 Marking.

(a) Marking on each container by marks at least 1" high as follows:

(1) ICC-36C; this mark shall be understood to certify that the container complies with all specification requirements.

(2) Name and address of maker; located above or below the mark specified in subparagraph (1) of this paragraph; symbol (letters) authorized if registered with the Bureau of Explosives.

§ 78.234-10 Closing for shipment.

(a) As specified for seams, § 78.234-7; or by tying with 2 steel wires of at least No. 16 Birmingham wire gauge, or any other type of equal efficiency that will be sift-proof and insure equal strength to body of bag.

§ 78.236 Specification 44B; multiwall paper bags.

§ 78.236-1 Compliance.

(a) Required in all details.

§ 78.236-2 Paper.

(a) Shipping sack kraft paper, plain, or extensible plain, shall conform to the average requirements specified in paragraph (a) (1) or (2) of this section.

(1) Shipping sack, kraft paper, plain:¹

(2) Shipping sack, extensible kraft paper, plain:¹

Nominal basis weight (500 sheets, 24" x 36") ³	Minimum dry tearing strength		Minimum tensile energy absorption ft./lbs. per square foot of paper	
	M. D. ³	Total M. D. plus C. D. ³	C. D. ^{3,4}	Total C. D. plus M. D. ^{3,4}
Pounds:	Grams	Grams		
40.....	88	188	4.5	14.0
50.....	110	235	5.6	17.0
60.....	132	282	7.0	20.0
70.....	154	329	8.0	23.0
80.....	176	376	9.0	26.0

¹ Extensible shipping sack kraft paper, plain, is paper that consists of all sulphate pulp and no other fiber, and which has not been treated by coloring, bleaching, creping, coating, spraying, laminating or impregnating for special qualities. Paper shall have a stretch factor of at least 7 percent in either direction, shall have a degree of water resistance as secured by normal rosin sizing, and shall comply with the requirements in paragraph (a) (2) of this section.

² A tolerance of minus 10 percent of the basis weight of individual plies of plain shipping sack kraft paper will

be permitted; an average tolerance of minus 5 percent will be permitted in the sum total basis weight of all plies in multiwall constructions. Variations in excess of specified basis weights will not be considered a defect or deviation. The basis weight of paper means the basis weight as produced by the paper machine, not including finish subsequently applied, such as coating or printing.

³ M. D. means machine direction. C. D. means cross direction.

⁴ Variations in cross-direction tensile energy absorption of not more than 0.5 units below the minimum requirements will be permitted, provided the variations are compensated by an increase in the machine-direction tearing strength in the ratio of twenty units of tearing strength to one unit of tensile energy absorption, and variations in total tensile energy absorption of not more than one unit below the minimum requirements will be permitted, provided the variations are compensated by an increase in the total tearing strength in the same ratio. Similarly, variations in machine-direction tearing strength of not more than ten units below minimum requirements will be permitted, provided variations are compensated by an increase in cross-direction tensile energy absorption in the ratio of one unit of tensile energy absorption to twenty units of tearing strength; and variations in total tearing strength of not more than twenty units below the minimum requirements will be permitted, provided the variations are compensated by an increase in the total tensile energy absorption in the same ratio. Conformance with the requirements of Table shall be established by comparing the sum of the basis weights and tests for all of the plies specified in the construction of the bag, with the sum of the specified basis weights and tests for the respective papers comprising the different plies. All requirements in this table are for a paper conditioned to a relative humidity of 50 percent at a temperature of 23° C (73° F).

(b) Asphalt laminated or polyethylene coated shipping sack kraft paper when used shall comply with the following requirements:

Type paper	Minimum average dry tearing strength		Minimum average dry tensile strength per inch width		Heat resistance hours at 150° F. without impairing function of sack	Maximum average water-vapor permeability from both sides at 50 percent R. H. and 73° F. g/m, 2/24 hours	
	M. D.	Total M. D. plus C. D.	C. D.	Total C. D. plus M. D.		Un-creased	Creased ¹
Asphalt laminated ^{2,4}	Grams	Grams	Pounds	Pounds			
10FE-50 1/50-10FE ²	110	235	19	53	5	9.0	15.0
16FE-50 1/50-16FE ²	110	235	19	53	5	7.0	12.0
16FE-50 1/50-16FE ²	110	235	19	53	5	4.5	7.5

¹ Creasing at 40° F.

² Asphalt laminated kraft paper when used as a wall in fabricated sacks, shall conform to the requirements of paragraph (b) of this section and shall consist of two sheets of kraft paper, the total basis weight of the two paper plies not less than 50 pounds per ream (500 sheets, 24" x 36"), continuously and uniformly laminated together with an average of not less than 25 pounds of asphalt per ream (500 sheets, 24" x 36"). Tolerance of minus 5 percent will be allowed on individual components. The total basis weight of the finished combination shall not exceed 100 pounds per ream (500 sheets, 24" x 36"). An asphalt laminated kraft wall meeting these requirements may be substituted for a plain kraft wall of 50 pounds basis or less, provided it meets the specification.

³ Polyethylene-coated shipping sack kraft paper. The polyethylene-coated kraft paper when used as walls in fabricated sacks shall meet the heat resistance and water-vapor permeability requirements as specified in the table. A tolerance of minus 10 percent will be allowed for the lot sample average coating weight of polyethylene on shipping sack kraft paper. Minimum samples for testing shall comprise not less than 3 specimens 16 square inches each selected representatively from each polyethylene-coated wall of each sack in the lot sample. Where barrier sheets are based on extensible kraft the weight of the barrier material shall be in addition to the basis weight of the paper.

⁴ Asphalt laminated extensible kraft paper must consist of two sheets of extensible kraft paper, the total basis weight of the paper in the finished combination being not less than 50 pounds per ream (24 x 36-500) with neither sheet weighing less than 25 pounds continuously and uniformly laminated together, with an average of not less than 25 pounds of asphalt per ream (24 x 36-500). In determining the basis weight and test conformance of bags containing an asphalt laminated extensible kraft wall, the asphalt laminated extensible kraft wall shall be treated as if it were a single extensible kraft wall or combination of walls of 10 pounds lower total paper basis weight than the sum of the nominal basis weight in the asphalt laminated wall, but in no case shall be treated as less than the equivalent of a 50 pounds basis weight wall.

(c) Laminating materials: Any laminant other than asphalt or other water-vapor barrier walls may be used provided they meet the requirements in paragraph (b) of this section.

(d) All values in paragraphs (a) and (b) of this section are for paper having a moisture content in equilibrium with an atmosphere having a relative humidity of 50 percent plus or minus 2 percent at a temperature of 73° F. plus or minus 3.5° F. following preconditioning of the test specimens to a moisture content between 3 and 5.5 percent by exposure to relatively dry air having a temperature no greater than 140° F.

(e) Conformance of sacks with paper strength requirements shall be established by comparing the sums of the

test values for all the walls of the new and unused sack with the sums of the respective strength values specified in paragraphs (a) and (b) of this section for the respective papers specified for the different walls of the sack by a method acceptable to the Bureau of Explosives.

(1) Variation in cross direction dry tensile strength of not more than 2 units below the minimum requirement based on paragraphs (a) and (b) of this section will be permitted for each wall of the sack, provided the variation is compensated for by a machine direction tearing strength test value in excess of the minimum requirement obtained from the tables, in the ratio of 5 units of tearing strength for each unit of dry tensile

Nominal basis weight (500 sheets, 24" x 36") ³	Minimum average dry tearing strength		Minimum average dry tensile strength per inch width	
	M. D. ³	Total M. D. plus C. D. ³	C. D. ³	Total C. D. plus M. D. ³
Pounds:	Grams	Grams	Pounds	Pounds
40.....	88	188	14	41
50.....	110	235	19	53
60.....	132	282	23	64
70.....	154	329	27	74

¹ Shipping sack kraft paper, plain, is paper that consists of all sulphate pulp and no other fiber, and which has not been treated by coloring, bleaching, creping, coating, spraying, laminating, or impregnating for special qualities. Paper shall have a degree of water resistance as secured by normal rosin sizing and shall comply with the requirements in paragraph (a) (1) of this section.

² A tolerance of minus 10 percent of the basis weight of individual plies of plain shipping sack kraft paper will be permitted; an average tolerance of minus 5 percent will be permitted in the sum total basis weight of all plies in multiwall constructions. Variations in excess of specified basis weights will not be considered a defect or deviation. The basis weight of paper means the basis weight as produced by the paper machine, not including finish subsequently applied, such as coating or printing.

³ M. D. means machine direction. C. D. means cross direction.

strength test below the minimum requirement; and variation in combined dry tensile strength of not more than 4 units below the minimum requirement based on paragraphs (a) and (b) of this section will be permitted for each wall used provided the variation is compensated for by a combined tearing strength test value in excess of the minimum requirement obtained from the tables in the ratio of 5 units of combined tearing strength for each unit of dry tensile strength test below the minimum requirement. Similarly, variation in machine direction tearing strength of not more than 10 units below the minimum requirement will be permitted for each wall, provided the variation is compensated for by a cross direction dry tensile strength test value in excess of the minimum requirement obtained from the tables in the ratio of 1 unit of dry tensile strength for each 5 units of tearing strength test below the minimum requirement; and variation in combined tearing strength of not more than 20 units below the minimum requirement obtained from the tables will be permitted for each wall provided the variation is compensated for by a combined dry tensile strength test value in excess of the minimum requirement obtained from the tables in the ratio of 5 units of tearing strength below the minimum requirement.

§ 78.236-3 Construction.

(a) Bags must be at least 4 thicknesses of paper; this must be heavy duty shipping sack kraft paper, conforming to the requirements of § 78.236-2 paragraphs (a) and (b) or equivalent, with a minimum total basis weight of 200 pounds of paper (500 sheets, 24" x 36"). Outer sheet must be of water-resistant stock and at least 60 pounds basis weight, inner sheets not less than 40 pounds basis weight. Bags to be of "satchel bottom" construction; bottoms to be reinforced with a kraft paper patch at least 30 pounds basis weight. Other bottoms of equal efficiency are authorized.

(b) Or, bags must be at least 2 thicknesses of paper; this must be heavy duty shipping sack kraft paper, or equivalent with a minimum total basis weight of 110 pounds (500 sheets, 24" x 36"), fastened together with waterproof composition reinforced with jute, sisal, cotton, or other yarn or cord imbedded in the composition and criss-crossed at intervals of not over 1/2", approximately, so as to give approximately the same tensile strength for both width and length. Bags to be of "satchel bottom" construction. Other bottoms of equal efficiency are authorized.

(c) Moistureproof barrier sheets of paper, if used, must meet the requirements of § 78.236-2 (b) and shall be considered as one thickness of paper and shall be counted as 50 pounds basis weight (500 sheets, 24" x 36").

§ 78.236-4 Adhesive.

(a) Moisture resistant adhesive must be used on all seams, joints, and bottom patch, if any.

§ 78.236-5 Closure.

(a) For 4-ply bags: Inner (fourth) ply to be diamond folded loose; the third ply to be diamond folded and silicated across all its overlapping folds; the two outer plies to be diamond folded, and cross sealed, front to back and side to side, with gummed tape extending at least 2 inches down sides of bag; sealing tape must be 4" wide, of No. 1 Kraft paper, 90 pounds basis weight (500 sheets, 24" x 36"), or equivalent, and having a Mullen or Cady test, of not less than 90 percent of basis weight. Other closures of equal efficiency are authorized.

(b) For all bags: Any closure for the top which is equal in efficiency to that of the bottom, is authorized.

§ 78.236-6 Tests for shipment.

(a) Bags as prepared for shipment must be able to withstand four 4-foot drops, one on each end and one each on opposite sides, without sifting or rupture.

§ 78.236-7 Marking.

(a) Marking on each bag with letters and figures at least 1/2 inch high in rectangle as follows:

ICC-44B

(1) This mark shall be understood to certify that bag complies with all specification requirements.

(2) Name and address of maker located just above or below the mark specified in paragraph (a) of this section; symbol (letters) authorized if registered with the Bureau of Explosives.

§ 78.237 Specification 44C; multiwall paper bags.

§ 78.237-1 Compliance.

(a) Required in all details.

§ 78.237 Specification 44C; multiwall paper bags.

§ 78.237-2 Paper.

(a) Shipping sack kraft paper, plain, or extensible plain, shall conform to the average requirements specified in paragraphs (a) (1) or (a) (2) of this section.

(1) Shipping sack, kraft paper, plain.¹

Nominal basis weight (500 sheets, 24" x 36") ¹	Minimum average dry tearing strength		Minimum average dry tensile strength per inch width	
	M. D. ²	Total M. D. plus C. D. ³	C. D. ³	Total C. D. plus M. D. ³
Pounds:	Grams	Grams	Pounds	Pounds
40.....	88	188	14	41
50.....	110	235	19	53
60.....	132	282	23	64
70.....	154	329	27	74

¹ Shipping sack kraft paper, plain, is paper that consists of all sulphate pulp and no other fiber, and which has not been treated by coloring, bleaching, creping, coating, spraying, laminating, or impregnating for special qualities. Paper shall have a degree of water resistance as secured by normal rosin sizing and shall comply with the requirements in paragraph (a) (1) of this section.

² A tolerance of minus 10 percent of the basis weight of individual plies of plain shipping sack kraft paper will be permitted; an average tolerance of minus 5 percent will be permitted in the sum total basis weight of all plies in multiwall constructions. Variations in excess of specified basis weights will not be considered a defect or deviation. The basis weight of paper means the basis weight as produced by the paper machine, not including finish subsequently applied, such as coating or printing.

³ M. D. means machine direction. C. D. means cross direction.

(2) Shipping sack, extensible kraft paper, plain:¹

Nominal basis weight (500 sheets, 24" x 36") ¹	Minimum dry tearing strength		Minimum tensile energy absorption ft./lbs. per square foot of paper	
	M. D. ²	Total M. D. plus C. D. ³	C. D. ³	Total C. D. plus M. D. ³
Pounds:	Grams	Grams		
40.....	88	188	4.5	14.0
50.....	110	235	5.6	17.0
60.....	132	282	7.0	20.0
70.....	154	329	8.0	23.0
80.....	176	376	9.0	26.0

¹ Extensible shipping sack kraft paper, plain, is paper that consists of all sulphate pulp and no other fiber, and which has not been treated by coloring, bleaching, creping, coating, spraying, laminating or impregnating for special qualities. Paper shall have a stretch factor of at least 7 percent in either direction, shall have a degree of water resistance as secured by normal rosin sizing, and shall comply with the requirements in paragraph (a) (2) of this section.

² A tolerance of minus 10 percent of the basis weight of individual plies of plain shipping sack kraft paper will be permitted; an average tolerance of minus 5 percent will be permitted in the sum total basis weight of all plies in multiwall constructions. Variations in excess of specified basis weights will not be considered a defect or deviation. The basis weight of paper means the basis weight as produced by the paper machine, not including finish subsequently applied, such as coating or printing.

³ M. D. means machine direction. C. D. means cross direction.

⁴ Variations in cross-direction tensile energy absorption of not more than 0.5 units below the minimum requirements will be permitted, provided the variations are compensated by an increase in the machine-direction tearing strength in the ratio of twenty units of tearing strength to one unit of tensile energy absorption, and variations in total tensile energy absorption of not more than one unit below the minimum requirements will be permitted, provided the variations are compensated by an increase in the total tearing strength in the same

ratio. Similarly, variations in machine-direction tearing strength of not more than ten units below minimum requirements will be permitted, provided variations are compensated by an increase in cross-direction tensile energy absorption in the ratio of one unit of tensile energy absorption to twenty units of tearing strength; and variations in total tearing strength of not more than twenty units below the minimum requirements will be permitted, provided the variations are compensated by an

increase in the total tensile energy absorption in the same ratio. Conformance with the requirements of Table shall be established by comparing the sum of the basis weights and tests for all of the piles specified in the construction of the bag, with the sum of the specified basis weights and tests for the respective papers comprising the different piles. All requirements in this table are for a paper conditioned to a relative humidity of 50 percent at a temperature of 23° C (73° F).

(b) Asphalt laminated or polyethylene coated shipping sack kraft paper when used shall comply with the following requirements:

Type paper	Minimum average dry tearing strength		Minimum average dry tensile strength per inch width		Heat resistance hours at 150° F. without impairing function of sack	Maximum average water-vapor permeability from both sides at 50 percent R. H. and 73° F. g/m 2/24 hours	
	M. D.	Total M. D. plus C. D.	C. D.	Total C. D. plus M. D.		Un-creased	Creased ¹
Asphalt laminated ²	Grams 110	Grams 235	Pounds 19	Pounds 53	5	9.0	15.0
10PE-50 1/50-10PE ³	110	235	19	53	5	7.0	12.0
15PE-50 1/50-15PE ³	110	235	19	53	5	4.5	7.5

¹ Creasing at 40° F.

² Asphalt laminated kraft paper when used as a wall in fabricated sacks, shall conform to the requirements of paragraph (b) of this section and shall consist of two sheets of kraft paper, the total basis weight of the two paper piles not less than 50 pounds per ream (500 sheets, 24" x 36"), continuously and uniformly laminated together with an average of not less than 25 pounds of asphalt per ream (500 sheets, 24" x 36"). Tolerance of minus 5 percent will be allowed on individual components. The total basis weight of the finished combination shall not exceed 100 pounds per ream (500 sheets, 24" x 36"). An asphalt laminated kraft wall meeting these requirements may be substituted for a plain kraft wall of 50 pounds basis or less, provided it meets the specification.

³ Polyethylene-coated shipping sack kraft paper. The polyethylene-coated kraft paper when used as walls in fabricated sacks shall meet the heat resistance and water-vapor permeability requirements as specified in the table. A tolerance of minus 10 percent will be allowed for the lot sample average coating weight of polyethylene on shipping sack kraft paper. Minimum samples for testing shall comprise not less than 3 specimens 16 square inches each selected representatively from each polyethylene-coated wall of each sack in the lot sample. Where barrier sheets are based on extensible kraft, the weight of the barrier material shall be in addition to the basis weight of the paper.

⁴ Asphalt laminated extensible kraft paper must consist of two sheets of extensible kraft paper, the total basis weight of the paper in the finished combination being not less than 50 pounds per ream (24 x 36-500) with neither sheet weighing less than 23 pounds continuously and uniformly laminated together, with an average of not less than 25 pounds of asphalt per ream (24 x 36-500). In determining the basis weight and test conformance of bags containing an asphalt laminated extensible kraft wall, the asphalt laminated extensible kraft wall shall be treated as if it were a single extensible kraft wall or combination of walls of 10 pounds lower total paper basis weight than the sum of the nominal basis weight in the asphalt laminated wall, but in no case shall be treated as less than the equivalent of a 50 pounds basis weight wall.

(c) Laminating materials: Any laminant other than asphalt or other water-vapor barrier walls may be used provided they meet the requirements in paragraph (b) of this section.

(d) All values in paragraphs (a) and (b) of this section are for paper having a moisture content in equilibrium with an atmosphere having a relative humidity of 50 percent plus or minus 2 percent at a temperature of 73° F. plus or minus 3.5° F. following preconditioning of the test specimens to a moisture content between 3 and 5.5 percent by exposure to relatively dry air having a temperature no greater than 140° F.

(e) Conformance of sacks with paper strength requirements shall be established by comparing the sums of the test values for all the walls of the new and unused sack with the sums of the respective strength values specified in paragraphs (a) and (b) of this section for the respective papers specified for the different walls of the sack by a method acceptable to the Bureau of Explosives.

(1) Variation in cross direction dry tensile strength of not more than 2 units below the minimum requirement based on paragraphs (a) and (b) of this section will be permitted for each wall of the sack, provided the variation is com-

pensated for by a machine direction tearing strength test value in excess of the minimum requirement obtained from the tables, in the ratio of 5 units of tearing strength for each unit of dry tensile strength test below the minimum requirement; and variation in combined dry tensile strength of not more than 4 units below the minimum requirement based on paragraphs (a) and (b) of this section will be permitted for each wall used provided the variation is compensated for by a combined tearing strength test value in excess of the minimum requirement obtained from the tables in the ratio of 5 units of combined tearing strength for each unit of dry tensile strength test below the minimum requirement. Similarly, variation in machine direction tearing strength of not more than 10 units below the minimum requirement will be permitted for each wall, provided the variation is compensated for by a cross direction dry tensile strength test value in excess of the minimum requirement obtained from the tables in the ratio of 1 unit of dry tensile strength for each 5 units of tearing strength test below the minimum requirement; and variation in combined tearing strength of not more than 20 units below the minimum requirement obtained from the tables will be per-

mitted for each wall provided the variation is compensated for by a combined dry tensile strength test value in excess of the minimum requirement obtained from the tables in the ratio of 5 units of tearing strength for each unit of dry tensile strength below the minimum requirement.

§ 78.237-3 Construction.

(a) Bags must be at least 4 thicknesses of paper; this must be heavy duty shipping sack kraft paper conforming to the requirements of § 78.237-2 paragraphs (a) and (b), or equivalent, with a minimum total basis weight of 250 pounds of paper (500 sheets, 24" x 36"). Outer sheet must be of water resistant stock and at least 60 pounds basis weight, inner sheets not less than 40 pounds basis weight. Bags to be of woven, sift-proof bottom construction. Other bottoms of equal efficiency authorized.

(b) Moistureproof barrier sheets of paper, if used, must meet the requirements of § 78.237-2 (b) and shall be considered as one thickness of paper and shall be counted as 50 pounds basis weight (500 sheets, 24" x 36").

§ 78.237-4 Adhesive.

(a) Moisture resistant adhesive must be used on all seams, joints, and bottom patch, if any.

§ 78.237-5 Closure.

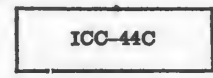
(a) For all bags: Any closure for the top which is equal in efficiency to that of the bottom, is authorized.

§ 78.237-6 Tests for shipment.

(a) Bags as prepared for shipment must be able to withstand four 4-foot drops, one on each end and one each on opposite sides, without sifting or rupture.

§ 78.237-7 Marking.

(a) On each bag with letters and figures at least 1/2 inch high in rectangle as follows:



(1) This mark shall be understood to certify that bag complies with all specification requirements.

(2) Name and address of maker located just above or below the mark specified in paragraph (a) of this section; symbol (letters) authorized if registered with the Bureau of Explosives.

§ 78.238 Specification 44D; multiwall paper bags.

§ 78.238-1 Compliance.

(a) Required in all details.

§ 78.238-2 Paper.

(a) Shipping sack kraft paper, plain, or extensible plain shall conform to the average requirements specified in subparagraphs (a)(1) and (a)(2) of this paragraph.

(1) Shipping sack, kraft paper, plain: ¹

Nominal basis weight (500 sheets, 24" x 36") ^{1, 2}	Minimum average dry tearing strength		Minimum average dry tensile strength per inch width	
	M. D. ³	Total M. D. plus C. D. ³	C. D. ³	Total C. D. plus M. D. ³
Pounds:	Grams	Grams	Pounds	Pounds
40	88	188	14	41
50	110	235	19	53
60	132	282	23	64
70	154	329	27	74

¹ Shipping sack kraft paper, plain, is paper that consists of all sulphate pulp and no other fiber, and which has not been treated by coloring, bleaching, creping, coating, spraying, laminating, or impregnating for special qualities. Paper shall have a degree of water resistance as secured by normal rosin sizing and shall comply with the requirements in paragraph (a) (1) of this section.

² A tolerance of minus 10 percent of the basis weight of individual plies of plain shipping sack kraft paper will be permitted; an average tolerance of minus 5 percent will be permitted in the sum total basis weight of all plies in multiwall constructions. Variations in excess of specified basis weights will not be considered a defect or deviation. The basis weight of paper means the basis weight as produced by the paper machine, not including finish subsequently applied, such as coating or printing.

³ M. D. means machine direction. C. D. means cross direction.

⁴ A bleached sulphate kraft outer wall of 70 pounds basis weight will be permitted provided the combined test values of all of the 5 walls of the completed multiwall sack are in conformance with paragraph (e) of this section and § 78.238-3.

(2) Shipping sack, extensible kraft paper, plain: ¹

Nominal basis weight (500 sheets, 24" x 36") ²	Minimum dry tearing strength		Minimum tensile energy absorption ft./lbs. per square foot of paper	
	M. D. ³	Total M. D. plus C. D. ³	C. D. ^{3, 4}	Total C. D. plus M. D. ^{3, 4}
Pounds:	Grams	Grams		
40	88	188	4.5	14.0
50	110	235	5.6	17.0
60	132	282	7.0	20.0
70	154	329	8.0	23.0
80	176	376	9.0	28.0

¹ Extensible shipping sack kraft paper, plain, is paper that consists of all sulphate pulp and no other fiber, and which has not been treated by coloring, bleaching, creping, coating, spraying, laminating or impregnating for special qualities. Paper shall have a stretch factor of at least 7 percent in either direction, shall have a degree of water resistance as secured by normal rosin sizing, and shall comply with the requirements in paragraph (a) (2) of this section.

² A tolerance of minus 10 percent of the basis weight of individual plies of plain shipping sack kraft paper will be permitted; an average tolerance of minus 5 percent will be permitted in the sum total basis weight of all plies in multiwall constructions. Variations in excess of specified basis weights will not be considered a defect or deviation. The basis weight of paper means the basis weight as produced by the paper machine, not including finish subsequently applied, such as coating or printing.

³ M. D. means machine direction. C. D. means cross direction.

⁴ Variations in cross-direction tensile energy absorption of not more than 0.5 units below the minimum requirements will be permitted, provided the variations are compensated by an increase in the machine-direction tearing strength in the ratio of twenty units of tearing strength to one unit of tensile energy absorption, and variations in total tensile energy absorption of not more than one unit below the minimum requirements will be permitted, provided the variations are compensated by an increase in the total tearing strength in the same ratio. Similarly, variations in machine direction tearing strength of not more than ten units below minimum requirements will be permitted, provided variations are compensated by an increase in cross-direction tensile energy absorption in the ratio of one unit of tensile energy absorption to twenty units of tearing strength; and variations in total tearing strength of not more than twenty units below the minimum requirements will be permitted, provided the variations are compensated by an increase in the total tensile energy absorption in the same ratio. Conformance with the requirements of table shall be established by comparing the sum of the

(b) Asphalt laminated or polyethylene coated shipping sack kraft paper when used shall comply with the following requirements:

Type paper	Minimum average dry tearing strength		Minimum average dry tensile strength per inch width		Heat resistance hours at 150° F. without impairing function of sack	Maximum average water-vapor permeability from both sides at 50 percent R. H. and 73° F. g/m, 2/24 hours	
	M. D.	Total M. D. plus C. D.	C. D.	Total C. D. plus M. D.		Un-creased	Creased ¹
	Grams	Grams	Pounds	Pounds			
Asphalt laminated ^{2, 4}	110	235	19	53	5	9.0	15.0
10PE-50 1/50-10PE ³	110	235	19	53	5	7.0	12.0
15PE-50 1/50-15PE ³	110	235	19	53	5	4.5	7.5

¹ Creasing at 40° F.

² Asphalt laminated kraft paper when used as a wall in fabricated sacks, shall conform to the requirements of paragraph (b) of this section and shall consist of two sheets of kraft paper, the total basis weight of the two paper plies not less than 50 pounds per ream (500 sheets, 24" x 36"), continuously and uniformly laminated together with an average of not less than 25 pounds of asphalt per ream (500 sheets, 24" x 36"). Tolerance of minus 5 percent will be allowed on individual components. The total basis weight of the finished combination shall not exceed 100 pounds per ream (500 sheets, 24" x 36"). An asphalt laminated kraft wall meeting these requirements may be substituted for a plain kraft wall of 50 pounds basis or less, provided it meets the specification.

³ Polyethylene-coated shipping sack kraft paper. The polyethylene-coated kraft paper when used as walls in fabricated sacks shall meet the heat resistance and water-vapor permeability requirements as specified in the table. A tolerance of minus 10 percent will be allowed for the lot sample average coating weight of polyethylene on shipping sack kraft paper. Minimum samples for testing shall comprise not less than 3 specimens 16 square inches each selected representatively from each polyethylene-coated wall of each sack in the lot sample. Where barrier sheets are based on extensible kraft, the weight of the barrier material shall be in addition to the basis weight of the paper.

⁴ Asphalt laminated extensible kraft paper must consist of two sheets of extensible kraft paper, the total basis weight of the paper in the finished combination being not less than 50 pounds per ream (24 x 36-500) with neither sheet weighing less than 23 pounds continuously and uniformly laminated together, with an average of not less than 25 pounds of asphalt per ream (24 x 36-500). In determining the basis weight and test conformance of bags containing an asphalt laminated extensible kraft wall, the asphalt laminated extensible kraft wall shall be treated as if it were a single extensible kraft wall or combination of walls of 10 pounds lower total paper basis weight than the sum of the nominal basis weight in the asphalt laminated wall, but in no case shall be treated as less than the equivalent of a 50 pounds basis weight wall.

(c) Laminating materials: Any laminant other than asphalt or other water-vapor barrier walls may be used provided they meet the requirements in paragraph (b) of this section.

(d) All values in paragraphs (a) and (b) of this section are for paper having a moisture content in equilibrium with an atmosphere having a relative humidity of 50 percent plus or minus 2 percent at a temperature of 73° F. plus or minus 3.5° F. following preconditioning of the test specimens to a moisture content between 3 and 5.5 percent by exposure to relatively dry air having a temperature no greater than 140° F.

(e) Conformance of sacks with paper strength requirements shall be established by comparing the sums of the test values for all the walls of the new and unused sack with the sums of the respective strength values specified in paragraphs (a) and (b) of this section for the respective papers specified for the different walls of the sack by a method acceptable to the Bureau of Explosives.

(1) Variation in cross direction dry tensile strength of not more than 2 units below the minimum requirements based on paragraphs (a) and (b) of this section will be permitted for each wall of the sack, provided the variation is compensated for by a machine direction tearing strength test value in excess of the minimum requirement obtained from the tables, in the ratio of 5 units of tearing strength for each unit of dry tensile strength test below the minimum requirement; and variation in combined dry tensile strength of not more than 4 units below the minimum requirement

based on paragraphs (a) and (b) of this section will be permitted for each wall used provided the variation is compensated for by a combined tearing strength test value in excess of the minimum requirement obtained from the tables in the ratio of 5 units of combined tearing strength for each unit of dry tensile strength test below the minimum requirement. Similarly, variation in machine direction tearing strength of not more than 10 units below the minimum requirement will be permitted for each wall, provided the variation is compensated for by a cross direction dry tensile strength test value in excess of the minimum requirement obtained from the tables in the ratio of 1 unit of dry tensile strength for each 5 units of tearing strength test below the minimum requirement; and variation in combined tearing strength of not more than 20 units below the minimum requirement obtained from the tables will be permitted for each wall provided the variation is compensated for by a combined dry tensile strength test value in excess of the minimum requirement obtained from the tables in the ratio of 5 units of tearing strength for each unit of dry tensile strength below the minimum requirement.

§ 78.238-3 Construction.

(a) Bags must be at least 5 thicknesses of paper; this must be heavy duty shipping sack kraft paper, conforming to the requirements of § 78.238-2 paragraphs (a) and (b), or equivalent, with a minimum total basis weight of 320 pounds of paper (500 sheets, 24" x 36"). Outer sheet must be of water resistant stock and at least 70 pounds basis weight, inner sheets not less than 50 pounds basis weight. Bags to be of sewn, sift-proof bottom construction. Other bottoms of equal efficiency authorized.

basis weights and tests for all of the plies specified in the construction of the bag, with the sum of the specified basis weights and tests for the respective papers comprising the different plies. All requirements in this table are for a paper conditioned to a relative humidity of 50 percent at a temperature of 23° C (73° F).

(b) Moistureproof barrier sheets of paper, if used, must meet the requirements of § 78.238-2 (b) and shall be considered as one thickness of paper and shall be counted as 50 pounds basis weight (500 sheets, 24" x 36").

§ 78.238-4 Adhesive.

(a) Moisture resistant adhesive must be used on all seams, joints, and bottom patch, if any.

§ 78.238-5 Closure.

(a) For all bags: Any closure for the top which is equal in efficiency to that of the bottom, is authorized.

§ 78.238-6 Tests for shipment.

(a) Bags as prepared for shipment must be able to withstand four 4-foot drops, one on each end and one each on opposite sides, without sifting or rupture.

§ 78.238-7 Marking.

(a) On each bag with letters and figures at least 1/2 inch high in rectangle as follows:

ICC-44D

(1) This mark shall be understood to certify bag complies with all specification requirements.

(2) Name and address of maker located just above or below the mark specified in paragraph (a) of this section; symbol (letters) authorized if registered with the Bureau of Explosives.

§ 78.239 Specification 44E; multiwall paper bags.

§ 78.239-1 Compliance.

(a) Required in all details.

§ 78.239-2 Paper.

(a) Shipping sack kraft paper, plain, or extensible plain, shall conform to the average requirements specified in paragraphs (a)(1) or (a)(2) of this section.

(1) Shipping sack, kraft paper, plain:¹

Nominal basis weight (500 sheets, 24" x 36") ^{1,2}	Minimum average dry tearing strength		Minimum average dry tensile strength per inch width	
	M. D. ³	Total M. D. plus C. D. ³	C. D. ³	Total C. D. plus M. D. ³
	Grams	Grams	Pounds	Pounds
Pounds:				
40.....	88	188	14	41
50.....	110	235	19	53
60.....	132	282	23	64
70.....	154	329	27	74

(2) Shipping sack, extensible kraft paper, plain.¹

Nominal basis weight (500 sheets, 24" x 36") ^{1,2}	Minimum dry tearing strength		Minimum tensile energy absorption ft./lbs. per square foot of paper ⁴	
	M. D. ³	Total M. D. plus C. D. ³	C. D. ³	Total C. D. plus M. D. ³
	Grams	Grams		
Pounds:				
40.....	88	188	4.5	14.0
50.....	110	235	5.6	17.0
60.....	132	282	7.0	20.0
70.....	154	329	8.0	23.0
80.....	176	376	9.0	26.0

¹ Extensible shipping sack kraft paper, plain, is paper that consists of all sulphate pulp and no other fiber, and which has not been treated by coloring, bleaching (except as provided by footnote 4 of this table), creping, coating, spraying, laminating or impregnating for special qualities. Paper shall have a stretch factor of at least 7 percent in either direction, shall have a degree of water resistance as secured by normal rosin sizing, and shall comply with the requirements in paragraph (a)(2) of this section.

² A tolerance of minus 10 percent of the basis weight of individual plies of plain shipping sack kraft paper will be permitted; an average tolerance of minus 5 percent will be permitted in the sum total basis weight of all plies

in multiwall constructions. Variations in excess of specified basis weights will not be considered a defect or deviation. The basis weight of paper means the basis weight as produced by the paper machine, not including finish subsequently applied, such as coating or printing.

³ M. D. means machine direction. C. D. means cross direction.

⁴ A bleached sulphate extensible kraft outer sheet of not less than 50 pounds basis weight is authorized providing the combined test values of all the sheets of the bag are in conformance with paragraph (e) of this section and § 78.239-3.

⁵ Variations in cross-direction tensile energy absorption of not more than 0.5 units below the minimum requirements will be permitted, provided the variations are compensated by an increase in the machine-direction tearing strength in the ratio of twenty units of tearing strength to one unit of tensile energy absorption, and variations in total tensile energy absorption of not more than one unit below the minimum requirements will be permitted, provided the variations are compensated by an increase in the total tearing strength in the same ratio. Similarly, variations in machine-direction tearing strength of not more than ten units below minimum requirements will be permitted, provided variations are compensated by an increase in cross-direction tensile energy absorption in the ratio of one unit of tensile energy absorption to twenty units of tearing strength; and variations in total tearing strength of not more than twenty units below the minimum requirements will be permitted, provided the variations are compensated by an increase in the total tensile energy absorption in the same ratio. Conformance with the requirements of Table shall be established by comparing the sum of the basis weights and tests for all of the plies specified in the construction of the bag, with the sum of the specified basis weights and tests for the respective papers comprising the different plies. All requirements in this table are for a paper conditioned to a relative humidity of 50 percent at a temperature of 23° C (73° F).

(b) Asphalt laminated or polyethylene coated shipping sack kraft paper when used shall comply with the following requirements:

Type paper	Minimum average dry tearing strength		Minimum average dry tensile strength per inch width		Heat resistance hours at 160° F. without impairing function of sack	Maximum average water-vapor permeability from both sides at 50 percent R. H. and 73° F. g/m, 2/24 hours	
	M. D.	Total M. D. plus C. D.	C. D.	Total C. D. plus M. D.		Un-creased ¹	Creased ¹
	Grams	Grams	Pounds	Pounds			
Asphalt laminated ^{2,4}	110	235	19	53	5	9.0	15.0
10PE-50 1/50-10PE ³	110	235	19	53	5	7.0	12.0
15PE-50 1/50-15PE ³	110	235	19	53	5	4.5	7.5

¹ Creasing at 40° F.

² Asphalt laminated kraft paper when used as a wall in fabricated sacks, shall conform to the requirements of paragraph (b) of this section and shall consist of two sheets of kraft paper, the total basis weight of the two paper plies not less than 50 pounds per ream (500 sheets, 24" x 36"), continuously and uniformly laminated together with an average of not less than 25 pounds of asphalt per ream (500 sheets, 24" x 36"). Tolerance of minus 5 percent will be allowed on individual components. The total basis weight of the finished combination shall not exceed 100 pounds per ream (500 sheets, 24" x 36"). An asphalt laminated kraft wall meeting these requirements may be substituted for a plain kraft wall of 50 pounds basis or less, provided it meets the specification.

³ Polyethylene-coated shipping sack kraft paper. The polyethylene-coated kraft paper when used as walls in fabricated sacks shall meet the heat resistance and water-vapor permeability requirements as specified in the table. A tolerance of minus 10 percent will be allowed for the lot sample average coating weight of polyethylene on shipping sack kraft paper. Minimum samples for testing shall comprise not less than 3 specimens 16 square inches each selected representatively from each polyethylene-coated wall of each sack in the lot sample. Where barrier sheets are based on extensible kraft; the weight of the barrier material shall be in addition to the basis weight of the paper.

⁴ Asphalt laminated extensible kraft paper must consist of two sheets of extensible kraft paper, the total basis weight of the paper in the finished combination being not less than 50 pounds per ream (24 x 36-500) with neither sheet weighing less than 23 pounds continuously and uniformly laminated together, with an average of not less than 25 pounds of asphalt per ream (24 x 36-500). In determining the basis weight and test conformance of bags containing an asphalt laminated extensible kraft wall, the asphalt laminated extensible kraft wall shall be treated as if it were a single extensible kraft wall or combination of walls of 10 pounds lower total paper basis weight than the sum of the nominal basis weight in the asphalt laminated wall, but in no case shall be treated as less than the equivalent of a 50 pounds basis weight wall.

(c) Laminating materials: Any laminant other than asphalt or other water-vapor barrier walls may be used provided they meet the requirements in paragraph (b) of this section.

(d) All values in paragraphs (a) and (b) of this section are for paper having a moisture content in equilibrium with an atmosphere having a relative humidity of 50 percent plus or minus 2 percent at a temperature of 73° F. plus or minus 3.5° F. following preconditioning of the test specimens to a moisture content between 3 and 5.5 percent by exposure to relatively dry air having a temperature no greater than 140° F.

(e) Conformance of sacks with paper strength requirements shall be estab-

lished by comparing the sums of the test values for all the walls of the new and unused sack with the sums of the respective strength values specified in paragraphs (a) and (b) of this section for the respective papers specified for the different walls of the sack by a method acceptable to the Bureau of Explosives.

(1) Variation in cross direction dry tensile strength of not more than 2 units below the minimum requirement based on paragraphs (a) and (b) of this section will be permitted for each wall of the sack, provided the variation is compensated for by a machine direction tearing strength test value in excess of the minimum requirement obtained from the tables, in the ratio of 5 units of tear-

¹ Shipping sack kraft paper, plain, is paper that consists of all sulphate pulp and no other fiber, and which has not been treated by coloring, bleaching (except as provided by footnote 4 of this table), creping, coating, spraying, laminating, or impregnating for special qualities. Paper shall have a degree of water resistance as secured by normal rosin sizing and shall comply with the requirements in paragraph (a)(1) of this section.

² A tolerance of minus 10 percent of the basis weight of individual plies of plain shipping sack kraft paper will be permitted; an average tolerance of minus 5 percent will be permitted in the sum total basis weight of all plies in multiwall constructions. Variations in excess of specified basis weights will not be considered a defect or deviation. The basis weight of paper means the basis weight as produced by the paper machine, not including finish subsequently applied, such as coating or printing.

³ M. D. means machine direction. C. D. means cross direction.

⁴ A bleached sulphate kraft outer sheet of not less than 50 pounds basis weight is authorized providing the combined test values of all of the sheets of the bag are in conformance with paragraph (e) of this section and § 78.239-3.

ing strength for each unit of dry tensile strength test below the minimum requirement; and variation in combined dry tensile strength of not more than 4 units below the minimum requirement based on paragraphs (a) and (b) of this section will be permitted for each wall used provided the variation is compensated for by a combined tearing strength test value in excess of the minimum requirement obtained from the tables in the ratio of 5 units of combined tearing strength for each unit of dry tensile strength test below the minimum requirement. Similarly, variation in machine direction tearing strength of not more than 10 units below the minimum requirement will be permitted for each wall, provided the variation is compensated for by a cross direction dry tensile strength test value in excess of the minimum requirement obtained from the tables in the ratio of 1 unit of dry tensile strength for each 5 units of tearing strength test below the minimum requirement; and variation in combined tearing strength of not more than 20 units below the minimum requirement obtained from the tables will be permitted for each wall provided the variation is compensated for by a combined dry tensile strength test value in excess of the minimum requirement obtained from the tables in the ratio of 5 units of tearing strength for each unit of dry tensile strength below the minimum requirement.

§ 78.239-3 Construction and capacity.

(a) Bags must be at least 3 thicknesses of paper; this must be heavy duty shipping sack kraft paper conforming to the requirements of § 78.239-2 paragraphs (a) and (b), or equivalent, with a minimum total basis weight of 130 pounds of paper (500 sheets, 24" x 36"). Outer sheet must be of water-resistant stock and at least 50 pounds basis weight, inner sheets not less than 40 pounds basis weight. Bags to be of sewn and taped, cemented, taped, satchel bottom or other construction of equal efficiency to form a sift-proof and reasonably airtight container. Authorized for not over 50 pounds net weight, except that bags having a minimum total basis weight of 160 pounds of paper (500 sheets, 24" x 36") with outer sheet of water-resistant stock and at least 60 pounds basis weight inner sheets not less than 50 pounds basis weight, are authorized for not to exceed 100 pounds net weight of contents.

(b) Moistureproof barrier sheets of paper, if used, must meet the requirements of § 78.239-2 (b) and shall be considered as one thickness of paper and shall be counted as 50 pounds basis weight (500 sheets, 24" x 36").

§ 78.239-4 Adhesive.

(a) Moisture resistant adhesive must be used on all seams, joints, and bottom patch, if any.

§ 78.239-5 Closure.

(a) For all bags: Any closure for the top which is equal in efficiency to that of the bottom, is authorized.

§ 78.239-6 Tests for shipment.

(a) Bags as prepared for shipment must be able to withstand four 4-foot drops, one on each end and one each on opposite sides, without sifting or rupture.

§ 78.239-7 Marking.

(a) On each bag with letters and figures at least ½ inch high in rectangle as follows:

ICC-44E

(1) This mark shall be understood to certify bag complies with all specification requirements.

(2) Name and address of maker located just above or below the mark specified in paragraph (a) of this section; symbol (letters) authorized if registered with the Bureau of Explosives.

§ 78.240 Specification 45B; bags, cloth and paper, lined.

§ 78.240-1 Compliance.

(a) Required in all details.

§ 78.240-2 Capacity.

(a) Not over 100 pounds net.

§ 78.240-3 Assembly.

(a) Bags shall consist of cloth and paper parts all cemented together with curing rubber latex or asphalt, thus making a waterproofed bag as follows:

- (1) Inside lining sheet.
- (2) Cloth sheet.
- (3) Intermediate sheet.
- (4) Outside paper sheet.

§ 78.240-4 Inside lining sheet and intermediate sheet.

(a) Inside lining sheet and intermediate sheet must be regenerated cellulose film at least 0.0012 inch thick or polyvinyl alcohol film at least 0.001 inch thick or other material of equal thickness and equivalent efficiency.

§ 78.240-5 Cloth sheet.

(a) Cloth sheet must be burlap at least 8-ounce, 40-inch Calcutta A or B mill grade or Osnaburg cotton cloth at least 8½ ounces per square yard.

§ 78.240-6 Paper.

(a) Paper must be shipping sack Kraft, creped, at least 45 pounds per ream (500 sheets 24" x 36") before creping.

§ 78.240-7 Latex and asphalt.

(a) Latex and asphalt must be in sufficient quantity to form a secure bond between the parts of the bags.

§ 78.240-8 Seams.

(a) Seams must be dust-tight and made by cementing or by sewing and taping with impregnated cloth tape to give seam strength at least equal to that of bag material and prevent sifting.

§ 78.240-9 Test.

(a) The finished container, filled and closed as for shipment, must be capable of withstanding 2 drop tests of 6 feet on the butt and 2 drop tests of 6 feet on the side without sifting or rupture of burlap or liner.

§ 78.240-10 Marking.

(a) Marking on each container by marks at least 1 inch high as follows:

(1) ICC-45B; this mark shall be understood to certify that the container complies with all specification requirements.

(2) Name and address of maker; located above or below the mark specified in subparagraph (1) of this paragraph; symbol (letters) authorized if registered with the Bureau of Explosives.

§ 78.240-11 Closing for shipment.

(a) By sewing and taping with impregnated cloth tape to give seam strength at least equal to that of bag material and prevent sifting.

Subpart H—Specifications for Portable Tanks

§ 78.245 Specification 51; steel portable tanks.

§ 78.245-1 Requirements for design and construction.

(a) Tanks shall be of seamless or welded steel construction or combination of both and shall have in excess of 1,000 pounds water capacity. Fusion welded tanks shall be stress-relieved and radiographed to provide the highest joint efficiency provided by the Code. Tanks shall be designed and constructed in accordance with and fulfill the requirements of (1) the 1950 edition, (2) 1952 edition, (3) 1956 edition, (4) 1959 edition, or (5) 1962 edition of Section VIII of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code; no revisions except to include ASME Case Interpretations Nos. 1204-9, 1297-3, and 1298-2 and all addendas through the 1962 addenda issued July 16, 1962 (any or all of which hereinafter is referred to as "the Code"). When the above referenced ASME Case interpretations are used for the construction of tanks, the following additional requirements shall be met:

(1) Welding procedure and welder performance tests shall be made in accordance with the 1962 edition of Section IX of the ASME Boiler and Pressure Vessel Code. In addition to the essential variables enumerated in Section IX of this Code, the following shall also be considered essential variables: number of passes, thickness of plate, heat input per pass, and manufacturer of rod or flux. The number of passes, thickness of plate and heat input per pass shall not vary more than 25 percent from the procedure qualification.

(2) Impact tests shall be made on a lot basis. A lot shall be defined as 100 tons or less of the same heat, and having a thickness variation no greater than plus or minus 25 percent. The minimum impact required for full size specimens shall be 20 ft.-lbs. (or 10 ft.-lbs. for half sized specimens) at 0° F Charpy V-notch in both the longitudinal and transverse direction. If the lot test does not pass this requirement, individual plates may be accepted if they individually meet this impact test requirement.

(3) Welding procedure and welder qualification tests shall be made each

year with one copy of the reports submitted to the Bureau of Explosives.

(b) Except as noted below, all openings in the tank shall be grouped in one location, either at the top of the tank or at one end of the tank.

Exceptions: (1) The openings for liquid level gauging devices, or for safety devices, may be installed separately at the other location or in the side of the shell; (2) one plugged opening of 2-inch National Pipe Thread or less provided for maintenance purposes may be located elsewhere; (3) an opening of 3-inch National Pipe Size or less may be provided at another location, when necessary, to facilitate installation of condensing coils.

(c) On and after August 31, 1953, every uninsulated portable tank shall, unless it be covered with a jacket made of aluminum, stainless steel, or other bright nontarnishing metal, be painted all over a white, aluminum, or similar reflecting color.

§ 78.245-2 Material.

(a) All material used for the construction of the tank and appurtenances shall be suitable for use with the commodity to be transported therein.

(b) A material of thickness less than 1/16 inch shall not be used for the shells and heads.

§ 78.245-3 Design pressure.

(a) The design pressure of a tank authorized under this specification shall be not less than the vapor pressure of the commodity contained therein at 115° F., or as prescribed for a particular commodity by Part 73 of this chapter, except that in no case shall the design pressure of any container be less than 100 psig nor more than 500 psig. When corrosion factor is prescribed by these regulations, the wall thickness of the tank calculated in accordance with the "Code" (see § 78.245-1(a)) shall be increased by 20 percent, or 0.10 inch, whichever is less.

NOTE 1: The term "design pressure" as used in this specification is identical to the term "maximum allowable working pressure" as used in the "Code" (see § 78.245-1 (a)).

§ 78.245-4 Tank mountings.

(a) Tanks shall be designed and fabricated with mountings to provide a secure base in transit. "Skids" or similar devices shall be deemed to comply with this requirement.

(b) All tank mountings such as skids, fastenings, brackets, cradles, lifting lugs, etc., intended to carry loadings shall be permanently secured to tanks in accordance with the requirements of the Code under which the tanks were fabricated and shall be designed to withstand static loadings in any direction equal to twice the weight of the tank and attachments when filled with the lading using a safety factor of not less than four, based on the ultimate strength of the material to be used. The specific gravity used in determining the static loadings shall be shown on the marking required by § 78.245-6(a) and on the report required by § 78.245-7(a).

(c) Lifting lugs or hold-down lugs may be added to either the tank or tank mountings. If lifting lugs and hold-

down lugs are added directly to the tank, they shall be secured to doubling plates welded to the tank and located at points of support, except that lifting lugs or hold-down lugs with integral bases serving as doubling plates may be welded directly to the tank. Each lifting lug and hold-down lug shall be designed to withstand static loadings in any direction equal to twice the weight of the tank and attachments when filled with the lading using a safety factor of not less than four, based on the ultimate strength of the material to be used.

(d) All tank mountings shall be designed so as to prevent the concentration of excessive loads on the tank shell.

§ 78.245-5 Protection of valves and accessories.

(a) All valves, fittings, accessories, safety devices, gaging devices, and the like shall be adequately protected against mechanical damage.

(b) The protective device or housing shall comply with the requirements under which the tanks are fabricated with respect to design and construction, and shall be designed to withstand static loadings in any direction equal to twice the weight of the tank and attachments when filled with the lading using a safety factor of not less than four, based on the ultimate strength of the material to be used.

(c) Requirements concerning types of valves, retesting, and qualification of portable tanks contained in §§ 73.32 and 73.315 of this chapter must be observed.

§ 78.245-6 Name plate.

(a) In addition to the markings required by the Code (see § 78.245-1(a)) under which tanks were constructed, they shall have permanently affixed, on one of the heads of the tank, a metal plate. This plate shall be permanently affixed by means of soldering, brazing, or welding around its complete perimeter. Neither the plate itself nor the means of attachment to the tank shall be subject to destructive attack by the contents of tank. Upon such plate shall be plainly marked by stamping, embossing, or other means of forming letters into or onto the metal of the plate itself the following information in characters at least 3/8 inch high:

Manufacturer's name _____
 Serial No. _____ Owner's serial No. _____
 I.C.C. Specification No. _____
 Water capacity (pounds) _____
 Tare weight (pounds) _____
 Design pressure (psig) _____
 Design specific gravity _____
 Original test date _____
 Tank retested at _____ (psig) on _____

(b) All tank outlets and inlets, except safety relief valves, shall be marked to designate whether they communicate with vapor or liquid when the tank is filled to the maximum permitted filling density.

§ 78.245-7 Report.

(a) A copy of the manufacturer's data report required by the Code (see § 78.245-1(a)) under which the tank is fabricated shall be furnished for each new tank to the owner and the Bureau of Explosives. In addition, the manu-

facturer or owner shall register each tank with the Bureau of Explosives in the following form:

Place _____
 Date _____
 Portable tank:
 Manufactured for _____ Company
 Location _____
 Manufactured by _____ Company
 Location _____
 Consigned to _____ Company
 Location _____
 Size ____ feet outside diameter by ____ long

Marks on tank as prescribed by § 78.245-6 of this specification are as follows:

Manufacturer's name _____
 Serial No. _____ Owner's serial No. _____
 I.C.C. specification ____ Code symbol ____
 Date of manufacture _____
 Water capacity (pounds) _____
 Tare weight (pounds) _____
 Design pressure (psig) _____
 Design specific gravity _____
 It is hereby certified that this tank is in complete compliance with the requirements of ICC Specification No. 51.
 (Signed) _____
 (Manufacturer or owner)

§ 78.246 Specification 52; aluminum or magnesium portable tanks.

§ 78.246-1 Compliance.

(a) Required in all details.

§ 78.246-2 Composition and capacity.

(a) Tanks shall be constructed of aluminum base alloy at least 96 percent pure, or other aluminum base alloys of equivalent strength and physical properties, or ZE-10A magnesium alloy suitable for use with the commodity to be transported therein and having a capacity not over 500 gallons.

§ 78.246-3 Construction.

(a) Tanks shall be of all welded fabrication. Welding shall be performed in a workmanlike manner using suitable welding materials. Tanks shall be formed of material at least 0.250 inch thick; material shall comply with the requirements of § 78.246-2. Cubical containers shall have corners reinforced with suitable pads or legs efficiently welded thereto.

§ 78.246-4 Openings and closures.

(a) Tanks shall have one fill opening with properly gasketed positive type closure and may have one threaded flange opening not over 2.3 inches in diameter which must be provided with secure gasketed closure plug or a 2-inch opening which shall be closed with a gasketed quick-locking cap. Bottom discharge opening not over 3 inches in diameter authorized.

§ 78.246-5 Tank mountings.

(a) Tanks shall be designed and fabricated with mountings to provide a secure base in transit. "Skids" or similar devices shall be deemed to comply with this requirement.

(b) All tank mountings such as skids, fastenings, brackets, cradles, lifting lugs, etc., intended to carry loadings shall be permanently secured to tanks in accordance with the requirements under which the tanks are fabricated and shall be designed with a factor of safety of four, and built to withstand loadings in any

direction equal to two times the weight of the tanks and attachments when filled with water.

§ 78.246-6 Tests.

(a) Each tank shall be tested by introduction of at least 2 pounds sustained air pressure during which time all welded areas shall be examined for leakage by coating entire welded seam area with soap suds. Areas that show leakage in this test may be repaired by welding and must be retested to determine efficiency.

§ 78.246-7 Marking.

(a) Marking on each container in an unobstructed area, by embossing or die-stamping on the container, or on a metal plate securely attached by welding, in letters and figures at least $\frac{3}{8}$ inch in height, as follows:

(1) ICC-52 * * * (stars to be replaced by rated gallonage capacity). These marks shall be understood to certify that the container complies with all specification requirements.

(2) Name or symbol (letters) of maker or user assuming responsibility for compliance with specification requirements. Symbol letters must be registered with the Bureau of Explosives.

§ 78.250 Specification 55; metal-encased, lead or uranium metal-shielded, radioactive materials container.

§ 78.250-1 Compliance.

(a) Required in all details.

§ 78.250-2 Requirements for design and construction.

(a) Lead or uranium metal shield to be encased in mild steel or equally fire resistant metal of minimum wall thickness as follows:

(1) One-eighth inch ($\frac{1}{8}$ "') thick for not more than 6 inches of lead or uranium metal (see Note 1).

(2) One-fourth inch ($\frac{1}{4}$ "') thick for more than 6 inches of lead or uranium metal (see Note 1).

NOTE 1: Thickness of lead to be measured from outer edge of source cavity to nearest point on outer container wall.

(b) Lead or uranium metal shield to be completely encased so that molten lead or uranium metal will not flow away or lose its shielding efficiency if involved in a fire. The shield must be supported in the outer container in such manner that it cannot change position under any ordinary conditions. Parts of the shield must be so designed that radiation cannot be "beamed" at point where sections join (offset design required).

(c) Containers weighing more than 500 pounds must be fitted with skids or otherwise designed so that excessive weight will be prevented on small areas of car or truck floors.

(d) Containers weighing more than 500 pounds must be provided with hooks, handles, skids, or other devices to facilitate handling.

(e) Containers must be of such size and design as are necessary to reduce the radiation from the container to within the limits prescribed in § 73.393 of this chapter.

(f) Containers constructed with tubing for drainage purpose must have the opening exterior to the shipping container plugged or capped. Drain lines must be plugged or capped with a material which will have a melt-point at or below that of lead, for example, lead, hard rubber or plastic.

§ 78.250-3 Welding and brazing.

(a) When used to join parts of the container must be performed in a workmanlike manner and shall provide a joint efficiency of not less than 85 percent. The melting point of brazing material must be in excess of 1,000° F.

§ 78.250-4 Closures.

(a) Closure must be by positive fastening device capable of withstanding severe impacts without failure.

(b) Lead or uranium metal shielding forming part of closing device must be completely encased in mild steel or equally fire-resistant metal.

(c) Closure must be of off-set design where inserted into other parts of the container.

(d) A means must be provided on the closure to accommodate a seal of a type that must be destroyed if container is opened for any purpose.

§ 78.250-5 Marking.

(a) Marking on each container in an unobstructed area, by embossing or die-stamping on the container, or on a metal plate attached to the container by welding or brazing, in letters and figures at least $\frac{1}{4}$ " in height, as follows:

(1) ICC-55 * * * (stars to be replaced by the tare weight of the container (for example: ICC-55 850)). These marks shall be understood to certify that the container complies with all specification requirements.

(2) The words "RADIOACTIVE MATERIAL."

(3) Name or symbol (letters) of maker or user assuming responsibility for compliance with specification requirements; this must be recorded with the Bureau of Explosives.

§ 78.255 Specification 60; steel portable tanks.

§ 78.255-1 General requirements.

(a) Tanks shall be constructed in accordance with all requirements of section VIII of the Code for Unfired Pressure Vessels of the American Society of Mechanical Engineers, 1946, Edition, for U-201 fusion-welded unfired pressure vessels.

(b) Tanks shall be of fusion-welded construction, cylindrical in shape, with seamless heads concave to the pressure. Tank shells may be of seamless construction.

(c) Tanks, including all permanent attachments, must be stress relieved as a unit.

(d) Requirements concerning types of valves, retesting, and qualification of portable tanks contained in §§ 73.32 and 73.315 of this chapter must be observed.

§ 78.255-2 Material.

(a) Material used in the tanks shall be steel of good weldable quality in con-

formity with requirements of paragraph U-71 of the A.S.M.E. Code, 1946 Edition.

(b) The minimum thickness of metal, exclusive of lining material, for shell and heads of tanks shall be as follows:

Tank capacity:	<i>Minimum thickness (inch)</i>
Not more than 1,200 gallons-----	1/8
Over 1,200 to 1,800 gallons-----	3/16
Over 1,800 gallons-----	1/4

§ 78.255-3 Expansion domes.

(a) Expansion domes, if applied, must have a minimum capacity of one percent of the combined capacity of the tank and dome.

§ 78.255-4 Closures for manholes and domes.

(a) The manhole cover shall be designed to provide a secure closure of the manhole. All covers, not hinged to the tanks, shall be attached to the outside of the dome by at least $\frac{1}{8}$ inch chain or its equivalent. Closures shall be made tight against leakage of vapor and liquid by use of gaskets of suitable material.

§ 78.255-5 Bottom discharge outlets.

(a) Bottom discharge outlets prohibited, except on tanks used for shipments of sludge acid and alkaline corrosive liquids.

(b) If installed, bottom outlets or bottom washout chambers shall be of metal not subject to rapid deterioration by the lading, and each shall be provided with a valve or plug at its upper end and liquid-tight closure at its lower end. Every such valve or plug shall be designed to insure against unseating due to stresses or shocks incident to transportation. Bottom outlets shall be adequately protected against handling damage and outlet equipment must not extend to within less than one inch of the bottom bearing surface of the skids or tank mounting.

§ 78.255-6 Loading and unloading accessories.

(a) When installed, 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.

(b) Interior heater coils, if installed, must be of extra heavy pipe and so constructed that breaking off of exterior connections will not cause leakage of tanks.

§ 78.255-7 Protection of valves and accessories.

(a) All valves, fittings, accessories, safety devices, gauging devices, and the like shall be adequately protected against mechanical damage by a housing closed with a cover plate.

(b) Protective housing shall comply with the requirements under which the tanks are fabricated with respect to design and construction, and shall be designed with a minimum factor of safety of four to withstand loadings in any direction equal to two times the weight of the tank and attachments when filled with water.

§ 78.255-8 Safety devices.

(a) Safety devices are to be as required, subject to approval of the Bureau of Explosives, by shipping regulations.

§ 78.255-9 Compartments.

(a) When the interior of the tank is divided into compartments, each compartment shall be designed, constructed and tested as a separate tank. Thickness of shell and compartment heads shall be determined on the basis of total tank capacity.

§ 78.255-10 Lining.

(a) If a lining is required, the material used for lining the tank shall be homogeneous, nonporous, imperforate when applied, not less elastic than the metal of the tank proper. It shall be of substantially uniform thickness, not less than 1/32 inch thick if metallic, and not less than 1/16 inch thick if nonmetallic, and shall be directly bonded or attached by other equally satisfactory means. Rubber lining shall be not less than 3/16 inch thick. Joints and seams in the lining shall be made by fusing the material together or by other equally satisfactory means. The interior of the tank shall be free from scale, oxidation, moisture and all foreign matter during the lining operation.

§ 78.255-11 Tank mountings.

(a) Tanks shall be designed and fabricated with mountings to provide a secure base in transit. "Skids" or similar devices shall be deemed to comply with this requirement.

(b) All tank mountings such as skids, fastenings, brackets, cradles, lifting lugs, etc., intended to carry loadings shall be permanently secured to tanks in accordance with the requirements under which the tanks are fabricated, and shall be designed with a factor of safety of four, and built to withstand loadings in any direction equal to two times the weight of the tanks and attachments when filled to the maximum permissible loaded weight.

(c) Lifting lugs or side hold-down lugs shall be provided on the tank mountings in a manner suitable for attaching lifting gear and hold-down devices. Lifting lugs and hold-down lugs welded directly to the tank shall be of the pad-eye type. Doubling plates welded to the tank and located at the points of support shall be deemed to comply with this requirement.

(d) All tank mountings shall be so designed as to prevent the concentration of excessive loads on the tank shell.

§ 78.255-12 Pressure test.

(a) Each completed portable tank prior to application of lining shall be tested before being put into transportation service by completely filling the tank with water or other liquid having a similar viscosity, the temperature of which shall not exceed 100° F. during the test, and applying a pressure of 60 pounds per square inch gauge. The tank shall be capable of holding the prescribed pressure for at least 10 minutes without leakage, evidence of impending failure, or failure. All closures shall be in place while the test is made and the pressure

shall be gauged at the top of the tank. Safety devices and/or vents shall be plugged during this test.

§ 78.255-13 Repair of tanks.

(a) Tanks failing to meet the test may be repaired and retested, provided that repairs are made in complete compliance with the requirements of this specification.

§ 78.255-14 Marking.

(a) In addition to marking required by the American Society of Mechanical Engineers Code, every tank shall bear permanent marks at least 3/8 inch high stamped into the metal near the center of one of the tank heads or stamped into a plate permanently attached to the tank by means of brazing or welding or other suitable means as follows:

Manufacturer's name ----- Serial No. -----
 ICC specification -----
 Nominal capacity ----- (gallons)
 Tare weight ----- (pounds)
 Date of manufacture -----

§ 78.255-15 Report.

(a) A copy of the manufacturer's data report required by the "Code" (see § 78.255-1(a)) under which the tank is fabricated shall be furnished for each new tank to the owner and the Bureau of Explosives. In addition, the manufacturer or owner shall register each tank with the Bureau of Explosives in the following form:

Place -----
 Date -----
 Portable tank
 Manufactured for ----- Company
 Location -----
 Manufactured by ----- Company
 Location -----
 Consigned to ----- Company
 Location -----
 Size ----- feet outside diameter by -----
 long.
 Marks on tank as prescribed by § 78.255-14 of this specification are as follows:
 Manufacturer's name -----
 Serial number -----
 Owner's serial number -----
 ICC specification -----
 ASME Code Symbol (par U-201) -----
 Date of manufacture -----
 Nominal capacity ----- Gallons
 It is hereby certified that this tank is in complete compliance with the requirements of ICC Specification No. 60.
 (Signed) -----
 Manufacturer or owner

Subpart I—[Reserved]

Subpart J—Specifications for Containers for Motor Vehicle Transportation

§ 78.315 Specification MC 200; containers for liquid nitroglycerin, desensitized liquid nitroglycerin or diethylene glycol dinitrate.

§ 78.315-1 Motor vehicle body.

(a) Every motor vehicle used for the transportation of liquid nitroglycerin, desensitized liquid nitroglycerin or diethylene glycol dinitrate, other than desensitized liquid explosives, as defined in § 73.53(e) of this chapter, shall have a body constructed as set forth below, which body shall have component parts as specified hereinafter.

§ 78.315-2 Body proper.

(a) The motor-vehicle body proper shall have a hinged cover. Both the body and the cover shall be well and strongly built of wood or other non-sparking material of equal strength, thoroughly waterproofed, having no end or side openings, and lined with copper or other nonsparking sheet metal having all seams made tight against leakage of nitroglycerin, desensitized liquid nitroglycerin or diethylene glycol dinitrate by welding, brazing, or soldering. No metal of such character as to be capable of producing a spark when struck may be exposed on the inside or the top of the body, nor on the nether side or any edge of the cover, the top of which shall be covered with metal. The body shall be of such dimensions that it will contain only a single tier of individual containers and of such approximate height that the felt pads will securely constrain all inside containers from vertical motion with respect to the body, and shall be securely and firmly attached to the chassis of the motor vehicle. The total load shall not exceed nine hundred (900) quarts liquid measure of liquid nitroglycerin, desensitized liquid nitroglycerin or diethylene glycol dinitrate.

§ 78.315-3 Cellular construction.

(a) In the motor-vehicle body specified in § 78.315-2 shall be inserted suitable wooden or other nonmetallic, nonsparking cellular construction, the dimensions of each cell of which shall be such that the rubber "boot" or secondary container for the primary container of the nitroglycerin, desensitized liquid nitroglycerin or diethylene glycol dinitrate, both of which are specified hereinafter, shall snugly fit. The cellular construction shall extend from near the top to near the bottom of the full height of each "boot" to be fitted therein, and shall rest upon and be covered by at least one-half (1/2) inch of felt padding or other material affording equivalent shock-absorbing protection. The cellular construction shall be of such strength as to provide suitable restraint under all conditions of loading to prevent relative motion of inside containers to be inserted or carried therein.

§ 78.315-4 Inside containers and boots.

(a) Inside containers. Individual containers shall be made of copper or other nonsparking metal of equivalent strength, with all seams closed by welding, brazing or soldering, and shall be tight against leakage of liquid nitroglycerin, desensitized liquid nitroglycerin or diethylene glycol dinitrate. No individual container shall exceed ten (10) quarts (liquid measure) capacity of liquid nitroglycerin, desensitized liquid nitroglycerin or diethylene glycol dinitrate.

(b) Boots, rubber containers for individual containers. Each individual container of liquid nitroglycerin, desensitized liquid nitroglycerin or diethylene glycol dinitrate shall be contained in a rubber boot or outer container into which it shall snugly fit, and which, in turn, shall snugly fit into any cell of the cellu-

lar construction specified in § 78.315-3. This boot shall be watertight throughout and at least of such volume as to contain all of the liquid content of liquid nitroglycerin, desensitized liquid nitroglycerin or diethylene glycol dinitrate of any inside container inserted in it. It shall be provided with V-shaped grooves at suitable spacings throughout its inside surface, extending from top to bottom in such manner as to prevent the entrapment of air therein upon insertion of the inside container of liquid nitroglycerin, desensitized liquid nitroglycerin or diethylene glycol dinitrate. The inside height of the rubber boot shall approximate the height of the inside container (including stopper) as shipped.

§ 78.318 Specification MC 201; container for blasting caps, electric blasting caps and percussion caps.

§ 78.318-1 Scope.

(a) This specification pertains to a container to be used for the transportation of blasting caps, electric blasting caps, and percussion caps in connection with the transportation of liquid nitroglycerin, desensitized liquid nitroglycerin or diethylene glycol dinitrate, where any or all of such types of caps may be used for the detonation of liquid nitroglycerin, desensitized liquid nitroglycerin or diethylene glycol dinitrate in blasting operations. This specification is not intended to take the place of any shipping or packing requirements of this Commission where the caps in question are themselves articles of commerce.

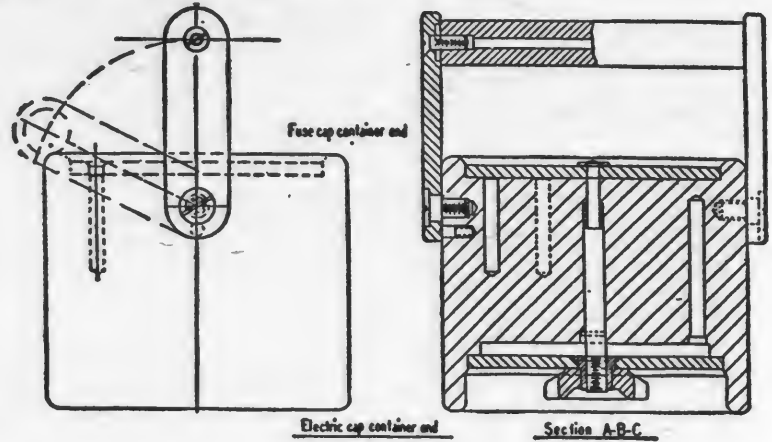
§ 78.318-2 Container.

(a) Every container for blasting caps, electric blasting caps, and percussion caps coming within the scope of this specification shall be constructed entirely of hard rubber, phenolresinous or other resinous material, or other nonmetallic, nonsparking material, except that metal parts may be used in such locations as not in any event to come in contact with any of the caps. Space shall be provided so that each blasting cap of whatever nature may be inserted in an individual cell in the body of the container, into which each such cap shall snugly fit. There shall be provided no more than twenty (20) such cellular spaces. Space may be provided into which a plurality of percussion caps may be carried, provided that such space may be closed with a screw cap, and further provided that each or any such space is entirely separate from any space provided for any blasting cap. Each cellular space into which a blasting cap is to be inserted and carried shall be capable of being covered by a rotary cover so arranged as to expose not more than one cell at any time, and capable of rotation to such a place that all cells will be covered at the same time, at which place means shall be provided to lock the cover in place. Means shall be provided to lock in place the cover for the cells provided for the carrying of electric blasting caps. The requirement that not more than one cell be exposed at one time need not apply in the case of elec-

tric blasting caps, although spaces for such caps and blasting caps shall be separate. Sufficient annular space shall be provided inside the cover for such electric blasting caps that, when the cover is closed, there will be sufficient space to accommodate the wires customarily attached to such caps. If the material is of such a nature as to require treatment to prevent the absorption of moisture, such treatment shall be applied as shall be necessary in order to provide against

the penetration of water by permeation. A suitable carrying handle shall be provided, except for which handle no part of the container may project beyond the exterior of the body.

(b) Exhibited in plates I and II are line drawings of a container for blasting caps, electric blasting caps, and percussion caps, illustrative of the requirements set forth in § 78.318-2 (a). These plates shall not be construed as a part of this specification.



BLASTING CAP CONTAINER
PLATE I

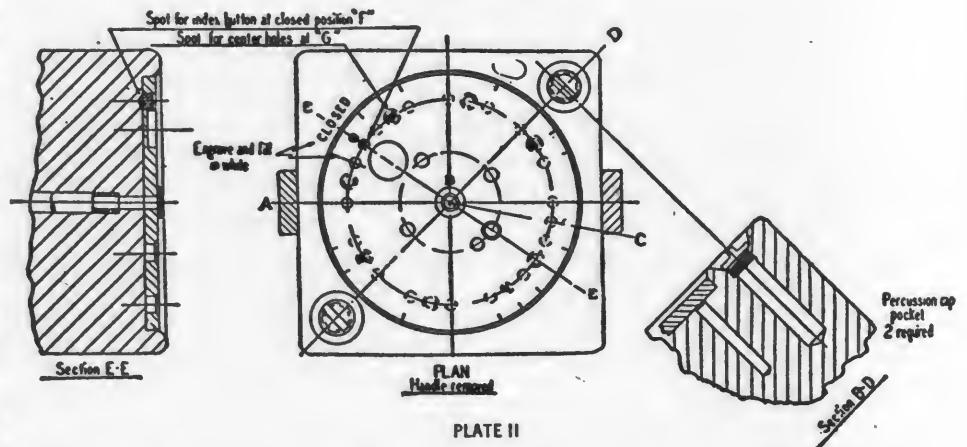


PLATE II

§ 78.321 Specification MC 300;¹ cargo tanks constructed of mild (open hearth or blue annealed) steel, or combination of mild steel with high-tensile steel, or stainless steel, primarily for the transportation of flammable liquids, or poisonous liquids, class B.

§ 78.321-1 General requirements.

(a) Every cargo tank shall be constructed in accordance with the best

¹ Existing tank motor vehicles continuing in service.

(a) Specification cargo tanks of tank motor vehicles. Cargo tanks of tank motor vehicles used for the transportation of flammable liquids or poisonous liquids, class B, which shall have been in service prior to June 15, 1940, may be continued in service provided that they have been designed and constructed in accordance with requirements of Specification No. 1001, 1937 edition, of the American Petroleum Institute, or in accord-

known and available practices, in addition to the other requirements of this specification.

ance with the requirements of specifications of the National Fire Protection Association, 1929 or 1933 editions.

(b) Existing nonspecification cargo tanks of tank motor vehicles. Cargo tanks of tank motor vehicles used for the transportation of flammable liquids or poisonous liquids, class B, not meeting the requirements set forth in paragraph (a) of this footnote, which shall have been in service prior to June 15, 1940, may be continued in service, provided that they fulfill the requirements set forth under §§ 77.824(a) and 77.854(h) of this chapter, and that they be provided with the accessories as specified in §§ 78.321-5(a), 78.321-8, and 78.321-9 through 78.321-12.

(c) On the required metal identification plate substitute "API Spec 1001, 1937," or "NFPA Spec 1929 (or 1933)" or "NO SPECIFICATION" in place of the specification number shown in the appropriate specification.

§ 78.321-2 Material.

(a) *Properties of mild steel sheets.* All mild steel sheets shall be of open hearth steel or blue annealed steel meeting the following minimum requirements:

Yield point, minimum----- 25,000 psi.
 Ultimate strength, minimum---- 45,000 psi.
 Minimum elongation, standard 20 percent.
 2-inch sample.

(b) *Properties of high-tensile steel sheets.* All high-tensile steel sheets for such cargo tanks shall meet the following minimum requirements:

Yield point, minimum----- 45,000 psi.
 Ultimate strength, minimum---- 60,000 psi.
 Minimum elongation, standard 25 percent.
 2-inch sample.

(c) *Properties of stainless steel sheets.* All stainless steel sheets shall meet the following minimum requirements:

Yield point, minimum----- 32,000 psi.
 Ultimate strength, minimum---- 75,000 psi.
 Minimum elongation, standard 20 percent.
 2-inch sample.

(d) *Cargo tanks constructed of a combination of mild and high-tensile steels or stainless steel.* Mild steel sheets as specified in § 78.321-3(a) may be used in combination with high-tensile steel sheets or stainless steel sheets as specified in § 78.321-3(b) in the construction of a single tank, provided each material, where used, shall comply with the minimum requirements for the material used in the construction for 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 on condition that the stainless steel electrodes or filler rods used in the welding be suitable for use with the grade of stainless steel concerned, according to the recommendations of the manufacturers of the stainless steel electrodes or filler rods.

§ 78.321-3 Thickness.

(a) *Thickness of mild steel sheets.* The minimum thickness of mild steel tank sheets shall be limited by the volume capacity of the tank expressed in terms of gallons per inch of length; and by the distance between bulkheads, baffles or other shell stiffeners, as well as by the radius of shell curvature in the case of shell sheets; as specified in Table I and Table II:

TABLE I—MINIMUM THICKNESS OF HEADS,¹ BULKHEADS, BAFFLES (DISHED, CORRUGATED, REINFORCED OR ROLLED) AND RING STIFFENERS

Volume capacity of tank in gallons per inch of length	10 or less	Over 10 to 14	Over 14 to 18	Over 18
United States Standard gauge number.....	14	13	12	11

¹ Thickness of exterior head sheets shall never be less than the minimum requirements for shell sheets in any specific unit.

TABLE II—MINIMUM THICKNESS OF SHELL SHEETS EXPRESSED IN UNITED STATES STANDARD GAUGE

Distance between attachments of bulkheads, baffles or other shell stiffeners	Volume capacity of tank in gallons per inch of length			
	10 or less	Over 10 to 14	Over 14 to 18	Over 18
Maximum shell radius of less than 70 inches ¹				
36 inches or less.....	14	14	14	13
Over 36 inches to 54 inches.....	14	14	13	12
Over 54 inches to 60 inches.....	14	13	12	11
Maximum shell radius of 70 inches or more, but less than 90 inches ¹				
36 inches or less.....	14	14	13	12
Over 36 inches to 54 inches.....	14	13	12	11
Over 54 inches to 60 inches.....	13	12	11	10
Maximum shell radius of 90 inches or more, but less than 125 inches ¹				
36 inches or less.....	14	13	12	11
Over 36 inches to 54 inches.....	13	12	11	10
Over 54 inches to 60 inches.....	12	11	10	9
Shell radius of 125 inches or more ¹				
36 inches or less.....	13	12	11	10
Over 36 inches to 54 inches.....	12	11	10	9
Over 54 inches to 60 inches.....	11	10	9	8

¹ If other than circular cross-section, the radius used shall be the maximum for that portion of the cross-section under consideration.

(b) *Thickness of high-tensile and stainless steel sheets.* The minimum thickness of high-tensile and stainless steel tank sheets shall be limited by the volume capacity of the tank expressed in terms of gallons per inch of length; and by the distance between bulkheads, baffles or other shell stiffeners, as well as by the radius of shell curvature in the case of shell sheets; as specified in Table III and Table IV:

TABLE III—MINIMUM THICKNESS OF HEADS,¹ BULKHEADS, BAFFLES (DISHED, CORRUGATED, REINFORCED OR ROLLED) AND RING STIFFENERS

Volume capacity of tank in gallons per inch of length	10 or less	Over 10 to 14	Over 14 to 18	Over 18
United States Standard gauge number.....	15	14	13	12

¹ Thickness of exterior head sheets shall never be less than the minimum requirements for shell sheets in any specific unit.

TABLE IV—MINIMUM THICKNESS OF SHELL SHEETS EXPRESSED IN UNITED STATES STANDARD GAUGE

Distance between attachments of bulkheads, baffles or other shell stiffeners	Volume capacity of tank in gallons per inch of length			
	10 or less	Over 10 to 14	Over 14 to 18	Over 18
Maximum shell radius of less than 70 inches¹				
36 inches or less.....	16	16	15	14
Over 36 inches to 54 inches.....	16	15	14	13
Over 54 inches to 60 inches.....	15	14	13	12
Maximum shell radius of 70 inches or more, but less than 90 inches¹				
36 inches or less.....	16	15	14	13
Over 36 inches to 54 inches.....	15	14	13	12
Over 54 inches to 60 inches.....	14	13	12	11
Maximum shell radius of 90 inches or more, but less than 125 inches¹				
36 inches or less.....	15	14	13	12
Over 36 inches to 54 inches.....	14	13	12	11
Over 54 inches to 60 inches.....	13	12	11	10
Shell radius of 125 inches or more¹				
36 inches or less.....	14	13	12	11
Over 36 inches to 54 inches.....	13	12	11	10
Over 54 inches to 60 inches.....	12	11	10	9

¹ If other than circular cross-section, the radius used shall be the maximum for that portion of the cross-section under consideration.

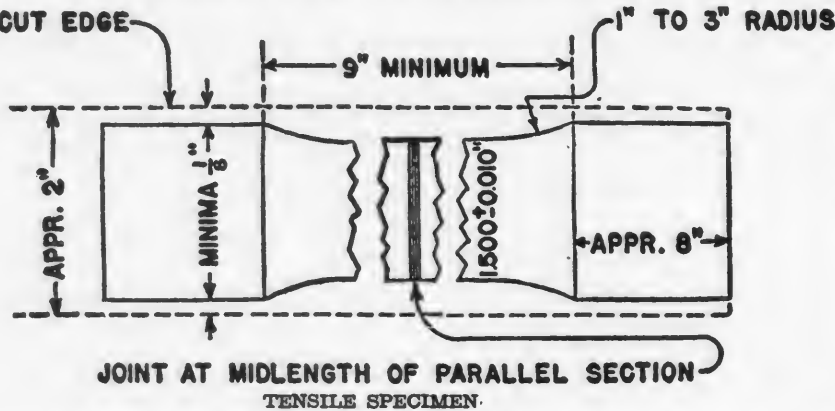
§ 78.321-4 Joints.

(a) *Method of joining.* Mild steel tank sheets, high-tensile steel tank sheets, or combination thereof and stainless steel tank sheets shall be joined by fusion welding.

(b) *Strength of joints.* The tensile strength of each joint in a tank made of steel other than stainless steel shall

be not less than 85 percent of that of the adjacent metal in the tank. The tensile strength of each joint in a stainless steel tank shall be not less than 60,000 psi. Compliance with either requirement 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

FLAME-CUT EDGE



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 6 months after the tests on such samples have been completed.

§ 78.321-5 Bulkheads, baffles, and ring stiffeners.

(a) *When bulkheads not required.* No bulkheads shall be required in any cargo tank, regardless of capacity, which is used in a service in which the entire tank is never loaded less than 80 percent full or in which no compartment of the tank

is ever loaded less than 80 percent full, provided that the entire contents of the tank or of one or more compartments of the tank is discharged at each unloading point.

(b) *Number, dimensions and capacities of bulkheads, baffles, and ring stiffeners.* Except as provided in paragraph (a) of this section, every cargo tank shall be divided into compartments and/or provided with baffles or ring stiffeners as follows:

(1) Every cargo tank having a total capacity in excess of 3,000 gallons shall be divided by bulkheads into compartments, none of which shall exceed 2,500 gallons.

(2) Every cargo tank, and every compartment of a cargo tank over 90 inches in length, shall be provided with baffles or ring stiffeners, the number of which shall be such that the linear distance between any two adjacent baffles or ring stiffeners, or between any tank head or bulkhead and the baffle or ring stiffener nearest it, shall in no case exceed 60 inches.

(3) Each bulkhead required by this paragraph shall have adequate strength to sustain without undue stress or any permanent set a horizontal force equal to the weight of so much of the contents of the tank as may come between it and any adjacent bulkhead or tank head, applied as a uniformly distributed load on the surface of the bulkhead or tank head. Flat bulkheads without reinforcement shall not be permitted.

(4) Each baffle required by this paragraph shall have at least an area as great as 80 percent of the cross-sectional area of the tank.

(5) If spaces are provided between compartments, such spaces shall be arranged for venting and for complete drainage at all times.

(6) Ring stiffeners shall be continuous around the circumference of the tank shell, and shall have at least the section modulus required by the following table:

MINIMUM SECTION MODULUS REQUIRED FOR STEEL RING STIFFENERS

Width of tank	Section modulus
42 inches or less.....	¹ 0.0104L
Over 42 inches to 60 inches.....	¹ 0.0162L
Over 60 inches to 96 inches.....	¹ 0.0234L

¹ L is the maximum distance from midpoint of unsupported shell on one side of ring stiffener to the midpoint of unsupported shell on the opposite side of the ring stiffener. See § 78.321-3 for minimum thickness of ring stiffeners.

(1) If a ring stiffener is welded to the shell, a portion of the shell may, for purposes of computing the section modulus, be considered as a part of the ring section. If welded at one side of the ring stiffener only, such portion shall not exceed 20 times the shell thickness adjacent to the weld. If welded at both sides of the ring stiffener, such portion shall not exceed 40 times the shell thickness adjacent to the weld, or the width of the ring stiffener between welds plus 20 times the shell thickness adjacent to the welds, whichever is less.

§ 78.321-6 Closures for manholes.

(a) No applicable provision.

§ 78.321-7 Overturn protection.

(a) All closures for filling openings shall be protected from damage in the event of overturning of the motor vehicle by being enclosed within the body of the tank or a dome attached thereto, or by the use of suitable metal guards securely attached to the tank or the frame of the motor vehicle.

§ 78.321-8 Outlets.

(a) Outlet fixtures shall be substantially made and attached to the tank in such a manner as to prevent breakage at the outlet point.

§ 78.321-9 Vents, valves and connections.

(a) *Tank vents.* Each cargo tank or tank compartment shall be provided with a vacuum and pressure operated vent with a minimum effective opening of 0.44 square inch, and shall also be provided with an emergency venting facility so constructed as to provide a minimum free-venting opening having a net area in square inches equal to 1.25 plus 0.0025 times the capacity of the tank or compartment in gallons. If the emergency venting facility operates in response to elevated temperatures, the critical temperature for such operation shall not exceed 200° F.

(b) *Valve and faucet connections.* All draw-off valves or faucets of tanks and compartments shall have discharge ends threaded, or be otherwise so designed as to insure in every instance a tight connection with the hose extending to the storage fill pipe.

§ 78.321-10 Protection of fittings.

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

§ 78.321-11 Emergency discharge control.

(a) Each cargo tank or tank compartment of a bottom-discharge tank shall be equipped with a reliable and effective shut-off valve located inside the shell of the tank or tank compartment in the tank or compartment outlet; and the operating mechanism for such valve or valves shall be provided with a secondary closing mechanism remote from tank filling openings and discharge faucets, for operation in the event of fire or other accident. Such control mechanism shall be provided with a fusible section which will cause the valve to close automatically in case of fire, and the critical temperature for the fusing of such section shall not exceed 200° F.

§ 78.321-12 Shear section.

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

§ 78.321-13 Anchoring of tank.

(a) No applicable provision.

§ 78.321-14 Gauging devices.

(a) No applicable provision.

§ 78.321-15 Pumps.

(a) No applicable provision.

§ 78.321-16 Method of test.

(a) *Test for leaks.* Every cargo tank shall be tested by a minimum air or hydrostatic pressure of 3 psig. 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 maintained 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 to which this specification applies 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 returned to service unless a suitable repair is made. The suitability of the repair shall be determined by the same method of test.

(c) *Retest requirements.* See § 77.824 (a) of this chapter.

§ 78.321-17 Marking of cargo tanks.

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

Carrier's Serial Number ¹
 Manufacturer's Name ²
 Date of Manufacture ²
 ICC MC 300 ²
 Nominal Tank Capacity ----- U.S. Gallons

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

² In the event the identity of the tank manufacturer or the date of manufacture is

not known and cannot be ascertained, the spaces indicated shall be marked "MAKE UNKNOWN" and/or "DATE OF MANUFACTURE UNKNOWN."

³ Cargo tanks manufactured of mild steel shall be marked MC 300MS and cargo tanks manufactured of mild steel in combination with high-tensile steel shall be marked MC 300MSHTS.

(b) *Test date markings.* The date of the last test shall be painted on the tank in letters not less than 1¼ inches high, in legible colors, immediately below the metal identification plate specified in paragraph (a) of this section.

(c) *Additional markings.* In addition to the above markings, cargo tanks must be marked as required by § 77.823 of this chapter.

§ 78.321-18 Certification.

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

§ 78.323 Specification MC 302; ¹ cargo tanks constructed of welded aluminum alloy (ASTM B209-57T), primarily for the transportation of flammable liquids, or poisonous liquids, class B.

§ 78.323-1 General requirements.

(a) Every cargo tank shall be constructed in accordance with the best known and available practices, in addition to the following:

¹ Existing tank motor vehicles continuing in service.

(a) *Specification cargo tanks of tank motor vehicles.* Cargo tanks of tank motor vehicles used for the transportation of flammable liquids or poisonous liquids, class B, which shall have been in service prior to June 15, 1940, may be continued in service provided that they have been designed and constructed in accordance with the requirements of Specification No. 1001, 1937 edition of the American Petroleum Institute, or in accordance with the requirements of specifications of the National Fire Protection Association, 1929 or 1933 editions.

(b) *Existing nonspecification cargo tanks of tank motor vehicles.* Cargo tanks of tank motor vehicles used for the transportation of flammable liquids or poisonous liquids, class B, not meeting the requirements set forth in paragraph (a) of this footnote, which shall have been in service prior to June 15, 1940, may be continued in service, provided that they fulfill the requirements set forth under §§ 77.824(a) and 77.854(h) of this chapter, and that they be provided with the accessories as specified in §§ 78.323-5 (a), 78.323-8, and 78.323-9 through 78.323-12.

(c) On the required metal identification plate substitute "API Spec 1001, 1937," or "NFPA Spec 1929 (or 1933)" or "NO SPECIFICATION" in place of the specification number shown in the appropriate specification.

tion to the other requirements of this specification.

§ 78.323-2 Material.

(a) All sheets for such cargo tanks shall be of aluminum alloys GR20A (5052 commercial designation), GR40A (5154 commercial designation), GM40A (5088 commercial designation), or GM31A (5454 commercial designation) conforming to American Society for Testing Materials Specification B209-57T (as revised to include 5454),

and have the following minimum requirements:

Yield strength.....	26,000 psi.
Ultimate strength.....	34,000 psi.
Elongation, 2-inch sample.....	12 percent

NOTE 1: Yield strength is the stress which produces a permanent set of 0.2 percent of the initial gauge length (ASTM E8-36).

§ 78.323-3 Thickness of metal.

(a) The minimum thickness of tank sheets and ring stiffeners shall be as follows:

Aggregate capacity, United States gallons	Shell		Head, dished, corrugated or reinforced, and ring stiffener	
	United States gauge No.	Inch ¹	United States gauge No.	Inch ¹
600 or less.....	14	0.078	14	0.078
Over 600 to 1,200.....	12	.109	12	.109
Over 1,200:				
(a) Divided into compartments of 600 gallons or less.....	12	.109	10	.141
(b) If not divided into compartments or if divided into compartments of 1,200 or more.....	10	.141	8	.172

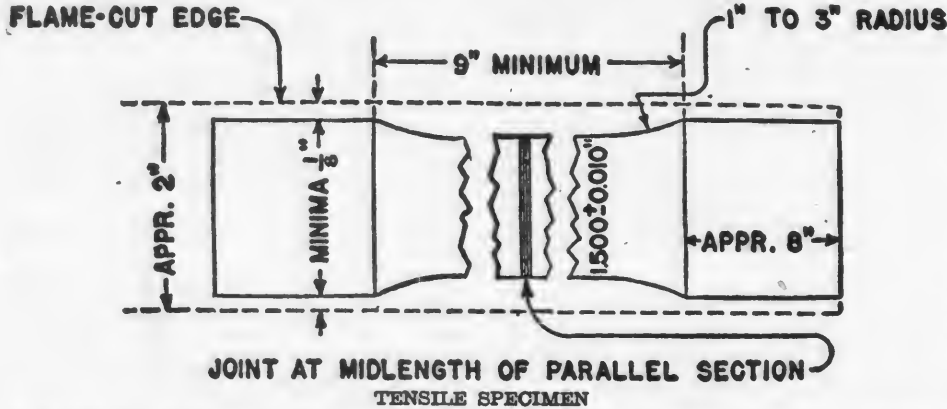
¹ Approximate.

NOTE 1: Flat heads without reinforcement no longer permitted.

§ 78.323-4 Joints.

(a) Sheets shall be joined by fusion welding. The tensile strength of each joint in a tank shall be not less than 15,000 psi. Compliance with this requirement 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 6 months after the tests on such samples have been completed.



§ 78.323-5 Bulkheads, baffles, and ring stiffeners.

(a) When bulkheads not required. No bulkheads shall be required in any cargo tank, regardless of capacity, which is used in a service in which the entire tank is never loaded less than 80 percent full or in which no compartment of the tank is ever loaded less than 80 percent full, provided that the entire contents of the tank or of one or more compartments of the tank is discharged at each unloading point.

(b) Number, dimensions and capacities of bulkheads, baffles, and ring stiffeners. Except as provided in paragraph (a) of this section, every cargo tank shall be divided into compartments and/or provided with baffles or ring stiffeners as follows:

(1) Every cargo tank having a total capacity in excess of 3,000 gallons shall

be divided by bulkheads into compartments, none of which shall exceed 2,500 gallons.

(2) Every cargo tank, and every compartment of a cargo tank over 90 inches in length, shall be provided with baffles or ring stiffeners, the number of which shall be such that the linear distance between any two adjacent baffles or ring stiffeners, or between any tank head or bulkhead and the baffle or ring stiffener nearest it, shall in no case exceed 60 inches.

(3) Each bulkhead required by this paragraph shall have adequate strength to sustain without undue stress or any permanent set a horizontal force equal to the weight of so much of the contents of the tank as may come between it and any adjacent bulkhead or tank head, applied as a uniformly distributed load on the surface of the bulkhead or tank head.

Flat bulkheads without reinforcement shall not be permitted.

(4) Each baffle required by this paragraph shall have at least an area as great as 80 percent of the cross-sectional area of the tank.

(5) If spaces are provided between compartments, such spaces shall be arranged for venting and for complete drainage at all times.

(6) Ring stiffeners shall be continuous around the circumference of the tank shell, and shall have at least the section modulus required by the following table:

MINIMUM SECTION MODULUS REQUIRED FOR ALUMINUM RING STIFFENERS

Width of tank	Section modulus
42 inches or less.....	¹ 0.0180L
Over 42 inches to 60 inches.....	1.0280L
Over 60 inches to 96 inches.....	1.0400L

¹ L is the maximum distance from midpoint of unsupported shell on one side of ring stiffener to the midpoint of unsupported shell on the opposite side of the ring stiffener. See § 78.323-3 for minimum thickness of ring stiffeners.

(1) If a ring stiffener is welded to the shell, a portion of the shell may, for purposes of computing the section modulus, be considered as a part of the ring section. If welded at one side of the ring stiffener only, such portion shall not exceed 20 times the shell thickness adjacent to the weld. If welded at both sides of the ring stiffener, such portion shall not exceed 40 times the shell thickness adjacent to the weld, or the width of the ring stiffener between welds plus 20 times the shell thickness adjacent to the welds, whichever is less.

§ 78.323-6 Closures for manholes.

(a) No applicable provision.

§ 78.323-7 Overturn protection.

(a) All closures for filling openings shall be protected from damage in the event of overturning of the motor vehicle by being enclosed within the body of the tank or a dome attached thereto or by the use of suitable metal guards securely attached to the tank or the frame of the motor vehicle.

§ 78.323-8 Tank outlets.

(a) Outlet fixtures shall be substantially made and attached to the tank in such a manner as to prevent breakage at the outlet point.

§ 78.323-9 Vents, valves and connections.

(a) Tank vents. Each cargo tank or tank compartment shall be provided with a vacuum and pressure operated vent with a minimum effective opening of 0.44 square inch, and shall also be provided with an emergency venting facility so constructed as to provide a minimum free-venting opening having a net area in square inches equal to 1.25 plus 0.0025 times the capacity of the tank or compartment in gallons. If the emergency venting facility operates in response to elevated temperatures, the critical temperature for such operation shall not exceed 200° F.

(b) Valve and faucet connections. All draw-off valves or faucets of tanks and compartments shall have discharge ends

threaded, or be otherwise so designed as to insure in every instance a tight connection with the hose extending to the storage fill pipe.

§ 78.323-10 Protection of fittings.

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

§ 78.323-11 Emergency discharge control.

(a) Each cargo tank or tank compartment of a bottom-discharge tank shall be equipped with a reliable and effective shut-off valve located inside the shell of the tank or tank compartment in the tank or compartment outlet; and the operating mechanism for such valve or valves shall be provided with a secondary closing mechanism remote from tank filling openings and discharge faucets, for operation in the event of fire or other accident. Such control mechanism shall be provided with a fusible section which will cause the valve to close automatically in case of fire, and the critical temperature for the fusing of such section shall not exceed 200° F.

§ 78.323-12 Shear section.

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

§ 78.323-13 Anchoring of tank.

(a) No applicable provision.

§ 78.323-14 Gauging devices.

(a) No applicable provision.

§ 78.323-15 Pumps.

(a) No applicable provision.

§ 78.323-16 Method of test.

(a) *Test for leaks.* Every cargo tank shall be tested by a minimum air or hydrostatic pressure of 3 psig. 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 maintained 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 inopera-

tive; 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 to which this specification applies 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 returned to service unless a suitable repair is made. The suitability of the repair shall be determined by the same method of test.

(c) *Retest requirements.* See § 77.824 (a) of this chapter.

§ 78.323-17 Marking of cargo tanks.

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

Carrier's Serial Number ¹

Manufacturer's Name ²

Date of Manufacture ³

ICC MC 302

Nominal Tank Capacity ----- U.S. Gallons

(b) *Test date markings.* The date of the last test shall be painted on the tank in letters not less than 1¼ inches high, in legible colors, immediately below the metal identification plate specified in paragraph (a) of this section.

(c) *Additional markings.* In addition to the above markings, cargo tanks must be marked as required by § 77.823 of this chapter.

§ 78.323-18 Certification.

(a) A certificate from the manufacturer of the cargo tank, or from a competent testing agency, certifying that each such cargo tank is designed and constructed in accordance with the requirements of the specification shall be procured, and such certificate shall be retained in the files of the carrier during

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

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

the time that such cargo tank is employed by him. In lieu of this certificate, if the motor carrier himself elects to ascertain if any such tank fulfills the requirements of the specification by his own test, he shall similarly retain the test data.

§ 78.324 Specification MC 303;¹ cargo tanks constructed of welded ferrous alloy (high-tensile steel) or stainless steel, primarily for the transportation of flammable liquids, or poisonous liquids, class B.

§ 78.324-1 General requirements.

(a) Every cargo tank shall be constructed in accordance with the best known and available practices, in addition to the other requirements of this specification.

§ 78.324-2 Material.

(a) *Properties of high-tensile steel sheets.* All high-tensile steel sheets for such cargo tanks shall be of ferrous alloy; commonly known as high-tensile steel, meeting the following minimum requirements:

Yield point.....	45,000 psi.
Ultimate strength.....	60,000 psi.
Elongation, 2-inch sample.....	25 percent.

(b) *Properties of stainless steel sheets.* All stainless steel sheets for such cargo tanks shall meet the following minimum requirements:

Yield point.....	32,000 psi.
Ultimate strength.....	75,000 psi.
Elongation, 2-inch sample.....	20 percent.

§ 78.324-3 Thickness of metal.

(a) The minimum thicknesses of tank sheets and ring stiffeners shall be limited by the volume capacity of the tank, expressed in terms of gallons per inch of length; by the distance between successive bulkheads in the case of bulkhead sheets; and by the distance between bulkheads, baffles, or other shell stiffeners as well as by the radius of shell curvature in the case of shell sheets as follows:

¹ Existing tank motor vehicles continuing in service.

(a) *Specification cargo tanks of tank motor vehicles.* Cargo tanks of tank motor vehicles used for the transportation of flammable liquids or poisonous liquids, class B, which shall have been in service prior to June 15, 1940, may be continued in service provided that they have been designed and constructed in accordance with the requirements of Specification No. 1001, 1937 edition, of the American Petroleum Institute, or in accordance with the requirements of specifications of the National Fire Protection Association, 1929 or 1933 editions.

(b) *Existing nonspecification cargo tanks of tank motor vehicles.* Cargo tanks of tank motor vehicles used for the transportation of flammable liquids or poisonous liquids, class B, not meeting the requirements set forth in paragraph (a) of this footnote, which shall have been in service prior to June 15, 1940, may be continued in service, provided that they fulfill the requirements set forth under §§ 77.824(a) and 77.854(h) of this chapter, and that they be provided with the accessories as specified in §§ 78.324-5, 78.324-8(a) and 78.324-9 through 78.324-12.

(c) On the required metal identification plate substitute "API Spec 1001, 1937," or "NFPA Spec 1929 (or 1933)" or "NO SPECIFICATION" in place of the specification number shown in the appropriate specification.

TABLE I—MINIMUM THICKNESS OF HEAD, BULKHEAD, Baffle SHEETS AND RING STIFFENERS

Distance between bulkhead attachments to shell in inches	Volume capacity of tank in gallons per inch of length			
	6 or less	Over 6 to 10	Over 10 to 14	Over 14 to 18
20 inches or less	17 0.086	16 0.062	15 0.070	14 0.078
Over 20 inches to 36 inches	18 0.050	17 0.056	16 0.062	15 0.068
Over 36 inches to 56 inches	17 0.056	16 0.062	15 0.070	14 0.078
Over 56 inches	16 0.062	15 0.070	14 0.078	13 0.086

NOTE 1: Flat heads without reinforcement no longer permitted.

TABLE II—THICKNESS OF SHELL SHEETS

Distance between bulkheads, baffles, or other shell stiffeners	Volume capacity of tank in gallons per inch of length			
	6 or less	Over 6 to 10	Over 10 to 14	Over 14 to 18
20 inches or less	17 0.086	16 0.062	15 0.070	14 0.078
Over 20 inches to 36 inches	18 0.050	17 0.056	16 0.062	15 0.068
Over 36 inches to 56 inches	17 0.056	16 0.062	15 0.070	14 0.078
Over 56 inches	16 0.062	15 0.070	14 0.078	13 0.086

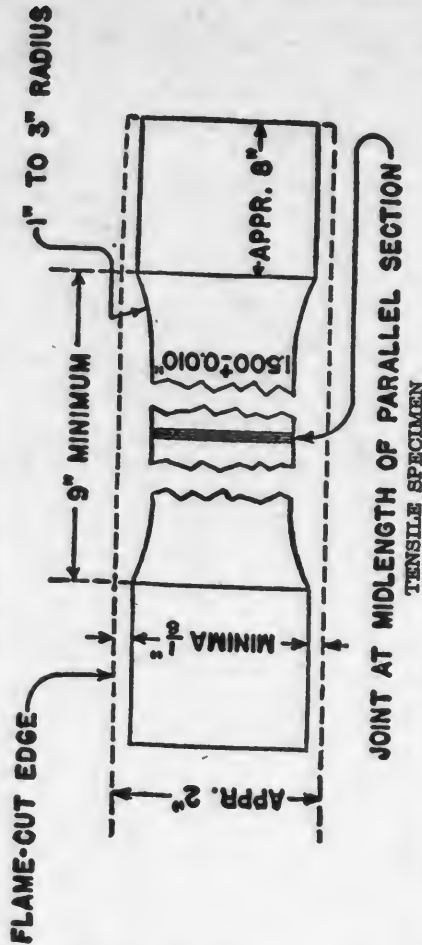
§ 78.324-4 Joints.

- (a) Method of joining. Sheets shall be joined by fusion welding.
- (b) Strength of joints. The tensile strength of each joint in a tank made of steel other than stainless steel shall be not less than 85 percent of that of the adjacent metal in the tank. The tensile strength of each joint in a stainless steel tank shall be not less than 60,000 psi. Compliance with either requirement shall be determined by preparing, from materials representative of those to be used in tanks subject to this specification, 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 6 months after the tests on such samples have been completed.

§ 78.324-5 Bulkheads, baffles, and ring stiffeners.

(a) When bulkheads not required. No bulkheads shall be required in any cargo tank, regardless of capacity, which is used in a service in which the entire tank is never loaded less than 80 percent full or in which no compartment of the tank is ever loaded less than 80 percent full, provided that the entire contents of the tank or of one or more compartments of the tank is discharged at each unloading point.



(b) Number, dimensions and capacities of bulkheads, baffles, and ring stiffeners. Except as provided in paragraph (a) of this section, every cargo tank shall be divided into compartments and/or provided with baffles or ring stiffeners as follows:

- (1) Every cargo tank having a total capacity in excess of 3,000 gallons shall be divided by bulkheads into compartments, none of which shall exceed 2,500 gallons.
- (2) Every cargo tank, and every compartment of a cargo tank over 90 inches in length, shall be provided with baffles or ring stiffeners, the number of which shall be such that the linear distance between any two adjacent baffles or ring stiffeners, or between any tank head or bulkhead and the baffle or ring stiffener

nearest it, shall in no case exceed 60 inches.

(3) Each bulkhead required by this paragraph shall have adequate strength to sustain without undue stress or any permanent set, a horizontal force equal to the weight of so much of the contents of the tank as may come between it and any adjacent bulkhead or tank head, applied as a uniformly distributed load on the surface of the bulkhead or tank head. Flat bulkheads without reinforcement shall not be permitted.

(4) Each baffle required by this paragraph shall have at least an area as great as 80 percent of the cross-sectional area of the tank.

(5) If spaces are provided between compartments, such spaces shall be arranged for venting and for complete drainage at all times.

(6) Ring stiffeners shall be continuous around the circumference of the tank shell, and shall have at least the section modulus required by the following table:

MINIMUM SECTION MODULUS REQUIRED FOR STEEL RING STIFFENERS

Width of tank	Section modulus
42 inches or less.....	¹ 0.0104L
Over 42 inches to 60 inches.....	¹ 0.0162L
Over 60 inches to 96 inches.....	¹ 0.0234L

¹ L is the maximum distance from midpoint of unsupported shell on one side of ring stiffener to the midpoint of unsupported shell on the opposite side of the ring stiffener. See § 78.324-3 for minimum thickness of ring stiffeners.

(1) If a ring stiffener is welded to the shell, a portion of the shell may, for purposes of computing the section modulus, be considered as a part of the ring section. If welded at one side of the ring stiffener only, such portion shall not exceed 20 times the shell thickness adjacent to the weld. If welded at both sides of the ring stiffener, such portion shall not exceed 40 times the shell thickness adjacent to the weld, or the width of the ring stiffener between welds plus 20 times the shell thickness adjacent to the welds, whichever is less.

(c) *Tank supports.* The distance from a tank support to the nearest bulkhead, baffle, or other shell stiffener, shall not exceed 40 times the thickness of the tank shell at the point of support.

§ 78.324-6 Closures for manholes.

(a) No applicable provision.

§ 78.324-7 Overturn protection.

(a) All closures for filling openings shall be protected from damage in the event of overturning of the motor vehicle by being enclosed within the body of the tank or a dome attached thereto or by the use of suitable metal guards securely attached to the tank or the frame of the motor vehicle.

§ 78.324-8 Outlets.

(a) Outlet fixtures shall be substantially made and attached to the tank in such a manner as to prevent breakage at the outlet point.

§ 78.324-9 Vents, valves and connections.

(a) *Tank vents.* Each cargo tank or tank compartment shall be provided with a vacuum and pressure operated vent with a minimum effective opening of 0.44 square inch, and shall also be provided with an emergency venting facility so constructed as to provide a minimum free-venting opening having a net area in square inches equal to 1.25 plus 0.0025 times the capacity of the tank or compartment in gallons. If the emergency venting facility operates in response to elevated temperatures, the critical temperature for such operation shall not exceed 200° F.

(b) *Valve and faucet connections.* All draw-off valves or faucets of tanks and compartments shall have discharge ends threaded, or be otherwise so designed as to insure in every instance a tight connection with the hose extending to the storage fill pipe.

§ 78.324-10 Protection of fittings.

(a) Draw-off valves and faucets projecting beyond the frame, or if the vehi-

cle be frameless, beyond the shell, at the rear, shall be adequately protected in the event of collision by steel bumpers or other equally effective devices.

§ 78.324-11 Emergency discharge control.

(a) Each cargo tank or tank compartment of a bottom-discharge tank shall be equipped with a reliable and effective shut-off valve located inside the shell of the tank or tank compartment in the tank or compartment outlet; and the operating mechanism for such valve or valves shall be provided with a secondary closing mechanism remote from tank filling openings and discharge faucets, for operation in the event of fire, or other accident. Such control mechanism shall be provided with a fusible section which will cause the valve to close automatically in case of fire, and the critical temperature for the fusing of such section shall not exceed 200° F.

§ 78.324-12 Shear section.

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

§ 78.324-13 Anchoring of tank.

(a) No applicable provision.

§ 78.324-14 Gauging devices.

(a) No applicable provision.

§ 78.324-15 Pumps.

(a) No applicable provision.

§ 78.324-16 Method of test.

(a) *Test for leaks.* Every cargo tank shall be tested by a minimum air or hydrostatic pressure of 3 psig. applied to the whole tank and dome if it be noncompartmented. If compartmented, each individual compartment shall be similarly tested with adjacent compartments empty and at atmospheric pressure. Air pressure, if used, shall be maintained 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 specifica-

tion. 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 to which this specification applies 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 returned to service unless a suitable repair is made. This suitability of the repair shall be determined by the same method of test.

(c) *Retest requirements.* See § 77.824 (a) of this chapter.

§ 78.324-17 Marking of cargo tanks.

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

Carrier's Serial Number ¹
 Manufacturer's Name ²
 Date of Manufacture ²
 ICC MC 303
 Nominal Tank Capacity ----- U.S. Gallons

(b) *Test date markings.* The date of the last test shall be painted on the tank in letters not less than 1¼ inches high, in legible colors, immediately below the metal identification plate specified in paragraph (a) of this section.

(c) *Additional markings.* In addition to the above markings, cargo tanks must be marked as required by § 77.823 of this chapter.

§ 78.324-18 Certification.

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

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

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

§ 78.325 Specification MC 304;¹ cargo tanks constructed of mild (open hearth or blue annealed) steel, welded ferrous alloy (high-tensile steel) or aluminum, primarily for the transportation of flammable liquids, or poisonous liquids, class B, having Reid (ASTM D-323) vapor pressures of 18 psia. or more at 100° F., but less than those stated in § 73.300 of this chapter, in defining compressed gases.

§ 78.325-1 General requirements.

(a) *Design pressure.* The design pressure of each cargo tank shall be not less than 25 psig.

	Mild steel	Aluminum	
	All vessel parts	Heads, bulkheads, baffles and other shell stiffeners	Shell
Yield point.....	25,000 psi.....	9,500 psi.....	23,000 psi.
Ultimate strength.....	45,000 psi.....	25,000 psi.....	31,000 psi.
Elongation, 2-inch sample.....	20 percent.....	18 percent.....	7 percent.

(b) *High-tensile and stainless steel.* All high-tensile and stainless steel shall meet the following minimum requirements:

	Steel other than stainless	Stainless steel
Yield point.....	45,000 psi.....	32,000 psi.
Ultimate strength.....	60,000 psi.....	75,000 psi.
Elongation, 2-inch sample.....	25 percent.....	20 percent.

(c) *Other material requirements.* Cargo tanks shall be of all-steel or aluminum construction, except that gaskets need not be metallic and except that piping and valves need not be ferrous metal or aluminum. Nonmalleable materials shall not be used in the construction of the tank, its mountings and protective devices, or any valves, piping, or fittings. The metal and gaskets shall be substantially immune to chemical attack by the materials to be transported therein, or shall be suitably lined to prevent corrosive attack, or shall have the thickness of the material suitably in-

¹ Existing tank motor vehicles continuing in service.

(a) *Specification cargo tanks of tank motor vehicles.* Cargo tanks of tank motor vehicles used for the transportation of flammable liquids or poisonous liquids, class B, which shall have been in service prior to December 31, 1955, may be continued in service, provided that they have been designed and constructed in accordance with specifications MC 300, MC 301 MC 302, or MC 303, and provided further that such tanks have, within six months of December 31, 1955, successfully passed the tests prescribed in § 78.325-16.

(b) *Existing nonspecification cargo tanks of tank motor vehicles.* Existing cargo tanks not meeting all requirements of this specification and continuing in service in accordance with paragraph (a) of this footnote, shall be marked by the number "304" applied adjacent to the existing specification number, which number and other data on the original metal identification plate shall remain legible.

(b) *Cross-sectional design.* Tanks shall be of circular cross section.

(c) *Workmanship.* Every cargo tank shall be constructed in accordance with the best known and available practices, in addition to the other requirements of this specification.

§ 78.325-2 Material.

(a) *Mild steel and aluminum.* All mild steel and aluminum used in the shell, heads and bulkheads of the cargo tank, shall meet or exceed the following minimum requirements:

	Mild steel	Aluminum	
	All vessel parts	Heads, bulkheads, baffles and other shell stiffeners	Shell
Yield point.....	25,000 psi.....	9,500 psi.....	23,000 psi.
Ultimate strength.....	45,000 psi.....	25,000 psi.....	31,000 psi.
Elongation, 2-inch sample.....	20 percent.....	18 percent.....	7 percent.

creased over that required elsewhere in this specification by an amount sufficient to provide for such corrosion during the estimated useful life of the tank. All aluminum cargo tanks and appurtenances built to this specification shall be fabricated of alloys authorized for welded construction by (1) the 1952 edition, or (2) the 1959 edition of Section VIII of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code, no revisions. A certification from the material supplier will suffice as evidence of compliance with this requirement.

§ 78.325-3 Thickness of metal.

(a) *Formulas.* Tanks for this service may be constructed of mild steel, high-tensile steel, stainless steel, or aluminum. The material thicknesses shall not be less than those obtained by applying the following formulas nor less than those specified in paragraph (d) of this section:

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

$$\text{Thickness of heads} = T_h$$

$$= \frac{0.85PL}{S E_h} \text{ (for pressure on concave side only)}$$

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 or maximum allowable working pressure, psi. The maximum allowable working pressure for aluminum shells shall be specified on the basis of the minimum tensile strength of the head material for the alloy used.

D = Inside diameter of shell, inches.

L = Inside crown radius of head, inches.

S = Maximum allowable stress value, psi.— Equals one-fourth of specified minimum ultimate tensile strength.

E_s = Lowest efficiency of any longitudinal joint in shell.

E_h = Lowest efficiency of any joint in head.

(1) The knuckle radius of the head shall not be less than three times the material thickness and the straight flange shall be not less than one inch.

(2) For heads with pressure on the convex side, the material thickness as obtained by the above formula shall be increased by 67 percent, 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 for the desired life of the vessel 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.

(c) *Other loadings.* In addition to the material requirements as specified in paragraphs (a) and (b) of this section, vessels shall be provided with stiffeners or other additional means of support if necessary, to prevent overstress or large distortions due to the following other loadings:

(1) Impact loads.

(2) Weight of vessel and contents but not less than the water weight of tank and contents. For determining the weight of the water contents of the tank, a gallon of water (231 cubic inches) shall be considered to weigh 8.32828 pounds.

(3) Superimposed loads such as operating equipment, insulation and piping.

(4) Reactions of supporting lugs or saddles.

(5) Effect of temperature gradients.

(d) *Thickness of mild steel.* Minimum thicknesses of mild steel tank sheets in U.S. standard gauges, subject to the foregoing requirements in this section. (These thicknesses are to be multiplied by 1.44 for aluminum.):

	Gallons per inch of tank length						
	10 or less	Over 10 to 14	Over 14 to 18	Over 18 to 22	Over 22 to 26	Over 26 to 30	Over 30
Heads, bulkheads, baffles, and ring stiffeners.....	14	13	12	11	10	9	8
SHELL							
Distance between attachments of bulkheads, baffles or other shell stiffeners:							
36 inches or less.....	14	14	14	13	12	11	10
Over 36 inches to 54 inches.....	14	14	13	12	11	10	9
Over 54 inches to 60 inches.....	14	13	12	11	10	9	8

(e) *Thickness of high-tensile and stainless steel.* Minimum thicknesses of high-tensile and stainless steel tank sheets, in U.S. standard gauges, subject to the foregoing requirements in this section:

	Gallons per inch of tank length						
	10 or less	Over 10 to 14	Over 14 to 18	Over 18 to 22	Over 22 to 26	Over 26 to 30	Over 30
Heads, bulkheads, baffles, and ring stiffeners.....	15	14	13	12	11	10	9
SHELL							
Distance between attachments of bulkheads, baffles or other shell stiffeners							
36 inches or less.....	16	16	15	14	13	12	11
Over 36 inches to 54 inches.....	16	15	14	13	12	11	10
Over 54 inches to 60 inches.....	15	14	13	12	11	10	9

§ 78.325-4 Joints.

(a) *Method of joining.* Joints in the tank structure shall be made by welding, and may be reinforced where desired. Care should be taken to avoid damage by galvanic action due to the presence of dissimilar metals at joints.

(b) *Pipe joints.* Welded pipe joints shall be used wherever possible. Joints in copper tubing shall be of the brazed type or of an equally strong metal union type. The melting point of brazing material must not be less than 1000° F. Such joints shall in any event be of such a character as not to decrease the strength of the tubing, as by the cutting of threads.

§ 78.325-5 Bulkheads, baffles, and ring stiffeners.

(a) *When bulkheads not required.* No bulkheads shall be required in any cargo tank regardless of capacity which is used in service in which there is never less than 80% of the capacity volume of the tank while in transportation over the highway and which in service has its entire contents discharged at one unloading point, provided that this requirement shall not apply to tanks operating in or through any jurisdiction where State or local regulations require seasonal reduction of vehicle weight limitations during the time such reductions are in force.

(b) *When bulkheads required.* Except as provided in paragraph (a) of this section, every cargo tank having a total capacity in excess of 3,000 gallons shall be divided by bulkheads into compartments none of which shall exceed 2,500 gallons. Each bulkhead required by this paragraph shall be of the same minimum strength as is required elsewhere in this specification for tank heads.

(c) *Double bulkheads.* Tanks with compartments carrying flammable liquids of different shipping names or with compartments containing flammable or poisonous liquids, class B, and liquids not so classified by the regulations, shall be provided with an air space between compartments. This air space shall be equipped and maintained with drainage facilities operative at all times.

(d) *Baffles or shell stiffeners.* Every cargo tank or compartment of a cargo tank over 90 inches in length shall be provided with baffles or equivalent shell stiffeners so located that the maximum distance between any two baffles or stiffeners and between any baffle or stiffener and the nearest tank head or

bulkhead shall not exceed 60 inches. Ring stiffeners shall be continuous around the circumference of the tank shell and shall have at least the section modulus required by the following table:

MINIMUM SECTION MODULUS REQUIRED FOR RING STIFFENERS

Width of tank	Section modulus	
	Steel	Aluminum
42 inches or less.....	1.0.0104L	1.0.0180L
Over 42 inches to 60 inches.....	1.0.0182L	1.0.0280L
Over 60 inches to 96 inches.....	1.0.0234L	1.0.0400L

¹ L is 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. See § 78.325-3 for minimum thickness of ring stiffeners.

(1) If a ring stiffener is welded to the shell, a portion of the shell may, for the purposes of computing the section modulus, be considered as a part of the ring section. If welded at one side of the ring stiffener only, such portion shall not exceed 20 times the shell thickness adjacent to the weld. If welded at both sides of the ring stiffener, such portion shall not exceed 40 times the shell thickness adjacent to the weld, or the width of the ring stiffener between welds plus 20 times the shell thickness adjacent to the welds, whichever is less.

§ 78.325-6 Closures for manholes.

(a) No applicable provision.

§ 78.325-7 Overturn protection.

(a) All closures for filling openings shall be protected from damage in the event of overturning of the motor vehicle by being enclosed within the body of the tank or dome attached to the tank or the frame of the motor vehicle. Protection shall also be provided for any protruding or projecting fitting or appurtenance by means of adequate metal guards. The calculated load for the protective devices shall be the weight of the tank motor vehicle with the tank full of water, at one "g" deceleration. If the overturn protection is so constructed as to permit accumulation of liquid on the top of the tank, it shall not be provided with drainage at or near the front of the tank.

§ 78.325-8 Tank outlets.

(a) Outlet fixtures shall be substantially made and attached to the tank in such a manner as to prevent breakage at the outlet point.

§ 78.325-9 Safety relief devices, valves and connections.

(a) *Safety relief devices required.* Each cargo tank and each compartment of a tank shall be provided with one or more safety relief valves of the spring-loaded type, provided that emergency pressure relief devices may be used for part of the required capacity thereof. All such valves and devices shall be arranged to discharge upward and unobstructed in such a manner as to prevent any impingement of escaping gas upon the tank. The emergency pressure relief devices shall be either springloaded type, frangible type or fusible type.

(b) *Safety relief device capacity.* The required safety relief valves shall be set to close after discharge at a pressure not lower than 25 psig. and remain closed at all lesser pressures, provided that this requirement shall not be so construed as to forbid the use of vacuum relief valves or of combination safety relief and vacuum relief valves. At a pressure not exceeding 40 psig. they shall have a discharge capacity not less than that of an unobstructed opening of one square inch for each 35 square feet of exterior area of the tank or compartment to which they are connected, provided that two or more such valves may be used on the same tank or compartment to obtain the discharge capacity herein required; alternatively, such valve or valves may at a pressure of 30 psig. have a total discharge capacity not less than that of an unobstructed opening of one square inch for each 350 square feet of exterior area of the tank or compartment to which they are connected, if in addition thereto, each such tank or compartment be provided with one or more frangible-type or fusible-type safety devices having a total discharge capacity not less than that of an unobstructed opening of 9 square inches for each 350 square feet of exterior area. The bursting pressure of the frangible-type devices shall be not less than 30 psig. nor more than 40 psig. Fusible elements, if used, shall have a fusing temperature no higher than 200° F. They shall not be exposed to contact with the tank lading or be in contact with any part of the tank or its accessories so exposed.

(c) *Marking inlets and outlets.* All tank inlets and outlets, except safety relief valves, shall be marked to indicate whether they communicate with vapor or liquid when the tank is filled to the maximum permitted filling level.

(d) *Markings on relief valves.* Each safety relief valve shall be plainly and permanently marked (1) with the pressure in psig. at which it is set to start to discharge, (2) with the actual rate of discharge of the device in cubic feet per minute of air at 60° F. and atmospheric pressure and (3) with the manufacturer's name and catalogue number. The rated discharge capacity of the device shall be determined at a pressure of 30 psig.

(e) *Connections to relief valves.* Connections to safety relief valves shall be of sufficient size to provide the required rate of discharge through the safety relief valves.

(f) *Protection of relief valves.* Safety relief valves shall be arranged so that the possibility of tampering will be minimized. If the pressure setting or adjustment is external, the safety relief valves shall be provided with suitable means for sealing the adjustment.

(g) *Shut-off valves.* No shut-off valves shall be installed between the safety relief valves and the tank except in cases where two or more safety relief valves are installed on the same tank, a shut-off valve may be used where the arrangement of the shut-off valve or valves is such as always to afford full required capacity flow through at least one safety relief valve.

(h) *Connection of safety relief valve to vapor space.* Safety relief valves shall have direct communication with the vapor space of the tank.

(i) *Prevention of excessive hydrostatic pressure.* Any portion of liquid piping or hose which at any time may be closed at each end must be provided with a safety valve to prevent excessive hydrostatic pressure. This safety relief valve must not have an intervening shut-off valve installed.

(j) *Strength of piping, fittings, hose and hose couplings.* Hose, piping and fittings shall be designed for a bursting pressure 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 a 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 percent in excess of the design pressure of the hose and shall be so designed that there will be no leakage when connected.

(k) *Provision for expansion and vibration.* Suitable provision 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.

§ 78.325-10 Protection of fittings.

(a) Piping, fittings and valves projecting beyond the frame, or if the vehicle be frameless beyond the shell, shall be adequately protected in the event of collision by steel bumpers or other equally effective devices. Any other part of any cargo tank connected with its cargo space and similarly protruding shall be similarly protected.

§ 78.325-11 Emergency discharge control.

(a) *Automatic excess-flow valves.* Each cargo tank outlet shall be provided with a suitable automatic excess-flow valve or, in lieu thereof, may be fitted with a quick-closing internal valve designed, installed and operated so as to assure against escape of the contents in event of failure of the outlet. 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

shall be located within a welded flange or its companion flange, or within a nozzle, or within a coupling. The installation shall be made in such a manner as reasonably to assure that any undue strain which causes failure requiring functioning of the valve shall cause failure in such a manner that it will not impair the operation of the valve, except that safety device connections and liquid level gauging devices, which are so constructed that the outward flow of tank contents shall not exceed that passed by a No. 54 drill size opening, are not required to be equipped with excess-flow valves.

(b) *Excess-flow valve settings.* Excess-flow valves shall be so installed and adjusted that they close automatically at the rated flows of gas or liquid as specified by the valve manufacturer.

(c) *Capacity of connections to valves.* The connections or lines on each side of an excess-flow valve, including valve fittings, etc., shall have a greater capacity than the rated flow of the excess-flow valve.

(d) *By-pass of valve.* Excess-flow valves may be designed with a by-pass, not to exceed a No. 60 drill size opening, to allow equalization of pressures.

(e) *Utilization of stop-check valves forbidden.* The use of combination stop-check valves to satisfy with one valve the requirements of paragraphs (b), (c) and (f) of this section is forbidden.

(f) *Filling and discharge shut-off valves.* Filling and discharge lines shall be provided with shut-off valves located as close to the tank outlet as is possible. If such valves are not manually operated they shall be of an automatic quick-closing internal valve type or an automatic shut-off type provided that if such valves are used, the lines must have manually-operated shut-off valve located in the line ahead of the hose connection. Stop-check or excess-flow valves shall not be used to satisfy the requirements of this section.

§ 78.325-12 Shear section.

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

§ 78.325-13 Anchoring of cargo tank.

(a) *Hold-down devices.* Adequate hold-down devices shall be provided to anchor each cargo tank in a suitable manner that will not introduce undue concentration of stresses and shall be built to withstand loadings in any direction equal to the weight of the tank and attachments when filled with water. These devices on vehicles with frames shall incorporate turnbuckles or similar positive action devices for drawing the tank down tight on the frame of the motor vehicle.

(b) *Stops and anchors.* Suitable stops and anchors shall be attached to the motor vehicle and the cargo tank to prevent relative movement between them

due to starting, stopping and turning. Stops and anchors shall be installed so as to be readily accessible for inspection and maintenance except that insulation on lagged tanks is permitted to cover such stops and anchors.

(c) *Anchoring integral cargo tanks.* Whenever any cargo tank is so designed and constructed that the cargo tank constitutes, in whole or in part, the stress member used in lieu of a frame, then such cargo tanks shall be designed so as to successfully and adequately withstand the stresses thereby imposed in addition to those otherwise imposed on the cargo tank.

§ 78.325-14 Gauging devices.

(a) *Gauge device design.* Every cargo tank except tanks filled by weight, shall be equipped with one or more gauging devices which shall indicate accurately the maximum permitted liquid level in each compartment. Additional gauging devices may be installed but may not be used as primary controls for filling of cargo tanks at pressures above atmospheric. Acceptable gauging devices for use at pressures above atmospheric are the rotary tube, the adjustable slip tube and the fixed length dip tube. Gauge glasses are not permitted to be installed on any cargo tank.

(b) *Fixed level indicators.* All liquid level gauging devices, except those on tanks provided with fixed maximum level indicators, shall be legibly and permanently marked in increments of not more than 20° F. to indicate the maximum levels to which the tank may be filled with liquid at temperatures above 20° F. In the event that it is impractical to put these markings on the gauging device, this information shall be marked on a suitable plate affixed to the tank in a location adjacent to the gauging device.

(c) *Dip tubes.* A fixed length dip tube gauging device, when used, shall consist of a dip pipe of small diameter equipped with a valve at the outer end, and extending into the tank to a specified fixed length. On horizontally-mounted cylindrical tanks, the fixed length to which the tube extends into the tank shall be such that the device will function to indicate when the liquid at a point equidistant from the heads of the tank in a vertical plane containing the longitudinal axis of the tank, reaches the maximum level permitted by these regulations. On spherical tanks and on vertically-mounted cylindrical tanks, the fixed length to which the tube extends into the tank shall be such that the device will function to indicate when the liquid at a point on the vertical axis of the tank in its normal position reaches the maximum level permitted by these regulations.

§ 78.325-15 Pumps.

(a) Liquid pumps, whenever used, must be of suitable design, adequately protected against breakage by collisions. Unless they are of the centrifugal type, they shall be equipped with suitable pressure actuated by-pass valves permitting flow from discharge to suction or to the tank.

§ 78.325-16 Method of test.

(a) *Test pressure.* For each existing specification MC 300, MC 301, MC 302, and MC 303 tank not complying with all requirements of this specification and continuing in service in accordance with the provisions of § 78.325 footnote 1(a) (see § 78.325-17 regarding marking of such tanks), the standard test pressure for each required test shall be 50 psig. For each tank complying with all requirements of this specification, whether new or existing, the standard test pressure for each required test shall be 40 psig.

(b) *Method of test.* Every cargo tank, and all piping, valves, and other accessories thereof which are subject to the pressure of the tank contents, except safety valves, shall be tested by complete filling (including domes, if any) with water or other liquid having a similar viscosity and applying a pressure of not less than the standard test pressure above specified. The pressure shall be gauged at the top of the tank. The tank must hold the prescribed pressure for at least 10 minutes. While under pressure, the tank shall be inspected for leakage, corroded areas, bad dents, or other conditions which indicate weakness that might render the tank unsafe for transportation service, and it shall not be placed in or returned to service if any evidence of such unsafe condition is discovered, until the deficiencies have been corrected and the tests repeated and passed successfully. Tank insulation and jacket need not be removed unless it is found to be impossible to reach the test pressure and to maintain a condition of pressure equilibrium after the test pressure is reached. All tank accessories shall be leakage tested after installation and proved tight at not less than the design pressure of the tank, except that hose used on such tanks may be tested either before or after installation.

(c) *Retest requirements.* See § 77.824 (b) of this chapter.

§ 78.325-17 Marking of cargo tanks.

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

Carrier's Serial Number ¹
 Manufacturer's Name ²
 Date of Manufacture ³

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

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

ICC MC 304
 Design Pressure ----- psig.
 Test Pressure ----- psig.
 Nominal Tank Capacity ----- U.S. Gallons.
 In compartments of -----, ----- and -----
 U.S. Gallons.

(b) *Test date and pressure markings.* The date of the last test shall be painted on the tank in letters not less than 1 1/4 inches high, in legible colors, immediately below the metal identification plate specified in paragraph (a) of this section. The test pressure shall be similarly indicated by painting on tanks requiring the test pressure of 50 psig. in accordance with § 78.325-16(a).

(c) *Additional markings.* In addition to the above markings, cargo tanks must be marked as required by § 77.823 of this chapter.

§ 78.325-18 Certification.

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

§ 78.326 Specification MC 305; cargo tanks constructed of aluminum alloys for high-strength welded construction, primarily for the transportation of flammable liquids, or poisonous liquids, class B.

§ 78.326-1 General requirements.

(a) Every cargo tank shall be constructed in accordance with the best known and available practices, in addition to the other requirements of this specification.

§ 78.326-2 Material.

(a) All sheets for shell, heads, bulkheads, and baffles of such cargo tanks shall be of aluminum alloys GR20A (5052 commercial designation), GR40A (5154 commercial designation), GM40A (5086 commercial designation), or GM31A (5454 commercial designation) conforming to American Society for Testing Materials Specification B209-57T (as revised to include 5454).

§ 78.326-3 Thickness of sheets.

(a) The minimum thicknesses of tank sheets shall be limited by the volume capacity of the tank, expressed in terms of gallons per inch of length; by the distance between successive bulkheads in the case of bulkhead sheets; and by the distance between bulkheads, baffles, or other shell stiffeners as well as by the radius of shell curvature in the case of shell sheets, as follows:

TABLE I—THICKNESS OF HEAD, BULKHEAD, BAFFLE SHEETS AND RING STIFFENERS ¹

Thickness in decimal of inches.....	Volume capacity of tank in gallons per inch of length			
	10 or less	Over 10 to 14	Over 14 to 18	Over 18
	Heads or bulkheads—dished, corrugated or reinforced			
0.096	0.109	0.130	0.151	

¹ Thickness of exterior head sheets shall never be less than the maximum requirements for shell sheets.

TABLE II—THICKNESS OF SHELL SHEETS

Distance between bulkheads, baffles or other shell stiffeners	Volume capacity of tank in gallons per inch of length			
	10 or less	Over 10 to 14	Over 14 to 18	Over 18
	Shell-sheet thickness in decimals of an inch for that portion of the shell rolled to a radius of less than 70 inches, depending on spacing of shell stiffeners			
36 inches or less.....	0.087	0.087	0.096	0.109
Over 36 inches to 54 inches.....	.087	.097	.109	.130
Over 54 inches.....	.096	.109	.130	.151
Distance between bulkheads, baffles or other shell stiffeners	Shell-sheet thickness in decimals of an inch for that portion of the shell rolled to a radius of 70 inches or more, but less than 90 inches, depending on spacing of shell stiffeners			
	10 or less	Over 10 to 14	Over 14 to 18	Over 18
	Shell-sheet thickness in decimals of an inch for that portion of the shell rolled to a radius of 90 inches or more, but less than 125 inches, depending on spacing of shell stiffeners			
36 inches or less.....	0.087	0.096	0.109	0.130
Over 36 inches to 54 inches.....	.096	.109	.130	.151
Over 54 inches.....	.109	.130	.151	.173
Distance between bulkheads, baffles or other shell stiffeners	Shell-sheet thickness in decimals of an inch for that portion of the shell rolled to a radius of 90 inches or more, but less than 125 inches, depending on spacing of shell stiffeners			
	10 or less	Over 10 to 14	Over 14 to 18	Over 18
	Shell-sheet thickness in decimals of an inch for that portion of the shell rolled to a radius of 125 inches or more, but less than 150 inches, depending on spacing of shell stiffeners			
36 inches or less.....	0.096	0.109	0.130	0.151
Over 36 inches to 54 inches.....	.109	.130	.151	.173
Over 54 inches.....	.130	.151	.173	.194

TABLE II—THICKNESS OF SHELL SHEETS

Distance between bulkheads, baffles or other shell stiffeners	Volume capacity of tank in gallons per inch of length			
	10 or less	Over 10 to 14	Over 14 to 18	Over 18
	Shell-sheet thickness in decimals of an inch for that portion of the shell rolled to a radius of 125 inches or more, depending on spacing of shell stiffeners			
36 inches or less.....	0.109	0.130	0.151	0.173
Over 36 inches to 54 inches.....	.130	.151	.173	.194
Over 54 inches.....	.151	.173	.194	.216

MINIMUM SECTION MODULUS REQUIRED FOR RING STIFFENERS

Width of tank	Section modulus
42 inches or less.....	¹ 0.0180L
Over 42 inches to 60 inches.....	1.0280L
Over 60 inches to 96 inches.....	1.0400L

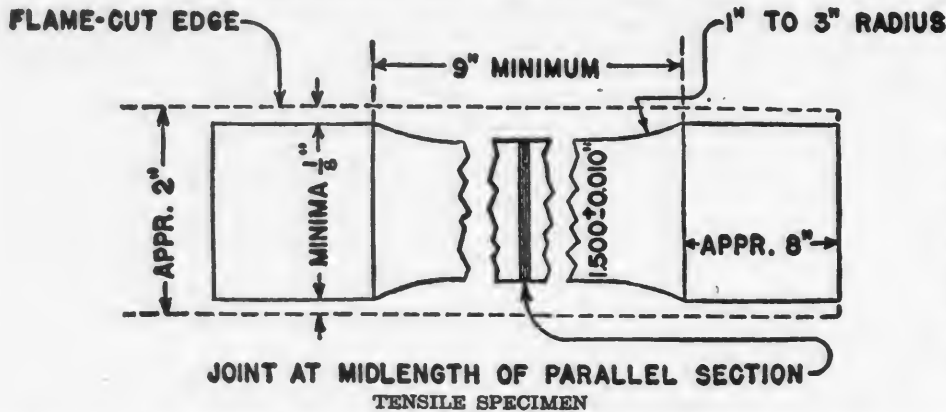
¹ L is the maximum distance from the midpoint of the unsupported shell on one side of the ring stiffener to the midpoint of the unsupported shell on the opposite side of the ring stiffener. See § 78.326-3 for minimum thickness of ring stiffeners.

§ 78.326-4 Joints.

(a) *Method of joining.* All joints in and to tank shells, head and bulkheads shall be welded.

(b) *Strength of joints.* All welded aluminum joints shall be made in accordance with recognized good practice, and the efficiency of a joint shall not be less than 85 percent of the annealed properties of the adjacent material. Aluminum alloys for high-strength welded construction shall be joined by an inert gas arc welding process using filler metals R-GR40A, E-GR40A (5154 alloy) or R-GM50A, E-GM50A (5356 alloy) conforming to American Society of Test-

ing Materials Specification No. B285-54T (American Welding Society Specification No. A5, 10-54T). Compliance with this requirement 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 6 months after the tests on such samples have been completed.



§ 78.326-5 Bulkheads, baffles and ring stiffeners.

(a) *When bulkheads not required.* The bulkhead requirements in paragraph (b) of this section do not apply to any cargo tank, regardless of capacity, which is used in a service in which the entire tank is never loaded less than 80% full or in which no compartment of the tank is ever loaded less than 80% full, provided that the entire contents of the tank or of one or more compartments of the tank is discharged at each unloading point. Flat bulkheads and baffles without reinforcement are not permitted.

(b) *When bulkheads required.* Except as provided in paragraph (a) of this section, every cargo tank having a total capacity in excess of 3,000 gallons shall be divided by bulkheads into compartments, none of which shall exceed 2,500 gallons. Each bulkhead required by this paragraph shall be of the same minimum strength as is required elsewhere in this specification for tank heads.

(c) *Double bulkheads.* Tanks with compartments carrying flammable liquids of different shipping names or with compartments containing flammable or poisonous liquids, class B and liquids not so classified by the regulations, shall be provided with an air space between compartments. This air space shall be arranged for venting and be equipped and maintained with drainage facilities operative at all times.

(d) *Baffles or shell stiffeners.* Every cargo tank, and every compartment of a cargo tank over 90 inches in length, shall be provided with baffles or ring stiffeners, the number of which shall be such that the linear distance between any two adjacent baffles or ring stiffeners, or between any tank head or bulkhead and the baffle or ring stiffener nearest it, shall in no case exceed 60 inches. Ring stiffeners shall be continuous around the circumference of the tank shell and shall have at least the section modulus required by the following table:

(1) If a ring stiffener is welded to the shell, a portion of the shell may, for purposes of computing the section modulus, be considered as a part of the ring section. If welded at one side of the ring stiffener only, such portion shall not exceed 20 times the shell thickness adjacent to the weld. If welded at both sides of the ring stiffener, such portion shall not exceed 40 times the shell thickness adjacent to the weld, or the width of the ring stiffener between welds plus 20 times the shell thickness adjacent to the welds, whichever is less.

(e) *Tank supports.* The distance from a tank support to the nearest bulkhead, baffle, or other shell stiffener shall not exceed 40 times the thickness of the tank shell at the point of support.

§ 78.326-6 Closures for manholes.

(a) No applicable provision.

§ 78.326-7 Overturn protection.

(a) All closures for filling openings shall be protected from damage in the event of overturning of the motor vehicle by being enclosed within the body of the tank or dome attached thereto or by the use of suitable metal guards securely attached to the tank or the frame of the motor vehicle. Protection shall also be provided for any protruding or projecting fitting or appurtenance by means of adequate metal guards. The calculated load for the protective devices shall be the weight of the tank motor vehicle with the tank full of water at one "g" deceleration. If the overturn protection is so constructed as to permit accumulation of liquid on the top of the tank, it shall not be provided with drainage facilities which will permit drainage at or near the front of the tank.

§ 78.326-8 Tank outlets.

(a) Outlet fixtures shall be substantially made and attached to the tank in such a manner as to prevent breakage at the outlet point.

§ 78.326-9 Vents, valves and connections.

(a) *Tank vents.* Each cargo tank or tank compartment shall be provided with a vacuum and pressure operated vent with a minimum effective opening of 0.44 square inch, and shall also be provided with an emergency venting facility so constructed as to provide a minimum free-venting opening having a net area in square inches equal to 1.25 plus 0.0025 times the capacity of the tank or compartment in gallons. If the emergency venting facility operates

in response to elevated temperatures, the critical temperature for such operation shall not exceed 200°F.

(b) *Valve and faucet connections.* All draw-off valves or faucets of tanks and compartments shall have discharge ends threaded, or be otherwise so designed as to insure in every instance a tight connection with the hose extending to the storage fill pipe.

§ 78.326-10 Protection of fittings.

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

§ 78.326-11 Emergency discharge control.

(a) Each cargo tank or tank compartment of a bottom-discharge tank shall be equipped with a reliable and effective shut-off valve located inside the shell of the tank or tank compartment in the tank or compartment outlet; and the operating mechanism for such valve or valves shall be provided with a secondary closing mechanism remote from tank filling openings and discharge faucets, for operation in the event of fire or other accident. Such control mechanism shall be provided with a fusible section which will cause the valve to close automatically in case of fire, and the critical temperature for the fusing of such section shall not exceed 200°F.

§ 78.326-12 Shear section.

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

§ 78.326-13 Anchoring of cargo tank.

(a) *Hold-down devices.* Adequate hold-down devices shall be provided to anchor each cargo tank in a suitable manner that will not introduce undue concentration of stresses and shall be built to withstand loadings in any direction equal to the weight of the tank and attachments when filled with water. These devices on vehicles with frames shall incorporate turnbuckles or similar positive action devices for drawing the tank down tight on the frame of the motor vehicle.

(b) *Stops and anchors.* Suitable stops and anchors shall be attached to the motor vehicle and the cargo tank to prevent relative movement between them due to starting, stopping and turning. Stops and anchors shall be installed so as to be readily accessible for inspection and maintenance except that insulation is permitted to cover such stops and anchors.

(c) *Anchoring integral cargo tanks.* Whenever any cargo tank is so designed and constructed that the cargo tank constitutes, in whole or in part, the stress member used in lieu of a frame, then such cargo tanks shall be designed so as to successfully and adequately

withstand the stresses thereby imposed in addition to those otherwise imposed on the cargo tank.

§ 78.326-14 Gauging devices.

(a) No applicable provision.

§ 78.326-15 Pumps.

(a) Liquid pumps, whenever used, must be of suitable design, adequately protected against breakage by collisions. Unless they are of the centrifugal type, they shall be equipped with suitable pressure actuated by-pass valves permitting flow from discharge to suction or to the tank.

§ 78.326-16 Method of test.

(a) *Test for leaks.* Every cargo tank shall be tested by a minimum air or hydrostatic pressure of 3 psig. applied to the whole tank and dome if it be noncompartmented. If compartmented, each individual compartment shall be similarly tested with adjacent compartments empty and at atmospheric pressure. Air pressure, if used, shall be maintained 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 to which this specification applies 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 returned to service unless a suitable repair is made. The suitability of the repair shall be determined by the same method of test.

(c) *Retest requirements.* See § 77.824

(a) of this chapter.

§ 78.326-17 Marking of cargo tanks.

(a) *Metal identification plate.* There shall be on every cargo tank a metal plate located on the right side, near the

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

Carrier's Serial Number¹

Manufacturer's Name²

Date of Manufacture²

ICC MC 305

Nominal Tank Capacity ----- U.S. Gallons

(b) *Test date markings.* The date of the last test shall be painted on the tank in letters not less than 1¼ inches high, in legible colors, immediately below the metal identification plate specified in paragraph (a) of this section.

(c) *Additional markings.* In addition to the above markings, cargo tanks must be marked as required by § 77.823 of this chapter.

§ 78.326-18 Certification.

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

§ 78.330 Specification MC 310; cargo tanks constructed of ferrous materials, primarily for the transportation of corrosive liquids.

§ 78.330-1 General requirements.

(a) *Must comply with A.S.M.E. Code.* Tanks built under this specification shall

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

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

³ Existing tank motor vehicles continuing in service.

(a) *Specification tank motor vehicles.* Tank motor vehicles used for the transportation of corrosive liquids which shall have been in service prior to June 15, 1940, may be continued in service provided they have been designed and constructed in accordance with the requirements set forth in paragraphs T-117(a), T-118 (a) and (b), T-120, T-121, T-122, T-123, and T-124 of Regulations for the Transportation of Explosives and Other Dangerous Articles on Public Highways by Motor Truck or Motor Vehicle, prescribed by order of the Commission dated November 6, 1934, and vacated on June 15, 1940.

(b) *Existing nonspecification tank motor vehicles.* Tank motor vehicles used for the transportation of corrosive liquids not meeting the requirements set forth in paragraph

be designed and constructed in accordance with and fulfill all requirements of (1) the 1949 edition, (2) 1950 edition, (3) 1952 edition, (4) 1956 edition, or (5) the 1959 edition of Section VIII of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code, no revisions, which are hereafter referred to as "the Code."

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

§ 78.330-2 Material.

(a) As specified in paragraphs U-12, U-13, and U-20 of the Code, 1949 edition, no revisions. Tanks may be constructed of ferrous materials listed in Table U-2 including the stainless steels or of nickel or nickel alloys as listed in Table U-3 of the Code. Use of other materials listed in Table U-3 may be authorized by the Commission upon submission of satisfactory supporting data. Materials for tanks transporting hydrogen peroxide over 52 percent by weight, must comply with the 1956 edition of the Code, but shall be limited to Aluminum Association Nos. 1060, 1260, 5254, and 5652. Other aluminum alloys may be authorized by the Commission upon submission of satisfactory supporting data.

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

(c) *Conditions under which tanks need not be lined.* Tanks need not be lined as provided in paragraph (b) of this section, if:

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

(2) The material of the tank is thick enough to withstand 10 years' normal service without being reduced at any point to less thickness than that specified in § 78.330-3 corresponding to its capacity, or

(3) the chemical reaction between the material of the tank and the commodity to be transported therein is such

(a) of this footnote, which shall have been in service prior to June 15, 1940, may be continued in service provided they fulfill the requirements set forth under § 77.824(c) of this chapter and are and can be maintained in safe operating condition, but in any event they shall be equipped with at least the accessories specified in § 78.330-6, -9, -10, and -12.

(c) On the required metal identification plate substitute "ICC Spec T-118," or "ICC 7.5-S-1" or "NO SPECIFICATION" as appropriate.

as to allow the tank to be properly passivated or neutralized as set forth elsewhere in this appendix, or

(4) for the transportation of hydrofluoric acid of 60 percent or higher concentration, they be passivated in the following or an equally effective method: By filling the tank to not less than 90 percent of its capacity with hydrofluoric acid of 58 percent strength and allowing it to stand at least 48 hours at a temperature of 80° F., then 7 hours at 140° F., the internal pressure being maintained at atmospheric pressure the meanwhile.

§ 78.330-3 Thickness of metal.

(a) The minimum thickness of metal for cargo tanks shall be as follows:

Tank capacity	Minimum thickness (inches)
Not more than 1,200 gallons.....	$\frac{3}{4}$
Over 1,200 to 1,800 gallons.....	$\frac{5}{16}$
Over 1,800 gallons.....	$\frac{3}{8}$

§ 78.330-4 Joints.

(a) All joints and seams formed in the manufacture of any cargo tank shall be made tight by welding, riveting, riveting and welding, brazing, or riveting and brazing, at the option of the motor carrier, subject to the limitation that any of the aforesaid methods are permissible only when any one of them or combination as used in the tank is not subject to adverse action by the nature of the corrosive liquid which is to be transported in such tank provided that joints in tanks for hydrogen peroxide of concentration exceeding 52 percent shall be made by welding only.

§ 78.330-5 Bulkheads, baffles, ring stiffeners, tank supports and compartmentation.

(a) No applicable provision.

§ 78.330-6 Closures for manholes.

(a) The manhole cover shall be designed to provide a secure closure of the manhole. All covers, not hinged to the tanks, shall be attached to the outside of the dome by at least $\frac{1}{8}$ -inch chain or its equivalent. All joints between manhole covers and their seats shall be made tight against leakage of vapor and liquid by use of gaskets of suitable material not subject to attack by the corrosive liquid to be transported in the tank.

§ 78.330-7 Overturn protection.

(a) No applicable provision.

§ 78.330-8 Outlets.

(a) *Outlet construction.* Except as provided hereinafter, no cargo tanks, except those used for the shipments of sludge acid or alkaline corrosive liquids, and no tanks for the transportation of hydrogen peroxide in concentrations exceeding 52 percent by weight, shall have bottom discharge outlets; outlets leaving the cargo tank at or near the top but having the end of the outlet below the top liquid level shall not be considered as bottom outlets but such outlets must be equipped with a shut-off valve at the point of outlet from the cargo tank and a shut-off valve or a blank flange or screw-on cap at the discharge end of

the outlet and must not be moved with any of the contents in the line beyond the point where it leaves the cargo tank. The valve at the tank shall be protected against damage in the event of overturn. Cargo tanks used for the transportation of sludge acid and/or alkaline corrosive liquids may be equipped with bottom outlets when the products to be transported are too viscous to be unloaded through a dome connection or top outlet.

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

(c) *Bottom washout chambers.* Except as specified in subparagraph (1) of this paragraph, tanks may be equipped with bottom washout chambers. Bottom washout chambers shall be of metal not subject to rapid deterioration by the lading and shall be provided with a liquid-tight closure at its lower end. If used for loading or unloading, they shall be equipped with a valve or plug at the upper end.

(1) Bottom washout chambers are not permitted on tanks used for the transportation of hydrogen peroxide of concentration exceeding 52 percent by weight.

§ 78.330-9 Vents, valves and connections.

(a) When installed, venting, 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.

§ 78.330-10 Protection of fittings.

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

§ 78.330-11 Emergency discharge control.

(a) See § 78.330-8(b).

§ 78.330-12 Shear section.

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

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

§ 78.330-13 Anchoring of tank.

(a) No applicable provision.

§ 78.330-14 Gauging devices.

(a) No applicable provision.

§ 78.330-15 Pumps and compressors.

(a) No applicable provision.

§ 78.330-16 Method of test.

(a) *Test for leaks.* Every cargo tank shall be tested by completely filling the tank and dome with water or other liquid having a similar viscosity, the temperature of which shall not exceed 100° F. during the test, and applying a pressure of 1½ times the design pressure but not less than 10 psig. The tank must hold the prescribed pressure for at least 10 minutes without leakage or evidence of distress. All closures shall be in place while test is made, and the pressure shall be gauged at the top of the tank.

(b) *Test for distortion or failure.* Every cargo tank shall be tested by the pressures prescribed in paragraph (a) of this section and shall withstand such pressures without undue distortion, or if failure impends or occurs, the cargo tank shall not be returned to service unless a suitable repair is made. The suitability of the repair shall be determined by the same method of test.

(c) *Retest requirements.* See § 77.824(c) of this chapter.

§ 78.330-17 Marking of cargo tanks.

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

Carrier's Serial Number ¹
 Manufacturer's Name ²
 Date of Manufacture ²
 ICC MC 310 ²
 Nominal Capacity ----- U.S. Gallons

(b) *Test date markings.* The date of the last test shall be painted on the tank in letters not less than 1¼ inches high, in legible colors, immediately below the metal identification plate specified in paragraph (a) of this section.

(c) *Additional markings.* In addition to the above markings, cargo tanks must be marked as required by § 77.823 of this chapter.

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

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

³ Substitute "ICC Spec-T-118," or "ICC 7.5-S-1," or "ICC MC 310-H₂O," or "NO SPECIFICATION," as appropriate.

§ 78.330-18 Certification.

(a) A certificate from the manufacturer of the cargo tank, or from a competent testing agency, certifying that each such tank is designed and constructed in accordance with the requirements of the specification, shall be procured and such certificate shall be retained in the files of the carrier during the time that such tank is employed in the transportation of corrosive liquids by him. In lieu of this certificate, if the motor carrier himself elects to ascertain if any such tank fulfills the requirements of the specification by his own test, he shall similarly retain the test data. Where such tanks are used for hydrogen peroxide in concentrations exceeding 52 percent by weight, such certificate or test data shall indicate that the tank complies with special provisions of this specification for that lading.

§ 78.331 Specification MC 311; cargo tanks constructed of ferrous metals or aluminum, primarily for the transportation of corrosive liquids.

§ 78.331-1 General requirements.

(a) *Tank design.* (1) *Ferrous materials.* Cargo tanks built of ferrous materials under this specification that

⁴ Existing tank motor vehicles continuing in service.

(a) *Specification tank motor vehicles.* Tank motor vehicles used for the transportation of corrosive liquids which shall have been in service prior to June 15, 1940, may be continued in service provided they have been designed and constructed in accordance with the requirements set forth in paragraphs T-117(a), T-118 (a) and (b), T-120, T-121, T-122, T-123 and T-124 of Regulations for the Transportation of Explosives and Other Dangerous Articles on Public Highways by Motor Truck or Motor Vehicle prescribed by order of the Commission dated November 6, 1934, and vacated on June 15, 1940.

(1) Tank motor vehicles used for the transportation of corrosive liquids which shall have been in service prior to December 31, 1953, may be continued in service provided they have been designed and constructed in accordance with the requirements of specification MC 310 (§ 78.330 of this chapter).

(b) *Existing nonspecification tank motor vehicles.* Tank motor vehicles used for the transportation of corrosive liquids not meeting the requirements set forth in paragraph (a) of this footnote, which shall have been in service prior to June 15, 1940, may be continued in service provided they fulfill the requirements set forth under § 78.331-16 and are and can be maintained in safe operating condition, but in any event they shall be equipped with at least the accessories specified in §§ 78.330-6, -9, -10 and -12 of specification MC 310 or §§ 78.331-6, -10 and -12 of specification MC 311.

(c) *Qualification of existing tank motor vehicles which conform to specification MC 311.* Tank motor vehicles used for the transportation of corrosive liquids which shall have been in service prior to December 31, 1953, and which meet all of the construction requirements of this specification may be continued in service provided such cargo tanks are marked ICC MC 311X on the plate required by § 78.331-17.

(d) On the required metal identification plate substitute "ICC Spec T-118," or "ICC 7.5-S-1," or "MC 311X," or "NO SPECIFICATION" as appropriate.

are unloaded by pressure must be built of welded construction in accordance with (1) the 1949 edition, (2) 1950 edition, (3) 1952 edition, or (4) the 1959 edition of Section VIII of the Society of Mechanical Engineers Boiler and Pressure Vessel Code, no revisions, except that for sheet thicknesses of less than ⅜ inch wherein the Code specifies both minimum and maximum limits of tensile value of materials, the maximum limits need not apply. Such tanks shall not have head, bulkhead, baffle or shell thicknesses less than that specified in § 78.331-3 (a) and (b), nor shall the spacing of bulkheads, baffles or shell stiffeners exceed that specified in those paragraphs.

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

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

§ 78.331-2 Material.

(a) *A.S.M.E. Code materials.* Cargo tanks required to comply with Section VIII of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code must be manufactured of materials authorized by the Code except that for sheet thicknesses of less than ⅜ inch wherein the Code specifies both minimum and maximum limits of tensile value of materials, the maximum limits need not apply.

(b) *Ferrous metal properties.* Materials used in cargo tanks built to conform with the tables in § 78.331-3 must have the following minimum physical properties:

Yield point.....	25,000 psi.
Ultimate strength.....	45,000 psi.
Minimum elongation, 2-inch sample.	20 percent.

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

Yield point.....	12,000 psi.
Ultimate strength.....	17,000 psi.
Minimum elongation, 2-inch sample.	6 percent.

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

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

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

(2) The material of the tank is thick enough to withstand 10 years' normal service without being reduced at any point to less thickness than that specified in § 78.331-3 corresponding to its type, or

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

§ 78.331-3 **Thickness of metal.**

(a) *Head, bulkhead and baffle thicknesses.* Tanks built under this specification that are not constructed in accordance with § 78.331-2 (a) shall have head thicknesses conforming with those in the following tables:

TABLE I—MINIMUM THICKNESS OF HEADS, BULKHEADS, AND BAFFLES (DISHD, CORRUGATED, REINFORCED OR ROLLED)—FOR MILD, HIGH-TENSILE AND STAINLESS STEELS

Weight of product at 60° F. in pounds per gallon	Volume capacity of tank in gallons per inch of length		
	10 or less	Over 10 to 14	Over 14 to 18
Less than 10.....	12 gauge.....	10 gauge.....	9 gauge.....
10 to 12.....	12 gauge.....	10 gauge.....	8 gauge.....
Over 12 to 16.....	12 gauge.....	10 gauge.....	8 gauge.....
			7/16 inch.....
			3/4 inch.....

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

(b) *Shell thickness.* Tanks built under this specification that are not constructed in accordance with § 78.331-2 (a), shall have shell thicknesses conforming with those in the following tables:

TABLE II—FOR LIQUIDS LESS THAN 10 POUNDS PER GALLON
[Minimum Shell Thickness in United States Standard Gauge and Inches—For Mild, High-tensile and Stainless Steel]

Distance between attachments of bulk-heads, baffles or other shell stiffeners	Volume capacity of tank in gallons per inch of length		
	10 or less	Over 10 to 14	Over 14 to 18
36 inches or less..... Over 36 inches to 54 inches..... Over 54 inches to 60 inches.....	Maximum shell radius of less than 70 inches		
	12 gauge.....	12 gauge.....	12 gauge.....
	12 gauge.....	10 gauge.....	10 gauge.....
6 inches or less..... Over 6 inches to 54 inches..... Over 54 inches to 60 inches.....	Maximum shell radius 70 inches or more but less than 90 inches		
	12 gauge.....	10 gauge.....	10 gauge.....
	10 gauge.....	9 gauge.....	9 gauge.....
36 inches or less..... Over 36 inches to 54 inches..... Over 54 inches to 60 inches.....	Maximum shell radius 90 inches or more but less than 125 inches		
	12 gauge.....	10 gauge.....	10 gauge.....
	10 gauge.....	9 gauge.....	9 gauge.....
36 inches or less..... Over 36 inches to 54 inches..... Over 54 inches to 60 inches.....	Maximum shell radius 125 inches or more		
	10 gauge.....	9 gauge.....	9 gauge.....
	9 gauge.....	8 gauge.....	8 gauge.....

TABLE III—FOR LIQUIDS OVER 10 TO 13 POUNDS PER GALLON
[Minimum Shell Thickness in United States Standard Gauge and Inches—For Mild, High-tensile and Stainless Steel]

Distance between attachments of bulk-heads, baffles or other shell stiffeners	Volume capacity of tank in gallons per inch of length		
	10 or less	Over 10 to 14	Over 14 to 18
36 inches or less..... Over 36 inches to 54 inches..... Over 54 inches to 60 inches.....	Maximum shell radius of less than 70 inches		
	10 gauge.....	10 gauge.....	10 gauge.....
	10 gauge.....	10 gauge.....	8 gauge.....
36 inches or less..... Over 36 inches to 54 inches..... Over 54 inches to 60 inches.....	Maximum shell radius 70 inches or more but less than 90 inches		
	10 gauge.....	10 gauge.....	8 gauge.....
	10 gauge.....	8 gauge.....	7/16 inch.....
36 inches or less..... Over 36 inches to 54 inches..... Over 54 inches to 60 inches.....	Maximum shell radius 90 inches or more but less than 125 inches		
	10 gauge.....	8 gauge.....	7/16 inch.....
	8 gauge.....	7/16 inch.....	3/4 inch.....
36 inches or less..... Over 36 inches to 54 inches..... Over 54 inches to 60 inches.....	Maximum shell radius 125 inches or more		
	8 gauge.....	7/16 inch.....	3/4 inch.....
	7/16 inch.....	3/4 inch.....	3/4 inch.....

TABLE IV—FOR LIQUIDS OVER 13 TO 16 POUNDS PER GALLON
[Minimum Shell Thickness in United States Standard Gauge and Inches—For Mild, High-tensile and Stainless Steel]

Distance between attachments of bulk-heads, baffles or other shell stiffeners	Volume capacity of tank in gallons per inch of length		
	10 or less	Over 10 to 14	Over 14 to 18
36 inches or less..... Over 36 inches to 54 inches..... Over 54 inches to 60 inches.....	Maximum shell radius of less than 70 inches		
	8 gauge.....	8 gauge.....	8 gauge.....
	8 gauge.....	8 gauge.....	7/16 inch.....
36 inches or less..... Over 36 inches to 54 inches..... Over 54 inches to 60 inches.....	Maximum shell radius 70 inches or more but less than 90 inches		
	8 gauge.....	8 gauge.....	7/16 inch.....
	8 gauge.....	7/16 inch.....	3/4 inch.....
36 inches or less..... Over 36 inches to 54 inches..... Over 54 inches to 60 inches.....	Maximum shell radius 90 inches or more but less than 125 inches		
	8 gauge.....	7/16 inch.....	3/4 inch.....
	7/16 inch.....	3/4 inch.....	3/4 inch.....
36 inches or less..... Over 36 inches to 54 inches..... Over 54 inches to 60 inches.....	Maximum shell radius 125 inches or more		
	7/16 inch.....	3/4 inch.....	3/4 inch.....
	7/16 inch.....	3/4 inch.....	3/4 inch.....

(c) *Cargo tanks built of nonferrous metals.* Cargo tanks constructed of materials other than mild, high-tensile or stainless steel shall have shell and head thicknesses designed in accordance with the following formula:

$$\text{Thickness for materials other than steel} = \text{Steel thickness from tables} \times \sqrt[3]{\frac{3 \times 10^7}{\text{Modulus of elasticity of material to be used}}}$$

§ 78.331-4 Joints.

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

§ 78.331-5 Bulkheads, baffles, ring stiffeners, tank supports and compartmentation.

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

§ 78.331-6 Closures for manholes.

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

§ 78.331-7 Overturn protection.

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

§ 78.331-8 Outlets.

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

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

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

§ 78.331-9 Vents, valves and connections.

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

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

§ 78.331-10 Protection of fittings.

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

§ 78.331-11 Emergency discharge control.

(a) See § 78.331-8(b).

§ 78.331-12 Shear section.

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

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

§ 78.331-13 Anchoring of tank.

(a) No applicable provision.

§ 78.331-14 Gauging devices.

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

§ 78.331-15 Pumps and compressors.

(a) No applicable provision.

§ 78.331-16 Method of test.

(a) *Test for leaks.* Every cargo tank shall be tested by completely filling the tank and dome with water or other liquid having a similar viscosity, or with a corrosive liquid permitted to be transported

in the cargo tank, the temperature of which shall not exceed 100° F. during the test, and applying a pressure of 1½ times the design pressure but not less than 3 psig. The pressure shall be gauged at the top of the tank. The tank must hold the prescribed pressure for at least 10 minutes without failure, undue distortion, leakage or evidence of impending failure. All closures shall be in place while test is made.

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

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

(d) *Retest requirements.* See § 77.824 (c) of this chapter.

§ 78.331-17 Marking of cargo tanks.

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

Carrier's Serial Number ¹
 Manufacturer's Name ²
 Date of Manufacture ³
 ICC MC * * * *
 Maximum Working Pressure
 Material
 Lining
 Nominal Capacity _____ U.S. Gallons
 Density of Cargo, Maximum --- Lb./Gallon

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

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

³ For MC 311 cargo tanks insert MC 311-IIS for steel tanks designed in accordance with Table II of § 78.331-3(b); MC 311-IIIS for steel tanks designed in accordance with Table III of § 78.331-3(b); and MC 311-IVS for steel tanks designed in accordance with Table IV of § 78.331-3(b). For aluminum tanks substitute AL for S.

(b) *Test date markings.* The date of the last test shall be painted on the tank in letters not less than $1\frac{1}{4}$ inches high, in legible colors, immediately below the metal identification plate specified in paragraph (a) of this section.

(c) *Additional markings.* In addition to the above markings, cargo tanks must be marked as required by § 77.823 of this chapter.

§ 78.331-18 Certification.

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

§ 78.336 Specification MC 330; cargo tanks constructed of steel, primarily for transportation of compressed gases. For qualification of existing cargo tanks for continued service, see § 73.33 (b), (c), (d), (e), (f), (g), (h) and (i) of this chapter.

§ 78.336-1 General requirements.

(a) *Code construction.* Tanks shall be of seamless or welded steel construction or combination of both and shall be designed and constructed in accordance with and fulfill the requirements of (1) the 1950 edition, (2) 1952 edition, (3) 1956 edition, (4) 1959 edition, or (5) 1962 edition of Section VIII of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code; no revisions except to include ASME Case Interpretations Nos. 1204-9, 1297-3, and 1298-2 and all addendas through the 1962 addenda issued July 16, 1962, (any or all of which hereinafter is referred to as "the Code"). When the above referenced ASME Case interpretations are used for the construction of tanks, the following additional requirements shall be met:

(1) Welding procedure and welder performance tests shall be made in accordance with the 1962 edition of Section IX of the ASME Boiler and Pressure Vessel Code. In addition to the essential variables enumerated in Section IX of this Code, the following shall also be considered essential variables: number of passes, thickness of plate, heat input per pass, and manufacturer of rod or flux. The number of passes, thickness of plate and heat input per pass shall not vary more than 25 percent from the procedure qualification.

(2) Impact tests shall be made on a lot basis. A lot shall be defined as 100 tons or less of the same heat, and having a thickness variation no greater than plus or minus 25 percent. The minimum impact required for full size specimens shall be 20 ft.-lbs. (or 10 ft.-lbs. for half sized specimens) at 0° F. Charpy V-notch in both the longitudinal and transverse direction. If the lot test does not pass this requirement, in-

dividual plates may be accepted if they individually meet this impact test requirement.

(3) Welding procedure and welder qualification tests shall be made each year with one copy of the reports submitted to the Bureau of Explosives.

EXCEPTION: Chlorine tanks shall be fully radiographed and stress relieved in accordance with the provisions of the Code under which they are constructed.

(b) *Design pressure.* The design pressure of a tank authorized under this specification shall be not less than the vapor pressure of the commodity contained therein at 115° F. or as prescribed for a particular commodity in § 73.315 (a) (1) of this chapter, except that in no case shall the design pressure of any container be less than 100 psig. nor more than 500 psig. When corrosion factor is prescribed by these regulations (see § 73.315(a)(1) Note 4 of this chapter) the wall thickness of the tank calculated in accordance with the Code (see paragraph (a) of this section) shall be increased by 20 percent or 0.10 inch, whichever is less.

NOTE 1. The term "design pressure" as used in this specification is identical to the term "maximum allowable working pressure" as used in the Code (see paragraph (a) of this section).

(c) *Grouping openings.* Except as noted below, all openings in the tank shall be grouped in one location, either at the top of the tank or at one end of the tank.

EXCEPTIONS. (1) Chlorine tanks shall be equipped with a nozzle located in the top of the tank. The nozzle shall be fitted with a dome cover plate which shall conform with the standard of The Chlorine Institute, Inc. Dwg. 103-8, dated January 23, 1958. There shall be no other opening in the tank. (2) The openings for liquid level gauging devices, or for safety relief devices may be installed separately at the other location or in the side of the shell. (3) One plugged opening of 2-inch National Pipe Thread or less provided for maintenance purposes may be located elsewhere. (4) Loading and unloading connections may be located in the bottom of the tank.

(d) *Reflective design.* Every uninsulated cargo tank permanently attached to a tank motor vehicle shall, unless it be covered with a jacket made of aluminum, stainless steel, or other bright non-tarnishing metal, be painted all over a white, aluminum, or similar reflecting color.

(e) *Insulation for carbon dioxide, chlorine and nitrous oxide cargo tanks.* See § 73.33(p) of this chapter.

§ 78.336-2 Material.

(a) *General.* All material used for the construction of the tank and appurtenances shall be suitable for use with the commodity to be transported therein. See also § 73.33(n) of this chapter.

(b) *For chlorine.* All plates for tank, manway nozzle and anchorage of tanks used in the transportation of chlorine must be made of steel complying with requirements of A.S.T.M. Specification A-300-52T titled "Steel Plates for Pressure Vessels for Service at Low Temperatures," Class 1, Grade "A", flange or fire box quality. Impact test specimens

made by the plate manufacturers shall be of the Charpy Keyhole notch type and must meet impact requirements (in both longitudinal and transverse directions of rolling) of this specification at a temperature of minus 50° F.

§ 78.336-3 Thickness of metal.

(a) Material thickness shall be as required by the Code (see § 78.336-1(a)), except that material of thickness less than $\frac{3}{16}$ inch shall not be used for the shell, heads and protective housings or devices, except for chlorine tanks the wall thickness shall be not less than $\frac{5}{8}$ inch, including corrosion allowance.

§ 78.336-4 Joints.

(a) Joints shall be as required by the Code (see § 78.336-1(a)).

§ 78.336-5 Bulkheads, baffles and ring stiffeners.

(a) No applicable provision.

§ 78.336-6 Closures for manholes.

(a) No applicable provision.

§ 78.336-7 Overturn protection.

(a) See § 78.336-10.

§ 78.336-8 Outlets.

(a) See § 78.336-1(c).

§ 78.336-9 Safety relief devices, valves and connections.

(a) *Safety relief devices.* See § 73.315 (1) of this chapter.

(b) *Piping, valves and fittings.* See § 73.33(m) of this chapter. For manifolding of cargo tank containers, see § 73.301(f) of this chapter.

(c) *Marking inlets and outlets.* All tank inlets and outlets, except safety relief valves, shall be marked to designate whether they communicate with vapor or liquid when the tank is filled to the maximum permitted filling density.

(d) *Refrigerating and heating coils.* See § 73.33(q) of this chapter.

§ 78.336-10 Protection of fittings.

(a) All valves, fittings, accessories, safety relief devices, gauging devices, and the like shall be adequately protected against mechanical damage.

EXCEPTION: On chlorine tanks there shall be a protective housing and cover plate conforming to the Chlorine Institute, Inc., Dwg. 137-1 dated November 7, 1962 to permit the use of standard emergency kits for controlling leaks in fittings on the dome cover plate.

(b) The protective device or housing shall comply with the requirements under which the tanks are fabricated with respect to design and construction, and shall be designed to withstand static loadings in any direction equal to twice the weight of the tank and attachments when filled with the lading using a safety factor of not less than four, based on the ultimate strength of the material to be used.

§ 78.336-11 Emergency discharge control.

(a) *Excess-flow valves.* See § 73.33 (o) of this chapter.

(b) *Shut-off valves.* See § 73.33(o) (3) of this chapter.

§ 78.336-12 Shear section.

(a) No applicable provision.

§ 78.336-13 Anchoring of tank.

(a) **Hold-down devices.** Adequate "hold-down" devices shall be provided which will anchor each cargo tank to the cradle, frame or chassis in a suitable and safe manner that will not introduce undue concentration of stresses. The means of attachment of any cargo tank to the cradle, frame or chassis of a motor vehicle shall be designed to withstand static loadings in any direction equal to twice the weight of the tank and attachments when filled with the lading using a factor of safety of not less than four, based on the ultimate strength of the material to be used. Hold-down devices (on vehicles with frames not made integral with the tank, as by welding) shall incorporate turnbuckles or similar positive devices for drawing the tank down tight on the frame of the motor vehicle.

(b) **Stops and anchors.** Suitable stops or anchors shall be attached to the motor vehicle and the cargo tank to prevent relative movement between them due to stopping, starting and turning. Stops and anchors shall be installed so as to be readily accessible for inspection and maintenance, except that insulation is permitted to cover such stops and anchors.

(c) **Anchoring integral cargo tanks.** Whenever any tank motor vehicle is so designed and constructed that the cargo tank constitutes in whole or in part the stress member used in lieu of a frame, such cargo tanks shall be designed to withstand the stresses thereby imposed in addition to those covered by the Code (see § 78.336-1(a)).

§ 78.336-14 Gauging devices.

(a) See § 73.315(h) of this chapter.

§ 78.336-15 Pumps and compressors.

(a) See § 73.33(m) (7) of this chapter.

§ 78.336-16 Method of test.

(a) Original test at time of manufacture shall be as required by the Code (see § 78.336-1(a)). For retest requirements, see § 73.33(k) of this chapter.

§ 78.336-17 Marking of cargo tanks.

(a) **Metal identification plate.** In addition to the markings required by the Code (see § 78.336-1(a)) every cargo tank shall have a metal plate permanently affixed on one of the heads of the tank. This plate shall be permanently affixed by means of soldering, brazing, or welding around its perimeter. Neither the plate itself nor the means of attachment to the tank shall be subject to destructive attack by the contents of the tank. On uninsulated tanks the plate shall be in a place readily accessible for inspection. On insulated tanks an additional identical plate shall be permanently affixed to the jacket readily accessible for inspection. Upon such plate shall be plainly marked by stamping, embossing, or other means of forming letters into or on the metal of the plate itself the following information in characters at least 3/8 inch high:

Manufacturer's Name ----- Serial No. -----
 Owner's Serial Number -----
 ICC Specification Number MC 330 -----
 Water capacity (pounds) -----
 Design pressure (psig.) -----
 Original test date -----
 Tank retested at ----- (psig.) on -----

(b) **Additional markings.** In addition to the above markings, cargo tanks must be marked as required by § 77.823 of this chapter.

§ 78.336-18 Certification.

(a) A copy of the manufacturer's data report required by the Code (see § 78.336-1(a)) under which the tank is fabricated shall be furnished for each new tank to the owner and the Bureau of Explosives, 63 Vesey Street, New York 7, N.Y. In addition, the manufacturer or owner shall register each tank with the Bureau of Explosives in the following form:

Place -----
 Date -----
 Cargo Tank
 Manufactured for ----- Company
 Location -----
 Manufactured by ----- Company
 Location -----
 Consigned to ----- Company
 Location -----
 Size ---- feet outside diameter by ---- long

Marks on tank as prescribed by § 78.336-17 are as follows:

Manufacturer's Name ----- Serial No. -----
 Owner's Serial Number -----
 ICC specification -----
 Code symbol -----
 Date of manufacturer -----
 Water capacity (pounds) -----
 Design pressure (psig.) -----

It is hereby certified that this tank is in complete compliance with the requirements of I.C.C. Specification No. -----

(Signed) -----
 (Manufacturer or owner)

PART 79—SPECIFICATIONS FOR TANK CARS

Subpart A—Introduction, Approvals and Reports

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- Sec. 79.200 General specifications applicable to non-pressure tank car tanks.
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- 79.300 General specifications applicable to multi-unit tank car tanks designed to be removed from car structure for filling and emptying.
- 79.301 Individual specification requirements for multi-unit tank car tanks.
- 79.302 Special commodity requirements for multi-unit tank car tanks.

Subpart F—Specifications for Liquefied Hydrogen Tank Car Tanks and Seamless Steel Tanks (Classes ICC-113A-W and 107A)

- 79.400 General specifications applicable to liquefied hydrogen tank car tanks.
- 79.401 Individual specification requirements for liquefied hydrogen tank car tanks.
- 79.500 Specification ICC-107****, seamless steel tank car tanks.

AUTHORITY: The provisions of this Part 79 issued under 62 Stat. 738, 74 Stat. 808; 18 U.S.C. 834.

Subpart A—Introduction, Approvals and Reports

§ 79.1 General.

(a) The specifications in this part apply to tanks which are to be mounted on or form part of a tank car. Tanks when built shall comply with all applicable requirements of the specifications in effect at the time of construction. Tanks built to earlier specifications may continue in use as prescribed in § 73.31 of this chapter.

§ 79.2 Definitions and abbreviations.

- (a) The following apply in Part 79:
 - (1) "AAR" means Association of American Railroads.
 - (2) "Approved" means approval by the AAR Committee on Tank Cars.
 - (3) "ASTM" means American Society for Testing and Materials.
 - (4) "Commission" means Interstate Commerce Commission.
 - (5) Definitions in Part 73 of this chapter also apply.
 - (6) "F" means degrees Fahrenheit.
 - (7) "NGT" means National Gas Taper Threads.
 - (8) "NPT" means American Standard Taper Pipe Thread.
 - (9) "psi" means pounds per square inch gauge.
 - (10) "Tanks" means tank car tanks.

§ 79.3 Procedure for securing approval.

(a) Application for approval of designs, materials and construction, conversion or alteration of tank car tanks under these specifications, complete with detailed prints, shall be submitted in prescribed form to the Secretary, Mechanical Division, AAR, for consideration by its Committee on Tank Cars and other appropriate committees. Approvals or

rejections of applications, based on appropriate committee action, shall be issued by said Secretary.

(b) When, in the opinion of the Committee, such tanks or equipment therefor are in compliance with effective regulations and specifications of the Commission, the application will be approved.

(c) When, in the opinion of the Committee, such tanks or equipment therefor are not in compliance with effective regulations and specifications of the Commission, the Committee may recommend service trials to determine the merits of a change in specifications. Such service trials may be authorized by the Commission under the terms of "ICC Special Permits."

§ 79.4 Changes in specifications for tank cars.

(a) Proposed changes in or additions to specifications for tanks shall be submitted to the Secretary, Mechanical Division, AAR, for consideration by its Committee on Tank Cars. An application for construction of tanks to any new specification may be submitted with proposed specification. Construction should not be started until the specification has been approved or special permit has been issued. When proposing a new specification, the applicant shall furnish information to justify a new specification. This data should include the properties of the lading and the method of loading and unloading.

(b) The Subcommittee on Specifications of the Committee on Tank Cars shall review the proposed specification at its earliest convenience and report its recommendations to the Committee on Tank Cars for prompt consideration. The Committee on Tank Cars shall report its recommendations through said Secretary to the Commission; such reports may be submitted to the Bureau of Explosives for its recommendation before action by the Commission. Expert opinion thus obtained will be given due consideration by the Commission in determining appropriate action.

§ 79.5 Certificate of construction.

(a) Except as provided in paragraph (b) of this section, before a tank car is placed in service, the party assembling the completed car shall furnish to the Bureau of Explosives, to the Secretary, Mechanical Division, AAR, and to the car owner, a Certificate of Construction in prescribed form certifying that the tank, equipment and car complete, comply with all the requirements of the specifications.

(b) Before a tank of Class ICC-106A, 107A or 110A is placed in service, the builder shall furnish to the Bureau of Explosives, to the Secretary, Mechanical Division, AAR, and the owner, a Certificate of Construction in prescribed form certifying that the tank and appurtenances comply with all the requirements of the specifications.

(c) If the owner elects to furnish the appurtenances such as valves and safety devices, the owner shall furnish to the Bureau of Explosives, to the Secretary, Mechanical Division, AAR, a report in prescribed form, certifying that the appurtenances comply with all the requirements of the specifications.

(d) When cars or tanks which are identical in all details are built in groups, one certificate shall suffice for each group.

§ 79.6 Repairs and alterations.

(a) For procedure to be followed in making repairs or alterations, see § 73.31 (f) of this chapter.

Subpart B—General Design Requirements

§ 79.10 Tank mounting.

(a) The manner in which tanks are attached to the car structure shall be approved. The use of rivets to secure anchors to tanks prohibited.

§ 79.11 Welding certification.

(a) Welding procedures, welders and fabricators shall be approved.

§ 79.12 Interior heater systems.

§ 79.12-1 General.

(a) Interior heater systems shall be of approved design and materials. If a tank is divided into compartments, a separate system shall be provided for each compartment.

§ 79.12-2 Materials and dimensions.

(a) Interior heater systems and plug flanges, if welded to tank or dome, shall be cast, forged or fabricated metal, and be of good weldable quality in conjunction with metal of tank or dome.

(b) Piping shall be not less than 2-inch size. Tubing shall be not less than 2 $\frac{3}{8}$ inch outside diameter. Material specifications and minimum wall thickness are as follows:

Material	Minimum thickness	Specification
Carbon steel pipe.	Schedule 80.	ASTM A-53.
Carbon steel tube.	0.175 inch ¹ .	ASTM A-83, ASTM A-178.
Alloy steel pipe...	Schedule 40S.	ASTM A-312.
Alloy steel tube...	0.154 inch...	ASTM A-260.
Aluminum pipe...	Schedule 80.	ASTM B-241.
Aluminum tube...	0.218 inch...	ASTM B-210, ASTM B-235.
Nickel pipe.....	Schedule 40.	ASTM B-161.
Nickel tube.....	0.154 inch...	ASTM B-161.

¹ Nominal thickness.

(c) Systems may be fabricated of other materials and of other than circular cross section, if approved.

§ 79.12-3 Joints and fittings.

(a) Welded butt joints are preferable. Bolted joints with flange welded to piping may be used if welding is not feasible or to facilitate tank cleaning or application of linings. Return bends shall be forged or made by bending the pipe. Cast, forged or fabricated manifolds of approved design may be used.

(b) Inlets and outlets of heater systems shall be equipped with valve cock, cap or plug. Caps and plugs shall be secured by chain.

§ 79.12-4 Application to tank.

(a) Interior heater systems shall be so constructed that the breaking off of their external connections will not cause leakage of contents of tank.

(b) Inlets and outlets may be located in any portion of dome, shell, heads, or

steam jacketed outlet provided proper drainage of heater system is accomplished.

(c) If ends of coils are not attached to a manifold or steam jacketed outlet, they shall be attached to pads or reinforcements. Such reinforcements must be attached to tank in compliance with the requirements of the tank specification.

(1) Outside pipe connections to steam coils shall not be an integral part of the interior coils and shall be screwed or welded, or both, into outside of pads or reinforcements.

(d) All piping shall be secured so as to permit necessary expansion and contraction.

§ 79.12-5 Tests.

(a) Each interior heater system shall be hydrostatically tested at not less than 200 psi and shall hold the pressure for 10 minutes without leakage or evidence of distress.

§ 79.12-6 Reports.

(a) The Certificate of Construction for the completed car shall indicate installation of interior heater system and date of initial hydrostatic test.

§ 79.12-7 Stenciling.

(a) To indicate that tank is equipped with interior heater system, the tank, or the jacket if tank is insulated, shall be stenciled in compliance with the applicable requirements of AAR Specifications for Tank Cars, Appendix C.

Subpart C—Specifications for Pressure Tank Car Tanks (Classes ICC-105A, 109A-W, 112A-W and 114A-W)

§ 79.100 General specifications applicable to pressure tank car tanks.

§ 79.100-1 Tanks built under these specifications shall comply with the requirements of §§ 79.100, 79.101, and when applicable, §§ 79.102, 79.103, and 79.104.

§ 79.100-2 Approval.

(a) For procedure for securing approval see § 79.3.

§ 79.100-3 Type.

(a) Tanks built under this specification shall be fusion-welded with heads designed convex outward. Except as provided in § 79.103 or 79.104 they shall be circular in cross section, shall be provided with a manway nozzle on top of the tank of sufficient size to permit access to the interior, a manway cover to provide for the mounting of all valves, measuring and sampling devices, and a protective housing. Other openings in the tank are prohibited, except as provided in Part 73 of this chapter, §§ 79.100-14, 79.101-1 Note 10, or § 79.103.

§ 79.100-4 Insulation.

(a) If insulation is applied, the tank shell and manway nozzle shall be insulated with an approved material. The entire insulation shall be covered with a metal jacket not less than $\frac{1}{8}$ inch in thickness and flashed around all openings so as to be weather tight. The exterior surface of a carbon steel tank and the inside surface of a carbon steel

jacket shall be given a protective coating except that protective coating is not required when foam-in-place insulation that adheres to the tank and jacket is applied.

(b) If insulation is a specification requirement, it shall be of sufficient thickness so that the thermal conductance at 60° F is not more than 0.075 Btu per hour, per square foot, per degree F temperature differential. If exterior heaters are attached to tank, the thickness of the insulation over each heater element may be reduced to one-half that required for the shell.

§ 79.100-5 Bursting pressure.

(a) The minimum required bursting pressure is listed in § 79.101.

§ 79.100-6 Thickness of plates.

(a) The wall thickness of the tank shell and heads shall not be less than that specified in § 79.101, nor that calculated by the following formula:

$$t = \frac{Pd}{2SE}$$

where:

- d=inside diameter in inches;
- E=0.9 welded joint efficiency; except E=1.0 for seamless aluminum alloy heads;
- P=minimum required bursting pressure in psi;
- S=minimum strength of plate material in psi, as prescribed in § 79.100-7;
- t=minimum design thickness of plate in inches.

(b) If plates are clad with material having tensile strength properties at least equal to the base plate, the cladding may be considered a part of the base plate when determining thickness. If cladding material does not have tensile strength at least equal to the base plate, the base plate alone shall meet the thickness requirement.

(c) When aluminum plate is used, the minimum width of bottom sheet of tank shall be 60 inches, measured on the arc, but in all cases the width shall be sufficient to bring the entire width of the longitudinal welded joint, including welds, above the bolster.

§ 79.100-7 Material.

(a) Carbon steel plate material used to fabricate tank shell and manway nozzle shall be open hearth boiler plate of flange or firebox quality having a carbon content not exceeding 0.31 percent and complying with one of the following ASTM specifications for the material and with the indicated minimum tensile strength and elongation in the welded condition.

Specifications	Minimum tensile strength (psi) welded condition	Minimum elongation in 2 inches (percent) welded condition
ASTM A 201 Gr. A.....	55,000	28
ASTM A 201 Gr. B.....	60,000	25
ASTM A 212 Gr. A.....	65,000	20
ASTM A 212 Gr. B.....	70,000	20
ASTM A 285 Gr. A.....	45,000	29
ASTM A 285 Gr. B.....	50,000	20
ASTM A 285 Gr. C.....	55,000	20
ASTM A 302 Gr. B.....	80,000	20

(1) These plates may be clad with other approved metals.

(2) High tensile strength carbon-silicon steel plates to an approved specification having a minimum elongation of 21 percent in 2 inches may also be used.

(b) Aluminum alloy plate material used to fabricate tank shell and manway nozzle shall be suitable for fusion welding and shall comply with one of the following ASTM specifications for the material and with the indicated minimum tensile strength and elongation in the welded condition:

Specifications	Minimum tensile strength 0 temper (psi) welded condition	Minimum elongation in 2 inches 0 temper (percent) welded condition
ASTM B 209 Alloy 1060...	9,500	25
ASTM B 209 Alloy 1100...	11,000	28
ASTM B 209 Alloy 3003...	14,000	23
ASTM B 209 Alloy 5052...	25,000	18
ASTM B 209 Alloy 5083 ¹ ...	40,000	16
ASTM B 209 Alloy 5086...	35,000	14
ASTM B 209 Alloy 5154...	30,000	18
ASTM B 209 Alloy 5254...	30,000	18
ASTM B 209 Alloy 5454...	31,000	18
ASTM B 209 Alloy 5652...	25,000	18
ASTM B 209 Alloy 6061...	24,000	15

¹ Not 0 temper.
² Only 0 or H113 temper permitted.

(c) All attachments welded to tank shell shall be of approved material which is suitable for welding to the tank.

§ 79.100-8 Tank heads.

(a) The tank head shape shall be an ellipsoid of revolution in which the major axis shall equal the diameter of the shell adjacent to the head and the minor axis shall be one-half the major axis.

§ 79.100-9 Welding.

(a) All joints shall be fusion-welded in compliance with the requirements of AAR Specifications for Tank Cars, Appendix W. Welding procedures, welders and fabricators shall be approved. Also see § 79.104.

§ 79.100-10 Stress relieving.

(a) After welding is complete, steel tanks and all attachments welded thereto, shall be stress relieved as a unit in compliance with the requirements of AAR Specifications for Tank Cars, Appendix W.

(b) For aluminum tanks, stress relieving is prohibited.

§ 79.100-11 Tank mounting.

(a) See §§ 79.10 and 79.104-3.

§ 79.100-12 Manway nozzle, cover and protective housing.

(a) Manway nozzles shall be of approved design of forged or rolled steel for steel tanks or fabricated aluminum alloy for aluminum tanks, with access opening at least 18 inches inside diameter, or at least 14 inches by 18 inches obround or oval. Nozzle shall be welded to the tank and the opening reinforced in an approved manner in compliance with the requirements of AAR Specifications for Tank Cars, Appendix C, Figure 10.

(b) Manway cover shall be machined to approved dimensions and be of forged or rolled carbon or alloy steel, rolled aluminum alloy or nickel when required by the lading. Minimum thickness is

listed in § 79.101. Manway cover shall be attached to manway nozzle by through or stud bolts not entering tank, except as provided in § 79.103-2 (a).

(c) Except as provided in § 79.103, protective housing of cast, forged or fabricated approved materials shall be bolted to manway cover. The shearing value of the bolts attaching protective housing to manway cover shall not exceed 70 percent of the shearing value of bolts attaching manway cover to manway nozzle. Housing shall be equipped with a suitable metal cover that can be securely closed. Housing cover shall have suitable stop to prevent cover striking loading or unloading connections and be hinged on one side only with approved riveted pin or rod with nuts and cotters. Openings in wall of housing shall be equipped with screw plugs or other closures.

§ 79.100-13 Venting, loading and unloading valves, measuring and sampling devices.

(a) Venting, loading and unloading valves shall be of approved design, made of metal not subject to rapid deterioration by the lading, and shall withstand the tank test pressure without leakage. The valves shall be directly bolted to seatings on manway cover, except as provided in § 79.103. Valve outlets shall be closed with approved screw plugs or other closures fastened to prevent misplacement.

(b) The interior pipes of the loading and unloading valves shall be anchored and, except as prescribed in § 79.102, or 79.103, may be equipped with excess flow valves of approved design.

(c) Gaging device, sampling valve and thermometer well are not specification requirements. When used, they shall be of approved design, made of metal not subject to rapid deterioration by the lading, and shall withstand the tank test pressure without leakage. Interior pipes of the gaging device and sampling valve, except as prescribed in § 79.102, or 79.103, may be equipped with excess flow valves of approved design. Interior pipe of the thermometer well shall be anchored in an approved manner to prevent breakage due to vibration. The thermometer well shall be closed by an approved valve attached close to the manway cover, or other approved location, and closed by a screw plug. Other approved arrangements that permit testing thermometer well for leaks without complete removal of the closure may be used.

(d) An excess flow valve as referred to in this specification, is a device which closes automatically against the outward flow of the contents of the tank such as may be encountered in case the external closure valve is broken off or removed during transit. Excess flow valves may be designed with a by-pass to allow the equalization of pressures.

§ 79.100-14 Bottom outlets.

(a) Bottom outlets for discharge of lading is prohibited, except as provided in § 79.103-3. If indicated in § 79.101, tank may be equipped with a bottom washout of approved construction. If applied, bottom washout shall be in ac-

cordance with the following requirements:

(1) The extreme projection of the bottom washout shall be at least 12 inches above top of rail.

(2) Bottom washout shall be of cast, forged or fabricated metal and shall be fusion-welded to the tank. It shall be of good weldable quality in conjunction with metal of tank.

(3) If bottom washout nozzle extends 6 inches or more from shell of tank, a "V" groove shall be cut (not cast) in the upper part of the nozzle at a point immediately below the lowest part of inside closure seat or plug to a depth that will leave wall thickness of nozzle at the root of the "V" not over 3/8 inch. Where nozzle is not a single piece, provision shall be made for the equivalent of the breakage groove. The nozzle shall be of a thickness to insure that accidental breakage will occur at or below the "V" groove or its equivalent.

(4) The closure plug and seat shall be readily accessible or removable for repairs.

(5) Joints between closures and their seats may be gasketed with suitable material.

§ 79.100-15 Safety relief valves.

(a) The tank shall be equipped with one or more safety relief valves of approved design, made of metal not subject to rapid deterioration by the lading. The safety relief valve, or valves, shall be mounted on manway cover, except as provided in § 79.103. The total valve discharge capacity shall be sufficient to prevent building up pressure to tank in excess of 82½ percent of the tank test pressure. The start-to-discharge and vapor-tight pressures shall comply with § 79.101 and shall not be affected by any auxiliary closure or other combination. For certain commodities, alternate pressures are permitted (see § 79.102-11). See AAR Specifications for Tank Cars,

Appendix A, for formula for calculating discharge capacity.

(b) When a safety relief valve is used in combination with a breaking pin device, the breaking pin device shall be designed to fail at a pressure of 75 percent of the tank test pressure and safety relief valve shall be set for a start-to-discharge pressure of 71 percent of the tank test pressure.

(c) When a safety relief valve is used in combination with a frangible disc, the frangible disc shall be designed to burst at a pressure of 75 percent of the tank test pressure and the safety relief valve shall be set for a start-to-discharge pressure of 71 percent of the tank test pressure. Provision shall be made to prevent any accumulation of pressure between the frangible disc and safety relief valve.

§ 79.100-16 Attachments not otherwise specified.

(a) Attachments not otherwise specified shall be applied by approved means.

§ 79.100-17 Closures for openings.

(a) Closures shall be of approved design and made of metal not subject to rapid deterioration by the lading. Plugs, if used, shall be solid, with NPT threads, and shall be of a length which will screw at least six threads inside the face of fitting or tank.

§ 79.100-18 Tests of tanks.

(a) Each tank shall be tested by completely filling tank and manway nozzle with water or other liquid having similar viscosity, at a temperature which shall not exceed 100 F during the test; and applying the pressure prescribed in § 79.101. The tank shall hold the prescribed pressure for at least 10 minutes without leakage or evidence of distress.

(b) Insulated tanks shall be tested before insulation is applied.

(c) Calking of welded joints to stop leaks developed during the foregoing test is prohibited. Repairs in welded joints shall be made as prescribed in AAR specifications for Tank Cars, Appendix W.

(d) Testing of exterior heaters is not a specification requirement.

§ 79.100-19 Tests of safety relief valves.

(a) Each valve shall be tested by air or gas for compliance with § 79.101 before being put into service.

§ 79.100-20 Stamping.

(a) To certify that the tank complies with all specification requirements, each tank shall be plainly and permanently stamped in letters and figures at least 3/8 inch high into the metal near the center of both outside heads as follows:

	<i>Example of required stamping</i>
Specification.....	ICC-105A100-W
Material.....	ASTM A212 B
Cladding material (if any) -	ASTM A240-304 Clad
Tank builder's initials.....	ABC
Date of original test.....	00-0000
Car assembler (if other than tank builder).....	DEF
Water capacity.....	00000 lbs.

§ 79.100-21 Stenciling.

(a) The tank or the jacket if tank is insulated, shall be stenciled in compliance with the requirements of AAR Specifications for Tank Cars, Appendix C.

§ 79.100-22 Certificate of construction.

(a) See § 79.5.

§ 79.101 Individual specification requirements applicable to pressure tank car tanks.

§ 79.101-1 Individual specification requirements.

(a) In addition to § 79.100 the individual specification requirements are as follows:

ICC specifications	105A100W	105A200F	105A200W	105A300W	105A400W	105A500W	105A600W	105A100ALW	105A200ALW	105A300ALW
Material (see 79.100-7).....	Steel Required	Steel Required	Steel Required	Steel Required	Steel Required	Steel Required	Steel Required	Aluminum Required	Aluminum Required	Aluminum Required
Insulation (see 79.100-4).....										
Bursting pressure, p.s.i. (see 79.100-5).....	500		500	750	1000	1250	1500	500	500	750
Minimum plate thickness, inches, Shell, and Heads.....	5/16	5/16	5/16	1 1/16	1 1/16	1 1/16	1 1/16	5/8	5/8	5/8
Test pressure, p.s.i. (see 79.100-18).....	100	See 79.104	200	300	400	500	600	100	200	300
Safety relief valves, p.s.i.: * Start-to-discharge pressure.....	75	150	150	225	300	375	450	75	150	225
Start-to-discharge tolerance.....	±3.0	±4.5	±4.5	±6.75	±9.0	±11.25	±13.5	±3.0	±4.5	±6.75
Vapor-tight (minimum) pressure.....	60	120	120	180	240	300	360	60	120	180
Manway cover, thickness, inches (minimum).....	2 1/4	2 1/4	2 1/4	2 1/4	2 1/4	2 1/4	2 1/4	2 1/2	2 1/2	2 5/8
Special references.....	79.102-3 79.102-6	79.102-3 79.102-6 79.104	79.102-3 79.102-6	79.102-2 79.102-3 79.102-5 79.102-6 79.102-7 79.102-8 79.102-11	79.102-3	79.102-1 79.102-2 79.102-3 79.102-4 79.102-9 79.102-10	79.102-1 79.102-3 79.102-4 79.102-9 79.102-10	79.102-3	79.102-3	79.102-3
Bottom washout.....	Prohibited	Prohibited	Prohibited	Prohibited	Prohibited	Prohibited	Prohibited	Prohibited	Prohibited	Prohibited

See footnotes at end of table.

ICC specifications	109A300W	109A100ALW	109A200ALW	109A300ALW	112A200W	112A340W	112A400W	112A500W	114A340W	112A400F
Material (see 79.100-7)	Steel	Aluminum	Aluminum	Aluminum	Steel	Steel	Steel	Steel	Steel	
Insulation (see 79.100-4)	Optional	Optional	Optional	Optional	None	None	None	None	None	
Bursting pressure, p.s.i. (see 79.100-5)	750	500	500	750	500	850	1000	1250	850	
Minimum plate thickness, inches, Shell, and Heads	1 1/4	3/4	3/4	3/4	3/4	1 1/4	1 1/4	1 1/4	1 1/4	
Test pressure, p.s.i. (see 79.100-18)	300	100	200	300	200	340	400	500	340	
Safety relief valves, p.s.i.:										
Start-to-discharge pressure	225	75	150	225	150	255	300	375	255	
Start-to-discharge tolerance	±6.75	±3.0	±4.5	±6.75	±4.5	±7.65	±9.0	±11.25	±7.65	
Vapor tight (minimum) pressure	180	60	120	180	120	204	240	300	204	
Manway cover, thickness inches (minimum)	2 1/4	2 1/4	2 1/4	2 1/4	2 1/4	2 1/4	2 1/4	2 1/4	(7)	
Special references					¹⁰ 79.102-3	⁷ 79.102-3 ¹⁰ 79.102-11	⁷ 79.102-3 ¹⁰ 79.102-11	¹⁰ 79.102-3	⁷ 79.102-11 79.103	
Bottom washout	Optional	Optional	Optional	Optional	Prohibited	Prohibited	Prohibited	Prohibited	⁸ Optional	

¹ When steel of 65,000 to 81,000 p.s.i. minimum tensile strength is used, the thickness of plates shall not be less than 3/8 inch, and when steel of 81,000 p.s.i. minimum tensile strength is used, the minimum thickness of plate shall be not less than 1/2 inch.
² When approved material other than aluminum alloys are used, the thickness p.s.i. shall not be less than 2 1/4 inches.
³ When steel of 65,000 p.s.i. minimum tensile strength is used, minimum thickness of plates shall not be less than 1/2 inch.
⁴ At least the upper two-thirds of the exterior of the tank, manway nozzle and all appurtenances in contact with this area of the tank shall have a finish coat of light-reflective paint.
⁵ For inside diameter of 87 inches or less, the thickness of plates shall not be less than one-half inch.

⁶ See 79.102 for optional setting for certain commodities.
⁷ See 79.103-1(c).
⁸ See 79.103-3 for optional bottom loading and unloading.
⁹ When the use of nickel is required by the lading, the thickness shall not be less than 2 inches.
¹⁰ Each tank head of class 112A tank car tanks may be equipped with not more than one opening for use in purging tank interior.
¹¹ Tanks converted from existing forge-welded specification 105A500 tanks by modification using conversion details complying with ICC-112A specification requirements, shall be stenciled by substituting the letter "F" for the letter "W" in the specification designation.

§ 79.102 Special commodity requirements for pressure tank car tanks.

(a) In addition to §§ 79.100 and 79.101 the following requirements are applicable:

§ 79.102-1 Liquefied carbon dioxide.

(a) Spec. 105A500-W or 105A600-W tank cars used to transport Liquefied carbon dioxide shall comply with the following special requirements:

- (1) All plates for tank, manway nozzle and anchorage, shall be made of steel complying with a specification approved for service at low temperatures.
- (2) Tank shall be insulated with an approved material of sufficient thickness so that the thermal conductance at 60 F is not more than 0.03 Btu per hour per square foot per degree F temperature differential; except that in order to permit an anchorage which shall not exceed seven inches from top of center sills to bottom of tank, the insulation thickness directly over the sills may be reduced to give thermal conductance not exceeding 0.04 Btu per hour per square foot per degree F temperature differential.
- (3) Tank shall be equipped with one safety relief valve set for the start-to-discharge pressure listed in § 79.101, and one safety vent of approved design, set to function at a pressure less than the tank test pressure, and not less than 75 percent of tank test pressure. The discharge capacity of each of these safety relief devices shall be sufficient to prevent building up pressure in tank in excess of 82 1/2 percent of the tank test pressure.
- (4) Tank shall be equipped with two pressure-regulating valves of approved design, set to open at a pressure not exceeding 350 psi on spec. 105A500-W tanks or 400 psi on spec. 105A600-W tanks.
- (5) Each regulating valve and safety relief device shall have its final discharge piped to the outside of the protective housing.

§ 79.102-2 Chlorine.

(a) Spec. 105A300-W or 105A500-W tank cars used to transport chlorine shall comply with the following special requirements:

- (1) The quantity of chlorine loaded into a single-unit tank car shall not exceed 50,000 pounds, except that not more than 110,000 pounds nor less than 107,800 pounds of chlorine may be loaded in such cars if insulated with 4 inches of corkboard and constructed, maintained, and retested in compliance with spec. 105A500-W. Cars may be registered and jackets stenciled either 105A300-W or 105A500-W and equipped with the safety relief valve required by the specification to which registered.
- (2) The interior pipes of liquid discharge valves shall be equipped with excess flow valves of approved design.

§ 79.102-3 Liquefied flammable gases.

(a) Spec. 105A100-W, 105A200-F, 105A200-W, 105A300-W, 105A400-W, 105A500-W, 105A600-W, 105A100-ALW, 105A200-ALW, 105A300-ALW, 112A200-W, 112A340-W, 112A400-W or 112A500-W tank cars used to transport liquefied flammable gases shall comply with the following special requirements:

- (1) The interior pipes of the loading and unloading valves, gaging device and sampling valve shall be equipped with excess flow valves of an approved design.
- (2) The protective housing cover shall be equipped with an approved weather-proof cover over an opening having an unrestricted area at least equal to the total safety relief valve discharge area.

§ 79.102-4 Vinyl fluoride, inhibited.

(a) Spec. 105A600-W tank cars used to transport vinyl fluoride, inhibited, shall comply with the following special requirements:

- (1) Tank shall be insulated with an approved material of sufficient thickness so that the thermal conductance at 60 F is not more than 0.03 Btu per hour per

square foot per degree F temperature differential; except that in order to permit an anchorage which shall not exceed seven inches from top of center sill to bottom of tank, the insulation thickness directly over the sills may be reduced to give thermal conductance not exceeding 0.04 Btu per hour per square foot per degree F temperature differential.

(2) Tank shall be equipped with one safety relief valve, set for the start-to-discharge pressure listed in § 79.101, and one safety vent of approved design, set to function at a pressure less than the tank test pressure, and not less than 75 percent of the tank test pressure. The discharge capacity of each of these safety relief devices shall be sufficient to prevent building up pressure in tank in excess of 82 1/2 percent the tank test pressure.

(3) Each regulating valve and safety relief device shall have its final discharge piped to the outside of the protective housing.

§ 79.102-5 Nitrosyl chloride.

(a) Spec. 105A300-W tank cars used to transport Nitrosyl chloride shall comply with the following special requirements:

- (1) Tanks shall be made of or clad with a metal not subject to rapid deterioration by the lading; all appurtenances such as manway covers, venting, loading and unloading valves, safety relief valves, excess flow valves, and education pipes, shall be made of metal not subject to rapid deterioration by the lading; cork shall be used as an insulating material.

§ 79.102-6 Vinyl chloride or Vinyl methyl ether, inhibited.

(a) Spec. 105A200-W 112A400-W tank cars, used to transport Vinyl chloride, and spec. 105A100-W or 105A300-W tank cars used to transport Vinyl methyl ether, inhibited, shall comply with the following special requirements:

(1) All parts of valves and safety relief devices in contact with the lading shall be of a metal or other material suitably treated, if necessary, which will not cause formation of any acetylides.

(2) The interior pipes of the loading and unloading valves, gaging device and sampling valve shall be equipped with excess flow valves of an approved design.

(3) For Vinyl chloride in spec. 105A-200-W tank cars, openings in tank heads to facilitate nickel lining are authorized if closed in an approved manner.

§ 79.102-7 Bromine.

(a) Spec. 105A300-W tank cars used to transport Bromine shall comply with the following special requirements:

(1) The tank shall be nickel clad at least 20 percent or shall be lined with lead at least $\frac{3}{16}$ inch thick; openings in tank heads to facilitate application of lead lining are authorized if closed in an approved manner; all closures and appurtenances in contact with the lading shall be lead lined or shall be made of metal not subject to rapid deterioration by the lading; all interior welds in nickel clad tanks shall be protected by pure nickel butt straps to eliminate iron contamination. Except as otherwise provided herein, the water weight capacity of the tank shall not exceed 20,400 pounds. When tanks are equipped with manway cover plates, safety relief valves, venting, loading and unloading valves in accordance with spec. 105A300-W, and tank jackets are stenciled spec. 105A300-W, but in all other respects are constructed and maintained in full compliance with spec. 105A500-W, the water weight capacity of the tank shall not exceed 37,400 pounds.

§ 79.102-8 Motor fuel anti-knock compound.

(a) Spec. 105A300-W tank cars used to transport Motor fuel anti-knock compounds shall comply with the following special requirements:

(1) Jacket shall be stenciled on both sides "MOTOR FUEL ANTI-KNOCK COMPOUND ONLY." Openings in tank heads to facilitate application of nickel lining are authorized if closed in an approved manner.

§ 79.102-9 Nitrogen tetroxide or Nitrogen tetroxide-nitric oxide mixtures.

(a) Specs. 105A500-W and 105A600-W tank cars used to transport Nitrogen tetroxide or Nitrogen tetroxide-nitric oxide mixtures shall comply with the following special requirements:

(1) Tanks shall be insulated with not less than four inches of corkboard. All valves and fittings shall be protected by the securely attached cover made of metal not subject to rapid deterioration by the lading, and all valve openings, except the safety relief valves, shall be fitted with screw plugs or caps to prevent leakage in the event of valve failure. Safety relief valve shall be equipped with an approved stainless steel or platinum frangible disc. Jacket shall be stenciled on both sides in letters not less than 2 inches high "NITROGEN TETROXIDE ONLY" or "NITROGEN TETROXIDE-NITRIC OXIDE MIXTURES ONLY," as applicable. Written procedure covering details of tank car appurtenances, manway

fittings and safety relief devices, and marking, loading, handling, inspection and testing practices, shall be filed with and approved by the Bureau of Explosives before any tank car is offered for transportation of these commodities.

§ 79.102-10 Hydrocyanic acid.

(a) Spec. 105A500-W or 105A600-W tank cars used to transport Hydrocyanic acid shall comply with the following special requirements:

(1) Cars shall be registered and the jacket stenciled spec. 105A300-W and be equipped with the safety relief valves required by that specification. Tanks shall be insulated with not less than 4 inches of corkboard. Jacket shall be stenciled on both sides in letters not less than 2 inches high "HYDROCYANIC ACID ONLY." Written procedure covering details of tank car appurtenances, manway fittings and safety relief devices, and marking, loading, handling, inspection and testing practices, shall be filed with and approved by the Bureau of Explosives before any tank car is offered for transportation of hydrocyanic acid.

§ 79.102-11 Liquefied petroleum gas or Anhydrous ammonia.

(a) Spec. 105A300-W, 112A340-W, 112A400-W or 114A340-W tank cars used to transport Liquefied petroleum gas or Anhydrous ammonia, may as an alternate comply with the following special requirements:

(1) Safety relief valves may be set to the following pressures, provided the total valve discharge capacity is sufficient to prevent building up pressure in the tank in excess of 90 percent of the tank test pressure.

ICC specifications	105A300-W	112A340-W	112A400-W	114A340-W
Safety relief valves, psi:				
Start-to-discharge pressure	247.5	280.5	330	280.5
Start-to-discharge tolerance	±7.4	±8.4	±10	±8.4
Vapor tight pressure (minimum)	196	224	264	224

§ 79.103 Special requirements for class 114A * * * tank car tanks.

(a) In addition to the applicable requirements of §§ 79.100 and 79.101 the following requirements shall be complied with:

§ 79.103-1 Type.

(a) Tanks built under this section may be of any approved cross section.

(b) Any portion of the tank shell not circular in cross section shall have walls of such thickness and be so reinforced that the stresses in the walls caused by a given internal pressure are no greater than the circumferential stresses which would exist under the same internal pressure in the wall of a tank of circular cross section designed in accordance with paragraphs § 79.100-6 (a) and (b), but in no case shall the wall thickness be less than that specified in § 79.101.

(c) Manway and cover may be located other than at the top of the tank.

(d) Valves and fittings need not be mounted on the manway cover.

(e) One opening may be provided in each head for use in purging the tank interior.

§ 79.103-2 Manway cover.

(a) Manway cover may be of the internal self-energizing type and shall be of approved design.

(b) If no valves or measuring and sampling devices are mounted on manway cover, no protective housing is required.

§ 79.103-3 Venting, loading and unloading valves, measuring and sampling devices.

(a) Venting, loading and unloading valves, measuring and sampling devices, when used, shall be attached to a nozzle or nozzles on the tank shell or heads.

(b) These valves and appurtenances shall be grouped in one location, shall be provided with a protective cover or housing with cover or may be recessed into the tank shell. A duplicate set grouped in another location may be provided.

(c) The interior pipes of the loading, unloading, and sampling valves shall be equipped with excess flow valves of approved design, except when quick closing internal valves of approved design are used. When the interior pipe of the gaging device provides a means for the passage of lading from the interior to the exterior of the tank, it shall be equipped with an excess flow valve of approved design or with an orifice not exceeding a No. 54 drill size.

§ 79.103-4 Safety relief valves.

(a) Safety relief valve or valves shall be located on top of tank near the center of the car on a nozzle, mounting plate or recess in the shell. Through or stud bolts, if used, shall not enter the tank.

(b) Metal guard of approved design shall be provided to protect safety relief valve or valves from damage.

§ 79.104 Special requirements for spec. 105A200-F tank car tanks.

§ 79.104-1 Tanks built under these specifications shall meet the requirements of §§ 79.100, 79.101, 79.102 and 79.104.

§ 79.104-2 Type.

(a) Tanks built under this specification shall be fabricated by conversion from existing forge-welded steel tanks complying with specs. 105A300, 105A400, 105A500 or 105A600.

§ 79.104-3 Tank mounting.

(a) The use of rivets as a means of attaching anchor to tank is permitted.

§ 79.104-4 Welding.

(a) All joints shall be lap welded by the water gas process, hammered or rolled or other lap welded, hammered or rolled process which investigation and laboratory tests by the Mechanical Division of the AAR have proved will produce satisfactory results.

Subpart D—Specifications for Non-Pressure Tank Car Tanks (Classes ICC-103, 104, 111A-F and 111A-W)

§ 79.200 General specifications applicable to non-pressure tank car tanks.

§ 79.200-1 Tank built under these specifications shall meet the requirements of §§ 79.200, 79.201 and 79.202.

§ 79.200-2 Approval.

(a) For procedure for securing approval, see § 79.3.

§ 79.200-3 Type.

(a) Tanks built under this specification shall be cylindrical, with heads designed convex outward. When specified in § 79.201-1 tank shall have at least one manway or one expansion dome with manway, and such other external projections as are prescribed herein. When the tank is divided into compartments, each compartment shall be treated as a separate tank.

§ 79.200-4 Insulation.

(a) If insulation is applied, the tank shell and expansion dome when used shall be insulated with an approved material. The entire insulation shall be covered with a metal jacket not less than 1/8 inch in thickness and flashed around all openings so as to be weather tight. The exterior surface of a carbon steel tank and the inside surface of a carbon steel jacket shall be given a protective coating, except that protective coating is not required when foam-in-place insulation that adheres to the tank and jacket is applied.

(b) If insulation is a specification requirement, it shall be of sufficient thickness so that the thermal conductance at 60 F is not more than 0.225 Btu per hour, per square foot, per degree F temperature differential, unless otherwise provided in § 79.201-1. If exterior heaters are attached to tank, the thickness of the insulation over each heater element may be reduced to one-half that required for the shell.

§ 79.200-5 Bursting pressure.

(a) The minimum required bursting pressure is listed in § 79.201-1.

§ 79.200-6 Thickness of plates.

(a) The wall thickness of the tank shell, dome shell, and of 2:1 ellipsoidal heads shall not be less than specified in § 79.201-1, nor that calculated by the following formula:

$$t = \frac{Pd}{2SE}$$

where:

d=inside diameter in inches;

E=0.9 welded joint efficiency; except E=1.0 for seamless aluminum alloy heads and seamless heads of Class ICC-111A tanks;

P=minimum required bursting pressure in psi;

S=minimum tensile strength of plate material in psi as prescribed in § 79.200-7;

t=minimum design thickness of plate in inches.

(b) The thickness of a dished head shall not be less than specified in § 79.201-1, nor that calculated by the following formula:

$$t = \frac{5PL}{6SE}$$

where:

E=0.9 welded joint efficiency; except E=1.0 when head is formed from one piece;

L=main inside radius to which head is dished, measured on concave side in inches;

P=minimum required bursting pressure in psi;

S=minimum tensile strength of plate material in psi as prescribed in § 79.200-7;

t=minimum thickness of plate in inches.

(c) If plates are clad with material having tensile strength properties at least equal to the base plate, the cladding may be considered a part of the base plate when determining thickness. If cladding material does not have tensile strength at least equal to the base plate, the base plate alone shall meet the thickness requirements.

(d) For tanks constructed of longitudinal sections, the minimum width of bottom sheet of tank shall be 60 inches, measured on the arc, but in all cases the width shall be sufficient to bring the entire width of the longitudinal welded joint, including welds, above the bolster.

(e) For tanks built of one piece cylindrical sections, the thickness specified for bottom sheet shall apply to the entire cylindrical section.

(f) See § 79.200-9 for thickness requirements for compartment tanks.

§ 79.200-7 Material.

(a) Carbon steel plate material used to fabricate tank and expansion dome, when used, shall be open hearth boiler plate of flange or firebox quality having a carbon content not exceeding 0.31 percent and complying with one of the following ASTM specifications for the material and with the indicated minimum tensile strength and elongation in the welded condition:

Specifications	Minimum tensile strength (psi) welded condition	Minimum elongation in 2 inches (percent) welded condition
ASTM A201 Gr. A.....	55,000	28
ASTM A201 Gr. B.....	60,000	25
ASTM A212 Gr. A.....	65,000	20
ASTM A212 Gr. B.....	70,000	20
ASTM A285 Gr. A.....	45,000	29
ASTM A285 Gr. B.....	50,000	20
ASTM A285 Gr. C.....	55,000	20

(1) These plates may be clad with other approved metals.

(b) Aluminum alloy plate material used to fabricate tank and expansion dome, when used, shall be suitable for fusion welding, and shall comply with one of the following ASTM specifications for the material and with the indicated minimum tensile strength and elongation for the welded condition:

Specifications	Minimum tensile strength 0 temper (psi) welded condition	Minimum elongation in 2 inches 0 temper (percent) welded condition
ASTM B209 Alloy 1060...	9,500	25
ASTM B209 Alloy 1100...	11,000	28
ASTM B209 Alloy 3003...	14,000	23
ASTM B209 Alloy 5052...	25,000	18
ASTM B209 Alloy 5083 ¹ ...	40,000	16
ASTM B209 Alloy 5086...	35,000	14
ASTM B209 Alloy 5154...	30,000	18
ASTM B209 Alloy 5254...	30,000	18
ASTM B209 Alloy 5454...	31,000	18
ASTM B209 Alloy 5652...	25,000	18
ASTM B209 Alloy 6061...	24,000	15

¹ Not 0 temper.

² Only 0 temper or H-113 permitted.

(c) Alloy steel plate material used to fabricate tank and expansion dome, when used, shall be capable of resisting the action of nitric acid so that the maximum corrosion rate in inches penetration per month shall be 0.006 for the straight chromium-bearing stainless steel and 0.0015 for any of the chromium-nickel alloys when tested by the procedure in ASTM Specification A-262 titled Recommended Practice Boiling Nitric Acid Test for Corrosion-Resisting Steels.

(1) Alloy steel plate material used to fabricate tank and expansion dome, when used, shall comply with one of the following ASTM specifications for the material and with the indicated minimum tensile strength and elongation for the welded condition:

Specifications	Type	Minimum tensile strength (psi) welded condition	Minimum elongation in 2 inches (percent) welded condition
ASTM A-240.....	304	75,000	30
ASTM A-240.....	304L	70,000	30
ASTM A-240.....	316	75,000	30
ASTM A-240.....	316L	70,000	30
ASTM A-240.....	321	75,000	30
ASTM A-240.....	347	75,000	30
ASTM A-240.....	405	60,000	20
ASTM A-240.....	410	65,000	20
ASTM A-240.....	430A	65,000	22

(d) Nickel plate material used to fabricate tank and expansion dome shall comply with the following ASTM Specification for the material and with the indicated minimum tensile strength and elongation for the welded condition:

Specifications	Minimum tensile strength (psi) welded condition	Minimum elongation in 2 inches (percent) welded condition
ASTM B-162.....	40,000	20

(e) All parts and items of construction in contact with the lading shall be made of material compatible with plate material and not subject to rapid deterioration by the lading, or be coated or lined with suitable corrosion resistant material.

(f) All external projections which may be in contact with the lading and all castings, forgings or fabrications used

for fittings or attachments to tank and expansion dome, when used, in contact with lading shall be made of material to an approved specification. Use of cast iron is prohibited for Class ICC-111A cars.

§ 79.200-8 Tank heads.

(a) Tank heads shall be of approved contour, and may be dished or ellipsoidal for pressure on concave side.

(b) Dished heads shall have main inside radius not exceeding 10 feet and inside knuckle radius shall not be less than $3\frac{3}{4}$ inches for steel, alloy steel, or nickel tanks nor less than 5 inches for aluminum alloy tanks except the knuckle radius for interior heads of compartment tanks of steel, alloy steel, or nickel shall not be less than $1\frac{1}{2}$ inches.

(c) Ellipsoidal tank heads for aluminum alloy tanks and for Class ICC-111A tanks shall be an ellipsoid of revolution in which the major axis shall equal the diameter of the shell and the minor axis shall be one-half the major axis.

§ 79.200-9 Compartment tanks.

(a) When tank is divided into compartments, by inserting interior heads, interior heads shall comply with the requirements specified in § 79.201-1. When capacity is reduced by the insertion of interior heads, these heads shall comply with the requirements for interior compartment heads and exterior head reapplied. Voids, created by the addition of heads for division into compartments or reduction in capacity, shall be provided with at least one tapped drain hole at their lowest point, and a tapped hole at the top of the tank. Top hole shall be closed, and the bottom hole may be closed, with not less than $\frac{3}{4}$ inch nor more than $1\frac{1}{2}$ inch solid pipe plugs having NPT threads.

(b) When the tank is divided into compartments by constructing each compartment as a separate tank, these tanks shall be joined together by a cylinder made of plate, having a thickness not less than that required for the tank shell and applied to the outside surface of tank head flanges. The cylinder shall fit the straight flange portion of the compartment tank head tightly. The cylinder shall contact the head flange for a distance of at least two times the plate thickness, or a minimum of 1 inch, whichever is greater. The cylinder shall be joined to the head flange by a full fillet weld. Distance from head seam to cylinder shall not be less than $1\frac{1}{2}$ inches or three times the plate thickness, whichever is greater. Voids created by the space between heads of tanks joined together to form a compartment tank shall be provided with a tapped drain hole at their lowest point and a tapped hole at top of tank. The top hole shall be closed and the bottom hole may be closed with solid pipe plugs not less than $\frac{3}{4}$ inch nor more than $1\frac{1}{2}$ inches having NPT threads.

§ 79.200-10 Welding.

(a) All joints shall be fusion-welded in compliance with the requirements of AAR Specifications for Tank Cars, Appendix W. Welding procedures, welders and fabricators shall be approved.

§ 79.200-11 Stress relieving and heat treatment.

(a) After welding is complete stress relieving or heat treatment shall be in compliance with the requirements of AAR Specifications for Tank Cars, Appendix W, when specified in § 79.201-1.

§ 79.200-12 Tank mounting. See § 79.10.

§ 79.200-13 Manway ring or flange, safety relief device flange, bottom outlet nozzle flange, bottom washout nozzle flange and other attachments and openings.

(a) For steel and aluminum tanks, these attachments shall be riveted or fusion-welded.

(b) For alloy steel and nickel tanks these attachments shall be fusion-welded.

(c) Fusion-welding for securing these attachments in place shall be of the double-welded butt joint type or double full-fillet lap joint type.

(d) Rivets, if used, shall be to approved specifications compatible with plate material and shall meet the following requirements:

(1) Riveted joints shall be made metal to metal without interposition of other material.

(2) Rivets shall be driven hot and calked inside. All joints formed by all riveted attachments shall be calked inside. Split calking is prohibited.

(3) Use of rivets less than $\frac{5}{8}$ inch nominal diameter prohibited.

(4) For computing rivet areas the effective diameter of a driven rivet is the diameter of its reamed hole, which hole shall in no case exceed nominal diameter of rivet by more than $\frac{1}{16}$ inch.

(5) When attachments are applied by means of riveting, the edges of plates shall be beveled so that the angle of the calking edge will be between 60 and 70 degrees with the flat surface of the attachment. The extreme calking edge distance, measured from center line of rivet hole, shall be at least one and one-half times the diameter of the hole and not more than that distance plus $\frac{1}{4}$ inch.

(6) Rivets shall be handled and driven in a manner that will insure requisite strength.

(e) The opening in the manway ring shall be at least 16 inches in diameter except that acid resistant lined manways shall be at least 18 inches in diameter before lining.

(f) Manway ring or flange, if riveted to dome or tank, shall be of cast, forged or fabricated steel, malleable iron or other malleable metals.

(g) Manway ring or flange, if welded to dome, tank or nozzle, shall be made of cast, forged or fabricated metal and be of good weldable quality in conjunction with metal of dome, tank, or nozzle.

(h) Openings for manway or other fittings shall be reinforced in an approved manner.

§ 79.200-14 Expansion capacity.

(a) Tanks shall have expansion capacity as prescribed in § 79.201-1. This capacity shall be provided in the tank for Class ICC-111A cars, or in a dome for Class ICC-103 and 104 type cars.

(b) The capacity of the expansion dome, when used, shall be at least the percentage specified in § 79.201-1 of the total capacity of the tank and dome combined. The capacity of the dome shall be measured from the inside top of shell of tank to the inside top of dome or bottom of any vent pipe projecting inside of dome, except that when safety relief device is applied to side of dome, the effective capacity of the dome shall be measured from top of safety relief device opening inside of dome to inside top of shell of tank.

(c) The opening in the tank shell within the dome shall be at least 29 inches in diameter. When the opening in the tank shell exceeds 30 inches in diameter, the opening shall be reinforced in an approved manner. When the opening in the tank shell is less than the inside diameter of the dome, and the dome pocket is not closed off in an approved manner, dome pocket drain holes shall be provided in the tank shell with nipples projecting inside the tank at least 1 inch.

(d) The dome head shall be of approved contour and shall be designed for pressure on concave side.

(e) Aluminum alloy domes:

(1) The dome shell thickness shall be calculated by the formula in § 79.200-6(a).

(2) The dome head may be an ellipsoid of revolution in which the major axis shall be equal to the diameter of the dome shell and the minor axis shall be one-half the major axis. The thickness in this case shall be determined by using formula in § 79.200-6(a).

(3) The dome head, if dished, shall be dished to a radius not exceeding 96 inches. Thickness of dished dome head shall be calculated by the formula in § 79.200-6(b).

(4) Tank shell shall be reinforced by the addition of a plate equal to or greater than shell in thickness and the cross sectional area shall exceed metal removed for dome opening, or tank shell shall be reinforced by a seamless saddle plate equal to or greater than shell in thickness and butt welded to tank shell. The reinforcing saddle plate shall be provided with a fluid opening having a vertical flange of the diameter of the dome for butt welding shell of dome to the flange. The reinforcing saddle plate shall extend about the dome a distance measured along shell of tank at least equal to the extension at top of tank. Other approved designs may be used.

(f) For thickness of carbon or alloy steel domes, see § 79.201-2.

§ 79.200-15 Closures for manways.

(a) Manway covers shall be of approved type. See § 79.202-1 for special requirements for flammable liquids.

(b) Manway covers shall be designed to provide a secure closure of the manway.

(c) Manway covers shall be cast, forged or fabricated metal and be of the same metal as the metal of the tank except for aluminum tanks where manway covers of other approved materials may be used, or except for steel tanks where malleable iron manway covers may be used. Malleable iron, when used, shall

comply with AAR Specification M-402 Grade 35018—Malleable Iron Castings or ASTM A-47 Grade 35018—Malleable Iron Castings.

(d) All joints between manway covers and their seats shall be made tight against leakage of vapor and liquid by use of gaskets of suitable material.

(e) For other manway cover requirements see § 79.201-1.

§ 79.200-16 Gaging devices, top loading and unloading devices, venting and air inlet devices.

(a) When installed, these devices shall be of an approved design which will prevent interchange with any other fixture, and be tightly closed. Unloading pipes shall be securely anchored within the tank. Each tank or compartment may be equipped with one separate air connection.

(b) When the characteristics of the commodity for which the car is authorized are such that these devices must be equipped with valves or fittings to permit the loading and unloading of the contents, these devices, including valves, shall be of an approved design, and be provided with a protective housing except when plug or ball type valves with operating handles removed are used. Provision shall be made for closing pipe connections of valves.

(c) Tanks may be equipped with a vacuum relief valve of an approved design.

(d) When gaging device is required in § 79.201-1, an outage scale visible through manway opening shall be provided. If loading devices are applied to permit tank loading with cover closed, a telltale pipe may be provided. Telltale pipe shall be capable of determining that required outage is provided. Pipe shall be equipped with ¼ inch minimum NPT control valve mounted outside tank and enclosed within a housing. Other approved devices may be used in lieu of outage scale or telltale pipe.

(e) Bottom sump if applied may be of cast, fabricated, or forged metal.

§ 79.200-17 Bottom outlets.

(a) If indicated in § 79.201-1, tank may be equipped with bottom outlet. If applied, bottom outlet shall comply with the following requirements:

(1) The extreme projection of bottom outlet equipment shall be at least 12 inches above top of rail. All bottom outlet reducers and closures and their attachments shall be secured to car by at least ¾ inch chain or its equivalent, except that outlet closure plugs may be attached by ¼ inch chain. When the bottom outlet closure is of the combination cap and valve type, the pipe connection to the valve shall be closed by a plug or cap.

(2) Bottom outlet shall be of approved construction, and be provided with a liquid tight closure at its lower end.

(3) The valve and its operating mechanism may be applied to the outside bottom of the tank. When applied in this manner, the valve operating mechanism shall be provided with a suitable locking arrangement to insure positive closure during transit.

(4) The valve operating mechanism for valves applied to the interior of the tank, and outlet nozzle construction shall insure against the unseating of the valve due to stresses or shocks incident to transportation.

(5) Bottom outlet nozzle of interior valves and the valve body of exterior valves, shall be of cast, fabricated or forged metal. If welded to tank, they shall be of good weldable quality in conjunction with metal of tank.

(6) To provide for the attachment of unloading connections, the bottom of the main portion of the outlet nozzle or valve body of exterior valves, or some fixed attachment thereto, shall be provided with threaded cap closure arrangement or bolted flange closure arrangement having minimum 1 inch threaded pipe plug.

(7) If outlet nozzle extends 6 inches or more from shell of tank a "V" groove shall be cut (not cast) in the upper part of outlet nozzle at a point immediately below lowest part of valve to a depth that will leave thickness of nozzle wall at the root of the "V" not over ⅜ inch. The outlet nozzle on interior valves or the valve body on exterior valves may be steam jacketed, in which case the breakage groove or its equivalent shall be below the steam chamber but above the bottom of center sill construction. If outlet nozzle is not a single piece, or if exterior valves are applied, provision shall be made for the equivalent of the breakage groove.

(8) The flange on the outlet nozzle or the valve body of exterior valves shall be of a thickness which will prevent distortion of the valve seat or valve by any change in contour of the shell resulting from expansion of lading, or other causes, and which will insure that accidental breakage of the outlet nozzle will occur at or below the "V" groove, or its equivalent.

(9) The valve shall have no wings or stem projecting below the "V" groove or its equivalent. The valve and seat shall be readily accessible or removable for repairs, including grinding.

(10) The valve operating mechanism on interior valves shall have means for compensating for variation in the vertical diameter of the tank produced by expansion, weight of the liquid contents, or other causes, and may operate from the interior of the tank, but in the event the rod is carried through the dome, or tank shell, leakage shall be prevented by packing in stuffing box or other suitable seals and a cap.

(b) If indicated in § 79.201-1, tank may be equipped with bottom washout of approved construction. If applied,

bottom washout shall be in accordance with the following requirements:

(1) The extreme projection of the bottom washout shall be at least 12 inches above top of rail.

(2) Bottom washout shall be of cast, forged or fabricated metal. If welded to tank, they shall be of good weldable quality in conjunction with metal of tank.

(3) If washout nozzle extends 6 inches or more from shell of tank, a "V" groove shall be cut (not cast) in the upper part of the nozzle at a point immediately below the lowest part of inside closure seat or plug to a depth that will leave wall thickness of nozzle at the root of the "V" not over ⅜ inch. Where nozzle is not a single piece, provision shall be made for the equivalent of the breakage groove. The nozzle shall be of a thickness to insure that accidental breakage will occur at or below the "V" groove or its equivalent.

(4) The closure plug and seat shall be readily accessible or removable for repairs.

(5) Joints between closures and their seats may be gasketed with suitable material.

§ 79.200-18 Safety relief devices.

(a) Safety relief valves.

(1) When permitted in § 79.201-1, each tank or compartment shall be equipped with one or more safety relief valves of approved design, made of metal not subject to rapid deterioration by the lading, and mounted on expansion dome of Class ICC-103 or 104 cars or top of tank shell of Class ICC-111A cars. Total valve discharge capacity shall be sufficient to prevent building up of pressure in the tank to more than 10 psi above start-to-discharge pressure. See AAR Specifications for Tank Cars, Appendix A, for formula for calculating discharge capacity.

(2) The start-to-discharge pressures and vapor tight pressures shall comply with § 79.201-1.

(b) Safety vents:

(1) When permitted in § 79.201-1, each tank or compartment used for the transportation of corrosive liquids, flammable solids, oxidizing materials, or poisonous liquids or solids, class B, need not be equipped with safety relief valves, but if not so equipped, shall have one safety vent at least 1¼ inches inside diameter, of an approved design which will prevent interchange with fixtures prescribed in § 79.200-16(a), and closed with a frangible disc of lead or other approved material of a thickness that will rupture at not more than 75 percent of tank test pressure. Means for holding disc in place shall be such as to prevent distortion or damage to disc when applied. Safety vent closure shall be chained or otherwise fastened to prevent misplacement. All tanks equipped with vents shall be stenciled "NOT FOR FLAMMABLE LIQUIDS."

§ 79.200-19 Reinforcements, when used, and appurtenances not otherwise specified.

(a) All attachments to tank and dome shall be applied by approved means. Rivets if used shall be calked inside and outside.

§ 79.200-20 Interior heater systems.

(a) See § 79.12.

§ 79.200-21 Closures for openings.

(a) All plugs shall be solid, with NPT threads, and shall be of a length which will screw at least 6 threads inside the face of fitting or tank. Plugs, when inserted from the outside of tank heads, shall have the letter "S" at least 3/8 inch in size stamped with steel stamp or cast on the outside surface to indicate the plug is solid.

§ 79.200-22 Test of tanks.

(a) Each tank shall be tested by completely filling the tank and dome or nozzles with water, or other liquid having similar viscosity, of a temperature which shall not exceed 100° F during the test; and applying the pressure prescribed in

§ 79.201-1. Tank shall hold the prescribed pressure for at least 10 minutes without leakage or evidence of distress. All rivets and closures, except safety relief valves or safety vents, shall be in place when test is made.

(b) Insulated tanks shall be tested before insulation is applied.

(c) Rubber-lined tanks shall be tested before rubber lining is applied.

(d) Calking of welded joints to stop leaks developed during the foregoing tests is prohibited. Repairs in welded joints shall be made as prescribed in AAR Specifications for Tank Cars, Appendix W.

§ 79.200-23 Tests of safety relief valves.

(a) Each valve shall be tested by air or gas for compliance with § 79.201-1 before being put into service.

§ 79.200-24 Stamping.

(a) To certify that the tank complies with all specification requirements, each tank shall be plainly and permanently stamped in letters and figures at least 3/8 inch high into the metal near the center of both outside heads as follows:

Specification-----
 Material-----
 Cladding material (if any)-----
 Tank builder's initials-----
 Date of original test-----
 Car assembler (if other than tank builder)-----

Example of required stamping
 ICC-103-W
 ASTM A285 C
 ASTM A240-304 Clad
 ABC
 00-0000
 DEF

§ 79.200-25 Stenciling.

(a) The tank, or the jacket if tank is insulated, shall be stenciled in compliance with the requirements of AAR Specifications for Tank Cars, Appendix C.

§ 79.200-26 Certificate of construction.

(a) See § 79.5.

§ 79.201 Individual specification requirements applicable to non-pressure tank car tanks.

§ 79.201-1 Individual specification requirements.

(a) In addition to § 79.200 the individual specification requirements are as follows:

ICC specifications	103W	103A-W	103A-N-W	103AL-W	103A-AL-W	103B-W	103C-W	103D-W	103E-W	104W
Material (see 79.200-7)-----	Steel	Steel	Nickel	Aluminum alloy.	Aluminum alloy.	Steel	Alloy steel	Alloy steel	Alloy steel	Steel
Insulation (see 79.200-4)----	Optional	Optional	Optional	Optional	Optional	Optional	Optional	Optional	Optional	Required
Bursting pressure, p.s.i. (see 79.200-5).	240	240	240	240	240	240	240	240	240	240
Minimum plate thickness, inches:										
Shell (see 79.200-6)-----	79.201-2	79.201-2	79.201-2	1/2	1/2	79.201.2	79.201.2	79.201.2	79.201.2	79.201-2
Heads (see 79.200-6 and 79.200-8).	79.201-2	79.201-2	79.201-2	1/2	1/2	79.201-2	79.201-2	79.201-2	79.201-2	79.201-2
Dome-----	Required	Required	Required	Required	Required	Required	Required	Required	Required	Required
Minimum expansion capacity (see 79.200-14).	2 percent in dome.	1 percent in dome.	1 percent in dome.	2 percent in dome.	1 percent in dome.	1 percent in dome.	1 percent in dome.	2 percent in dome.	1 percent in dome.	2 percent in dome.
Test pressure, p.s.i. (see 79.200-22).	60	60	60	60	60	60	60	60	60	60
Safety relief devices (see 79.200-18).	Valve or vent.	79.201-7	79.201-7	Valve or vent.	Valve or vent.	-----	Valve-----	Valve or vent.	Valve or vent.	Valve or vent.
Valve start-to-discharge pressure, p.s.i. (±3 p.s.i.).	35	35	35	35	35	-----	35	35	35	35
Valve vapor tight pressure (minimum p.s.i.).	28	28	28	28	28	-----	28	28	28	28
Valve flow rating pressure (maximum p.s.i.).	45	45	45	45	45	-----	45	45	45	45
Vent rupture pressure (maximum p.s.i.).	45	45	45	45	45	45	-----	45	45	45
Gaging devices (see 79.200-16).	Optional	Optional	Optional	Optional	Optional	Optional	Optional	Optional	Optional	Optional
Top loading and unloading devices (see 79.200-16).	Optional	Required (valves optional). Prohibited	Required (valves optional). Prohibited	Optional	Required (valves optional). Prohibited	Required (valves optional). Prohibited	Required (valves optional). Prohibited	Optional	Required (valves optional). Prohibited	Optional
Bottom outlet (see 79.200-17)(a)).	Optional	Optional	Optional	Optional	Optional	Prohibited	Prohibited	Optional	Optional	Optional
Bottom washout (see 79.200-17)(b)).	Optional	Optional	Optional	Optional	Optional	Prohibited	Prohibited	Optional	Optional	Optional
Closure for manway (see 79.200-15).	79.201-6(a)	-----	79.201-6(d)	79.201-6(a)	-----	79.201-6(b)	79.201-6(c)	79.201-6 (a), (c)	79.201-6(c)	79.201-6(a)
Stress relief (SR) or heat treatment (HT) (see 79.200-11).	SR	SR	Not required	Prohibited	Prohibited	SR	HT	HT (79.201-5)	HT (79.201-5)	SR
Other requirements-----	-----	-----	-----	-----	-----	79.201-3	79.201-4	-----	-----	-----

ICC specifications	111A60-W-1	111A60-AL-W	111A100-W-1	111A100-W-2	111A100-W-3	111A100-W-4	111A100-W-5	111A100-W-6	111A60-F-1 111A100-F-1 111A100-F-2
Material (see 79.200-7)	Steel	Aluminum alloy	Steel	Steel	Steel	Steel	Steel	Alloy steel	
Insulation (see 79.200-4)	Optional	Optional	Optional	Optional	Required	Required (79.201-11)	Optional	Optional	
Bursting pressure, p.s.i. (see 79.200-5)	240	240	500	500	500	500	500	500	
Minimum plate thickness, inches:									
Shell (see 79.200-6)	3/16	1/2	3/16	3/16	3/16	3/16	3/16	3/16	3/16
Heads (see 79.200-6 and 79.200-8)	3/16	1/2	3/16	3/16	3/16	3/16	3/16	3/16	3/16
Dome	None	None	None	None	None	None	None	None	None
Minimum expansion capacity (see 79.200-14)	2 percent in tank	2 percent in tank	2 percent in tank	1 percent in tank	2 percent in tank	73.314(a)	1 percent in tank	2 percent in tank	
Test pressure, p.s.i. (see 79.200-22)	60	60	100	100	100	100	100	100	
Safety relief devices (see 79.200-18)	Valve or vent	Valve or vent	Valve or vent	79.201-7	Valve or vent	Valve	Vent	Valve or vent	
Valve start-to-discharge pressure, p.s.i. (±3 p.s.i.)	35	35	75	75	75	75	75	75	
Valve vapor tight pressure (minimum p.s.i.)	28	28	60	60	60	60	60	60	
Valve flow rating pressure (maximum p.s.i.)	45	45	85	85	85	85	85	85	
Vent rupture pressure (maximum p.s.i.)	45	45	75	75	75	75	75	75	
Gaging devices (see 79.200-16)	Required	Required	Required	Required	Required	Required (79.201-9)	Required	Required	
Top loading and unloading devices (see 79.200-16)	Optional	Optional	Optional	Required (valves optional)	Optional (if used, valves required)	Required (valves required)	Required (valves optional)	Optional (if used, valves required)	
Bottom outlet (see 79.200-17(a))	Optional	Optional	Optional	Prohibited	Optional	Prohibited	Prohibited	Optional	
Bottom washout (see 79.200-17(b))	Optional	Optional	Optional	Optional	Optional	Prohibited	Prohibited	Optional	
Closure for manway (see 79.200-15)	79.201-6(a)	79.201-6(a)	79.201-6(a)		79.201-6(a)	79.201-6(a)	79.201-6(b)	79.201-6 (a) and (c)	
Stress relief (SR) or heat treatment (HT) (see 79.200-11)	SR	Prohibited	SR	SR	SR	SR	SR	HT (79.201-5)	
Other requirements						79.201-8 & 79.201-10	79.201-3		

¹ Tanks converted to ICC-111A series from existing forge-welded specification ICC-105A300, 400, or 500 tanks, by modification using conversion details complying with ICC-111A specification requirements, shall be stenciled by substituting the letter "F" for the letter "W" in the specification designation.

§ 79.201-2 Minimum plate thickness.

(a) The minimum plate thickness shall be as follows:

Inside diameter of tanks	Bottom sheets (inch)	Shell sheets (inch)	Expansion dome sheets (inch)	2:1 ellip-soidal heads (inch)	3:1 ellip-soidal and dished tank heads (inch)	Expansion dome heads (inch)	Interior compartment heads (inch)
60 inches or under	3/16	3/4	5/16	3/16	1/2	5/16	5/16
Over 60 to 78 inches	3/16	3/16	5/16	3/16	1/2	5/16	5/16
Over 78 to 96 inches	1 1/2	3/8	5/16	3/16	1/2	5/16	3/8
Over 96 to 112 inches	1 1/2	3/8	5/16	3/16	1/2	5/16	3/8
Over 112 to 122 inches	1 1/2	3/8	5/16	3/16	1/2	5/16	3/8

¹ May be reduced to 3/16 inch when approved steels having tensile strength of 65,000 psi or higher are used.

§ 79.201-3 Lined tanks.

(a) Each tank or each compartment thereof shall be lined with acid resisting rubber or other approved material vulcanized or bonded directly or otherwise attached to the metal tank, to provide a non-porous laminated lining. The lining shall be at least 3/32 inch thick, except over all rivets and seams formed by riveted attachments where the lining shall be double thickness. The lining shall overlap at least 1 1/2 inches at all edges, which shall be straight and be beveled to an angle of approximately 45 degrees, or butted edges of lining shall be sealed with a 3-inch minimum strip of lining having 45 degree beveled edges. An additional reinforcing pad at least 4 1/2 feet square and at least 1/2 inch thick shall be applied by vulcanizing to the lining on bottom of tank directly under the manway opening. The edges of pad shall be beveled to an angle of approximately 45 degrees. An opening in this pad for sump is permitted. No lining shall be under tension when applied except due to conformation over rivet heads. Interior of tank shall be free

from scale, oxidation, moisture and all foreign matter during the lining operations.

(b) All rivet heads on inside of tank shall be button-head or similar shape, of uniform size and the under surface of heads shall be driven tight against plate. All plates, castings and rivet heads on inside of tank shall be calked. All projecting edges of plates, castings and rivet heads on inside of tank shall be rounded and free from fins and other irregular projections. Castings shall be free from porosity.

(c) All surfaces of attachments or fittings and their closures, exposed to the lading shall be covered with at least 1/8 inch acid resistant material. Attachments made of metal not affected by the lading need not be acid resistant material covered.

§ 79.201-4 Material.

(a) Except for protective housing, all fittings, tubes and castings and all projections and their closures shall also meet the requirements of § 79.200-7(c).

§ 79.201-5 Heat treatment.

(a) All welding of the tank shell and of attachments welded directly thereto shall be heat treated as a unit to remove stresses at the proper temperature to obtain corrosion resistance specified in § 79.200-7(c), except for commodities not classed as Corrosive Liquids in Part 73 of this chapter, tanks made of ASTM A240 Type 304L and 316L are not required to be heat treated as a unit to remove stresses, nor to obtain the corrosion resistance specified in § 79.200-7(c)(1).

§ 79.201-6 Closures for manways.

(a) The manway cover shall be designed to make it impossible to remove the cover while the interior of the tank is subjected to pressure.

(b) Manway cover shall be made of a suitable metal. The top, bottom and edge of manway cover shall be acid resistant material covered as prescribed in § 79.201-3. Through bolt holes shall be lined with acid resistant material at least 1/8 inch in thickness. Cover made of metal not affected by the lading need not be acid resistant material covered.

(c) Manway ring and cover shall be made of the metal prescribed in § 79.200-7(c).

(d) Manway rings shall be made of cast, forged or fabricated nickel and be a good weldable quality in conjunction with the metal of the dome.

§ 79.201-7 Safety relief devices.

(a) Each tank or compartment shall be equipped with a safety vent unless characteristics of the lading require a safety relief valve. Design of safety relief devices shall be such as to prevent interchange with fixtures prescribed in § 79.200-16(a).

(b) Safety vents, if used, shall be of approved design, at least $1\frac{3}{4}$ inches inside diameter, made of material not subject to rapid deterioration by the lading, and closed with a frangible disc of lead or other approved material of a thickness that will burst at not more than 75 percent of tank test pressure. Means for holding the disc in place shall be such as to prevent distortion or damage to disc when applied. Safety vent closure shall be chained or otherwise fastened to prevent misplacement.

(c) Safety relief valves, if used, shall be of approved design, made of metal not subject to rapid deterioration by the lading, and mounted on expansion dome of Class ICC-103 and 104 type tanks, or top of tank shell for Class ICC-111A type tanks.

§ 79.201-8 Sampling device and thermometer well.

(a) Sampling valve and thermometer well are not specification requirements. When used, they must be of approved design, made of metal not subject to rapid deterioration by lading, and must withstand a pressure of 100 pounds per square inch without leakage. Interior pipes of the sampling valve must be equipped with excess flow valves of an approved design. Interior pipe of thermometer well must be closed by an approved valve attached close to fitting where it passes through the tank and closed by a screw plug. Other approved arrangements that permit testing thermometer well for leaks without complete removal of the closure may be used.

§ 79.201-9 Gaging device.

(a) A gaging device of an approved design shall be applied to permit determining the liquid level of the lading. The interior pipe of the gaging device shall be equipped with an excess flow valve of an approved design. This device shall be provided with a protective housing.

(b) An excess flow valve, as referred to in this specification, is a device which closes automatically against the outward flow of the contents of the tank such as may be encountered in case the external closure valve is broken off or removed during transit. Excess flow valves may be designed with a by-pass to allow equalization of pressures.

§ 79.201-10 Water capacity marking.

(a) Water capacity of the tank in pounds stamped plainly and permanently in letters and figures at least $\frac{3}{8}$ inch high into the metal of the tank immediately below the stamped marks specified in § 79.200-24(a). This mark shall also be stenciled on the jacket immediately below the dome platform and directly behind or within 3 feet of the right or left side of the ladder, or ladders, if there is a ladder on each side of the tank, in letters and figures at least $1\frac{1}{2}$ inches high as follows:

WATER CAPACITY
000000 Pounds

§ 79.201-11 Insulation.

(a) Insulation shall be of sufficient thickness so that the thermal conductance at 60 F is not more than 0.075 Btu

per hour, per square foot, per degree F temperature differential.

§ 79.202 Special commodity requirements for non-pressure tank car tanks.

(a) In addition to §§ 79.200 and 79.201 the following requirements are applicable:

§ 79.202-1 Flammable liquids not specifically provided for.

(a) Specs. ICC-103, 103-W, 103AL-W, 103D-W, 104, 104-W, 111A60AL-W, 111A100-F-1, 111A100-W-1, 111A100-W-3, 111A100-W-4, and 111A100-W-6, tank cars used to transport flammable liquids not specifically provided for shall have manway closures so designed that pressure will be released automatically by starting the operation of removing the manway cover. Openings in tank heads to facilitate application of lining are authorized and shall be closed in an approved manner. Spec. 103, 103-W, 103AL-W, 104, 104-W, 111A60AL-W or 111A100-W-3, used to transport flammable liquids not specifically provided for, having a vapor pressure exceeding 27 pounds per square inch absolute at 100° F but not exceeding 40 pounds per square inch absolute at 100° F, shall have their manway closures equipped with approved safeguards making removal of closures from the manway opening practically impossible while car interior is subjected to vapor pressure of lading. These cars shall be stenciled on each side of domes in line with the ladders, and in a color contrasting to the color of the dome with the identification mark as prescribed in § 73.119(g) of this chapter.

§ 79.202-2 Dimethyl dichlorosilane, Ethyl dichlorosilane, Ethyl trichlorosilane, Methyl trichlorosilane, Trimethyl chlorosilane, Vinyl trichlorosilane, Methyl dichlorosilane and Trichlorosilane.

(a) Specs. 103, 103-W, 111A60-F-1, 111A60-W-1 and 111A100-W-1 tank cars used to transport Dimethyl dichlorosilane, Ethyl dichlorosilane, Ethyl trichlorosilane, Methyl trichlorosilane, Trimethyl chlorosilane, Vinyl trichlorosilane, Methyl dichlorosilane, and Trichlorosilane, shall not be equipped with bottom discharge outlet.

§ 79.202-3 Amyl mercaptan, Butyl mercaptan, Ethyl mercaptan, Isopropyl mercaptan, Propyl mercaptan, and Aliphatic mercaptan mixtures.

(a) Specs. 103-W, 111A60-F-1 and 111A60-W-1 tank cars used to transport Amyl mercaptan, Butyl mercaptan, Ethyl mercaptan, Isopropyl mercaptan, Propyl mercaptan, an Aliphatic mercaptan mixtures shall have bottom outlets effectively sealed. Bottom washout permitted.

§ 79.202-4 Potassium nitrate mixed (fused) with Sodium nitrite.

(a) Spec. 103-W tank cars used to transport Potassium nitrite mixed (fused) with Sodium nitrate shall be specially designed, equipped and approved for this service, without bottom discharge outlet and with heavier plate thicknesses than the minimum pre-

scribed for cars built under this specification. For spec. 103-W tank cars made of plates having the minimum prescribed thicknesses, internal reinforcement of the upper sheets of tank in the region of the dome and reinforcing plates attached to the bottom sheet of the tank which rests on bolsters is required, and these tanks shall be equipped with baffle plates. Heater pipes shall be of welded construction designed for a test pressure of 500 pounds per square inch. A one inch woven asbestos lining shall be placed between bolster slabbing and bottom of tank to prevent heat transmission. Safety vents of the frangible disc type may be used and if used the frangible discs shall be perforated with $\frac{1}{8}$ inch hole. If safety relief valves are used, a vacuum relief valve shall be installed on the dome. Tanks shall be stenciled on both sides "FUSED POTASSIUM NITRATE AND SODIUM NITRITE ONLY."

§ 79.202-5 Phosphorus, white or yellow.

(a) Specs. ICC-103, 103-W, 111A60-F-1, 111A60-W-1 and 111A100-W-1 tank cars used to transport Phosphorus, white or yellow, shall be equipped with approved dome fittings, external heater systems and with insulation at least 4 inches in thickness, except that thickness of insulation may be reduced to 2 inches over external heater coils. Bottom washout nozzle of approved design may be applied. Bottom outlet for discharge of lading prohibited.

§ 79.202-6 Cumene hydroperoxide, Diisopropylbenzene hydroperoxide and Paramethane hydroperoxide.

(a) Specs. ICC-103, 103-W, 111A60-F-1, 111A60-W-1 and 111A100-W-1 tank cars used to transport Cumene hydroperoxide of strength not exceeding 90 percent in a nonvolatile solvent, Paramethane hydroperoxide of strength not exceeding 60 percent in a nonvolatile solvent and Diisopropylbenzene hydroperoxide of strength not exceeding 60 percent in a nonvolatile solvent, shall have bottom outlets effectively sealed from the inside.

§ 79.202-7 Titanium tetrachloride, anhydrous.

(a) Specs. ICC-103A, 103A-W, 111A100-F-2 and 111A100-W-2 tank cars used to transport Titanium tetrachloride, anhydrous, shall have safety relief valves of approved design and not subject to rapid deterioration by the lading.

§ 79.202-8 Chloracetyl chloride.

(a) Specs. ICC-103A-W, 111A100-F-2 and 111A100-W-2 tank cars used to transport Chloracetyl chloride shall have a nickel cladding of $\frac{1}{16}$ inch minimum thickness. Nickel cladding in tanks shall have a minimum nickel content of at least 99 percent pure nickel. Spec. ICC-103A-N-W tank cars used to transport Chloracetyl chloride shall be of solid nickel at least 99 percent pure and all cast metal parts of the tank in contact with the lading shall have a minimum nickel content of approximately 96.7 percent.

§ 79.202-9 Hydrochloric (muriatic) acid not over 38 percent strength by weight except acid of 22° Baume strength or other fuming acids.

(a) Spec. ICC-103B, 103B-W, or 111A100-W-5 tank cars used to transport Hydrochloric (muriatic) acid not over 38 percent except acid of 22° Baume strength and other fuming acids, may be equipped with safety vent of approved design having a frangible disc with 1/8 inch breather hole in the center, or a safety vent of approved design using carbon discs permitting continuous venting.

§ 79.202-10 Hydrogen peroxide solution in water exceeding 52 percent by weight.

(a) Spec. ICC-103A-AL-W tank cars used to transport Hydrogen peroxide solution in water exceeding 52 percent by weight, shall be equipped with a venting arrangement approved by the Bureau of Explosives.

§ 79.202-11 Phosphorus oxychloride, Phosphorus trichloride, and Thiophosphoryl chloride.

(a) Spec. ICC-103A-N-W tank cars used to transport Phosphorus oxychloride, Phosphorus trichloride, and Thiophosphoryl chloride, shall be solid nickel at least 99 percent pure and all cast metal parts of the tank in contact with the lading have a minimum nickel content of approximately 96.7 percent. Spec. ICC-103A tank cars used to transport phosphorus oxychloride, phosphorus trichloride, and thiophosphoryl chloride shall be lead-lined steel, or made of steel at least 10 percent nickel clad. Spec. ICC-103A-W, 111A100-F-2 or 111A100-W-2 tank cars used to transport Phosphorus oxychloride, Phosphorus trichloride and Thiophosphoryl chloride shall be lead-lined steel or made of steel with a minimum thickness of nickel cladding of 1/16 inch. Nickel cladding in tanks shall have a minimum nickel content of at least 99 percent pure nickel. Spec. ICC-103E-W tank cars used to transport Phosphorus trichloride and Thiophosphoryl chloride shall have tanks fabricated from Type 316 stainless steel.

§ 79.202-12 Sulfuric acid of concentrations 65.25 percent (approximately 1.559 specific gravity) (52° Baume) or greater.

(a) Spec. ICC-103A, 103A-W, 111A100-F-2 or 111A100-W-2 tank cars used to transport Sulfuric acid of concentration 65.25 percent (approximately 1.559 specific gravity) (52° Baume) except oleum, mixed acid (nitric and sulfuric) (nitrating acid) and other fuming acids, may have safety vents equipped with lead discs having a 1/8 inch breather hole in the center thereof.

§ 79.20213 Sulfur trioxide, stabilized.

(a) Specs. ICC-103A, 103A-W, 111A100-F-2, 111A100-W2 and 105A300-W tank cars, used to transport Sulfur trioxide, stabilized, shall be equipped with safety relief valves of approved design and not subject to rapid deterioration by the lading. Tanks equipped with interior heating coils not permitted.

§ 79.202-14 Anhydrous hydrazine and Hydrazine solutions containing 50 percent or less of water.

(a) Specs. ICC-103C-W and 111A100-W-6 tank cars used to transport Anhydrous hydrazine or Hydrazine solutions containing 50 percent or less water, shall have tanks fabricated of Type 304L or 347 stainless steel with molybdenum content not exceeding one-half of one percent.

§ 79.202-15 Formic acid and Formic acid solutions.

(a) Spec. ICC-103E-W tank cars used to transport Formic acid or Formic acid solutions, shall have tanks fabricated from Type 316 stainless steel and be stenciled "FOR FORMIC ACID ONLY."

§ 79.202-16 Monochloroacetic acid, liquid.

(a) Specs. ICC-103A-W, 111A100-F-2 and 111A100-W-2 tank cars used to transport Monochloroacetic acid, liquid, shall have tanks nickel clad at least 20 percent.

§ 79.202-17 Benzyl chloride.

(a) Spec. ICC-103A, 103A-W, 111A100-F-2 or 111A100-W-2 tank cars used to transport Benzyl chloride, stabilized, may be 10 percent nickel clad. Spec. 103A-N-W tank cars used to transport Benzyl chloride shall have all cast metal parts in contact with the lading made from metal having a minimum nickel content of approximately 96.7 percent

§ 79.202-18 Ethylene oxide.

(a) Spec. ICC-111A100-W-4 tank cars used to transport Ethylene oxide, may have opening in the tank heads to facilitate application of nickel lining. Such openings in tank heads shall be closed in an approved manner.

§ 79.202-19 Dimethylhydrazine, unsymmetrical.

(a) Specs. ICC-103-W and 103C-W tank cars used to transport Dimethylhydrazine, unsymmetrical, shall be equipped with steel safety valves of approved design. Spec. 103-W tank cars shall not be equipped with bottom outlets.

Subpart E—Specifications for Multi-Unit Tank Car Tanks (Classes ICC-106A and 110A-W)

§ 79.300 General specifications applicable to multi-unit tank car tanks designed to be removed from car structure for filling and emptying.

§ 79.300-1 Tanks built under these specifications shall meet the requirements of § 79.300, § 79.301 and when applicable, § 79.302.

§ 79.300-2 Approval.

(a) For procedure for securing approval, see § 79.3.

§ 79.300-3 Type and general requirements.

(a) Tanks built under this specification shall be cylindrical, circular in cross section, and shall have heads of approved design. All openings shall be located in the heads.

(b) Each tank shall have a water capacity of at least 1500 pounds and not more than 2600 pounds.

(c) For tanks made in foreign countries, a chemical analysis of materials and all tests as specified shall be carried out within the limits of the United States under the supervision of a competent and impartial inspector.

§ 79.300-4 Insulation.

(a) Tanks shall not be insulated.

§ 79.300-5 Bursting pressure.

(a) The minimum required bursting pressure is listed in § 79.301.

§ 79.300-6 Thickness of plates.

(a) For Class ICC-110A tanks, the wall thickness of the cylindrical portion of the tank shall not be less than that specified in § 79.301 nor that calculated by the following formula:

$$t = \frac{Pd}{2SE}$$

where:

- d = inside diameter in inches;
- E = 0.9 welded joint efficiency;
- P = minimum required bursting pressure in psi;
- S = minimum tensile strength of plate material in psi as prescribed in § 79.300-7;
- t = minimum design thickness of plate in inches.

(b) For Class ICC-106A tanks, the wall thickness of the cylindrical portion of the tank shall not be less than that specified in § 79.301 and shall be such that at the tank test pressure the maximum fiber stress in the wall of the tank will not exceed 15,750 psi as calculated by the following formula:

$$s = \frac{p(1.3D^2 + 0.4d^2)}{D^2 - d^2}$$

where:

- d = inside diameter in inches;
- D = outside diameter in inches;
- p = tank test pressure in psi;
- s = wall stress in psi.

(c) If plates are clad with material having tensile strength at least equal to the base plate, the cladding may be considered a part of the base plate when determining the thickness. If cladding material does not have tensile strength at least equal to the base plate, the base plate alone shall meet the thickness requirements.

§ 79.300-7 Material.

(a) Carbon steel plate material used to fabricate tanks with fusion-welded heads shall be open hearth boiler plate of flange or firebox quality having a carbon content not exceeding 0.31 percent and complying with one of the following ASTM specifications for the material and with the indicated tensile strength and elongation in the welded condition:

Specification	Minimum tensile strength (psi) welded condition	Minimum elongation in 2 inches (percent) welded condition
ASTM A-212 Gr A.....	65,000	20
ASTM A-212 Gr B.....	70,000	20
ASTM A-285 Gr A.....	45,000	29
ASTM A-285 Gr B.....	50,000	20
ASTM A-285 Gr C.....	55,000	20

(1) These plates may be clad with other approved metals.

(b) Carbon steel plate material used to fabricate tanks with forge-welded heads shall be open hearth boiler plate of firebox quality complying with specification ASTM A-285 Grade A.

(c) All plates shall have their heat number and the name or brand of the manufacturer legibly stamped on them at the rolling mill.

§ 79.300-8 Tank heads.

(a) Class ICC-110A tanks shall have fusion-welded heads formed concave to pressure. Heads for fusion welding shall be an ellipsoid of revolution 2:1 ratio of major to minor axis. They shall be one piece, hot formed in one heat so as to provide a straight flange at least $1\frac{1}{2}$ inches long. The thickness shall not be less than that calculated by the following formula:

$$t = \frac{Pd}{2SE}$$

where symbols are as defined in § 79.300-6 (a).

(b) Class ICC-106A tanks shall have forged-welded heads formed convex to pressure. Heads for forge welding shall be torispherical with an inside radius not greater than the inside diameter of the shell. They shall be one piece, hot formed in one heat so as to provide a straight flange at least 4 inches long. They shall have snug drive fit into the shell for forge welding. The thickness shall be sufficient to meet the test requirements of § 79.300-16 and to provide for adequate threading of openings.

§ 79.300-9 Welding.

(a) Longitudinal joints shall be fusion welded. Head-to-shell joints shall be forge welded on Class ICC-106A tanks and fusion welded on Class ICC-110A tanks. Welding procedures, welders and fabricators shall be approved.

(b) Fusion-welded joints shall be in compliance with the requirements of AAR Specifications for Tank Cars, Appendix W, except that circumferential welds in tanks less than 36 inches inside diameter need not be radiographed.

(c) Forge-welded joints shall be thoroughly hammered or rolled to insure sound welds. The flanges of the heads shall be forge lapwelded to the shell and then crimped inwardly toward the center line at least one inch on the radius. Welding and crimping must be accomplished in one heat.

§ 79.300-10 Stress relieving.

(a) After welding is complete, steel tanks and all attachments welded thereto, shall be stress relieved as a unit in compliance with the requirements of AAR Specifications for Tank Cars, Appendix W.

§ 79.300-11 Tank mounting.

(a) For tank mounting, see § 79.10.

§ 79.300-12 Protection of fittings.

(a) Tanks shall be of such design as will afford maximum protection to any fittings or attachment to the head including the housing referred to in § 79.300-12(b). Tank ends shall slope or curve inward toward the axis so that

the diameter at each end is at least 2 inches less than the maximum diameter.

(b) Loading and unloading valves shall be protected by a detachable protective housing of approved design which shall not project beyond the end of the tank and shall be securely fastened to the tank head. Safety relief devices shall not be covered by the housing.

§ 79.300-13 Venting, loading and unloading valves.

(a) Valves shall be of approved type, made of metal not subject to rapid deterioration by lading, and shall withstand tank test pressure without leakage. The valves shall be screwed directly into or attached by other approved methods to one tank head. Provision shall be made for closing outlet connections of the valves.

(b) Threads for openings shall be National Gas Taper Threads (NGT) tapped to gage, clean cut, even and without checks.

§ 79.300-14 Attachments not otherwise specified.

(a) Siphon pipes and their couplings on the inside of the tank head and lugs on the outside of the tank head for attaching the valve protective housing shall be fusion-welded in place prior to stress relieving. All other fixtures and appurtenances, except as specifically provided for, are prohibited.

§ 79.300-15 Safety relief devices.

(a) Unless prohibited in § 79.302, or in Part 73 of this chapter, tanks shall be equipped with one or more safety relief devices of approved type, made of metal not subject to rapid deterioration by the lading and screwed directly into tank heads or attached to tank heads by other approved methods. The total discharge capacity shall be sufficient to prevent building up pressure in tank in excess of 82.5 percent of the tank test pressure. When safety relief devices of the fusible plug type are used, the required discharge capacity shall be available in each head. See AAR Specifications for Tank Cars, Appendix A, for formula for calculating discharge capacity.

(b) Threads for openings shall be National Gas Taper Threads (NGT) tapped to gage, clean cut, even and without checks.

(c) Safety relief valves shall be set for start-to-discharge and frangible discs shall burst at a pressure not exceeding that specified in § 79.301.

(d) Fusible plugs shall function at a temperature not exceeding 175 F and shall be vapor-tight at a temperature of not less than 130 F.

§ 79.300-16 Tests of tanks.

(a) After stress relieving, tanks shall be subjected to hydrostatic expansion test in a water jacket, or by other approved methods. No tank shall have been subjected previously to internal pressure within 100 pounds of the test pressure. Each tank shall be tested to the pressure prescribed in § 79.301. Pressure shall be maintained for 30 sec-

onds and sufficiently longer to insure complete expansion of tank. Pressure gage shall permit reading to accuracy of one percent. Expansion gage shall permit reading of total expansion to accuracy of one percent. Expansion shall be recorded in cubic centimeters.

(1) No leaks shall appear and permanent volumetric expansion shall not exceed 10 percent of total volumetric expansion at test pressure.

(b) After all fittings have been installed, each tank shall be subjected to interior air pressure test of at least 100 psi under conditions favorable to detection of any leakage. No leaks shall appear.

(c) Repairs of leaks detected in manufacture or in foregoing tests shall be made by the same process as employed in manufacture of tank. Calking, soldering, or similar repairing is prohibited.

§ 79.300-17 Tests of safety relief devices.

(a) Each valve shall be tested by air or gas before being put into service. The valve shall open and be vapor-tight at the pressures prescribed in § 79.301.

(b) For safety relief devices of the frangible disc type, a sample of the disc used shall be burst and be vapor-tight at the pressures prescribed in § 79.301.

(c) For safety relief devices of the fusible plug type, a sample of the plug used shall function at the temperatures prescribed in § 79.300-15.

(d) The start-to-discharge and vapor-tight pressures shall not be affected by any auxiliary closure or other combination.

§ 79.300-18 Stamping.

(a) To certify that the tank complies with all specification requirements, each tank shall be plainly and permanently stamped in letters and figures $\frac{3}{8}$ inch high into the metal of valve end chime as follows:

(1) ICC Specification number.

(2) Material and cladding material if any (immediately below the specification number).

(3) Owner's or builder's identifying symbol and serial number (immediately below the material identification). The symbol shall be registered with the Bureau of Explosives, duplications are not authorized.

(4) Inspector's official mark (immediately below the owner's or builder's symbol).

(5) Date of original tank test (month and year, such as 1-64 for January 1964). This should be so placed that dates of subsequent tests may easily be added thereto.

(6) Water capacity — 0000 pounds.

(b) A copy of the above stamping in letters and figures of the prescribed size stamped on a brass plate secured to one of the tank heads is authorized.

§ 79.300-19 Inspection.

(a) Tank shall be inspected within the United States and Canada by a competent and impartial inspector acceptable to the Bureau of Explosives. For tanks made outside the United States and

Canada, the specified inspection shall be made within the United States.

(b) The inspector shall carefully inspect all plates from which tanks are to be made and secure records certifying that plates comply with the specification. Plates which do not comply with § 79.300-7 shall be rejected.

(c) The inspector shall make such inspection as may be necessary to see that all the requirements of this specification, including markings, are fully complied with; shall see that the finished tanks are properly stress relieved and tested.

(d) The inspector shall stamp his official mark on each accepted tank as required in § 79.300-18, and render the report required in § 79.300-20.

§ 79.300-20 Reports.

(a) Before a tank is placed in service, the inspector shall furnish to the builder, tank owner, Bureau of Explosives and the Secretary, Mechanical Division, Association of American Railroads, a report in approved form certifying that the tank and its equipment comply with all the requirements of this specification.

(b) For builder's Certificate of Construction, see § 79.5(b).

§ 79.301 Individual specification requirements for multi-unit tank car tanks.

(a) In addition to § 79.300 the individual specification requirements are as follows:

ICC specifications	106A500-X	106A800-X	110A500-W	110A800-W	110A1000-W
Bursting pressure, psi (see § 79.300-5)	None specified	None specified	1250	2000	2500
Minimum thickness shell, inches	¹ / ₃₂	¹ / ₁₆	¹ / ₃₂	¹ / ₃₂	¹ / ₃₂
Test pressure, psi (see § 79.300-16)	500	800	500	800	1000
Safety relief devices psi (see § 79.300-15)					
Start-to-discharge, or burst maximum	375	600	375	600	700
Vapor-tight, minimum	300	480	300	480	650

§ 79.302 Special commodity requirements for multi-unit tank car tanks.

(a) In addition to §§ 79.300 and 79.301 the following requirements are applicable:

Commodity	Safety relief device	Valve protective housing	Miscellaneous
Aluminum triethyl	Valve required		
Aluminum trimethyl	do.		
Pyroforic fuel	do.		
Triisobutyl aluminum	do.		
Ethyl aluminum sesquichloride	do.		
Diethyl aluminum chloride	do.		
Ethyl aluminum dichloride	do.		
Methyl aluminum sesquichloride	do.		
Methyl aluminum sesquibromide	do.		
Nitrosyl chloride	Fusible plug required		(9)
Chlorine trifluoride	Prohibited ¹		
Hydrogen sulfide	do. ¹	Gas tight ²	§ 73.357
Chloroacetylene	do. ¹	do. ²	
Methyl mercaptan	do. ¹		
Hydrofluoric acid	do. ¹		
Nitrogen dioxide liquid	do. ¹	Gas tight ²	
Nitrogen peroxide liquid	do. ¹	do. ²	
Nitrogen tetroxide liquid	do. ¹	do. ²	
Nitrogen tetroxide-nitric oxide mixtures	do. ¹	do. ²	
Phosgene	do. ¹	do. ²	
Vinyl chloride			(9)
Vinyl methyl ether			(9)
Titanium tetrachloride (anhydrous)	Prohibited ¹		

¹ When safety relief devices are prohibited, containers may be equipped with solid steel plugs in the safety device openings.

² The detachable protective housing for the loading and unloading valves must withstand tank test pressure without leakage and must be approved by the Bureau of Explosives.

³ All parts of valves and safety relief devices in contact with the lading must be of a metal or other material, suitably treated if necessary, which will not cause formation of any acetylides.

⁴ Tanks for Nitrosyl chloride shall be nickel-clad and safety relief devices shall be of the fusible plug type and shall function at a temperature not exceeding 175 F and be vaportight at 130 F.

Subpart F—Specifications for Liquefied Hydrogen Tank Car Tanks and Seamless Steel Tanks (Classes ICC-113A-W and 107A)

§ 79.400 General specifications applicable to liquefied hydrogen tank car tanks.

§ 79.400-1 General.

(a) Tanks built under these specifications must meet the requirements of §§ 79.400 and 79.401.

§ 79.400-2 Approval.

(a) For procedure for securing approval, see § 79.3.

§ 79.400-3 Type.

(a) A tank built in accordance with this specification shall consist of an inner (pressure) container suitably sup-

ported within an outer shell, and forming a part of a railway car. The car shall be equipped with piping systems for vapor venting, transfer of the lading and with safety relief devices, controls, gages and valves prescribed herein for safe operation of the unit in storage, transport and transfer of the lading.

(b) The inner (pressure) container shall be a fusion-welded cylindrical shell closed at each end with formed heads convex outward and suitable for operation at temperatures as low as -423 F.

(c) The outershell shall be a fusion-welded cylindrical shell with formed heads.

(d) *Compartments.* When the interior of the tank is divided into compartments, each compartment must have two heads designed convex outward and comply with all other requirements described in this specification.

§ 79.400-4 Bursting pressure.

(a) The minimum required bursting pressure of the inner container is listed in § 79.401.

§ 79.400-5 Thickness of plates.

(a) The wall thickness of the inner container shell and heads shall not be less than that specified in § 79.401, nor that calculated by the following formula:

$$t = \frac{Pd}{2SE}$$

where:

d = inside diameter in inches;

E = efficiency of longitudinal welded joint — 90 per cent;

P = minimum required bursting pressure in psi;

S = minimum ultimate tensile strength of plate material in psi as prescribed in § 79.400-6;

t = minimum design thickness of plate in inches.

§ 79.400-6 Materials.

(a) The material used in the shell, heads and appurtenances shall be suitable for use at minus 423° F and compatible with the lading and the usual cleaning compounds recommended for this service. Chromium-nickel steel plate made to ASTM specification A-240-61T, Type 304, is an approved material and, when used, it shall be in the annealed condition prior to fabricating, forming or fusion-welding. Other approved materials may be used. The minimum ultimate tensile strength shall be as given in ASTM specification A-240, Type 304.

§ 79.400-7 Heads.

(a) The formed heads on the inner container shall preferably be ellipsoids of revolution in which the major axis shall equal the inside diameter of the shell and the minor axis shall be one-half of the major axis. The minimum thickness after forming shall be determined by the provisions of § 79.400-5(a) except that an efficiency of 100 percent may be used for a seamless head. Formed heads of other approved contours and thicknesses may be used but in no case shall the plate thickness be less than 3/16 inch.

§ 79.400-8 Welding—inner container.

(a) All joints must be fusion-welded in compliance with the requirements of the AAR Specifications for Tank Cars, Appendix W, except that the following requirements supersede requirements listed under "Test Plates," "Bend Test," and "Impact Test" of Appendix W.

(b) *Test plates.* A welded test plate of the dimensions shown in Figure W-2 of AAR Specifications for Tank Cars, Appendix W shall be made for each container using the same weld procedure as used in welding the longitudinal seams of the container. Test plates shall be prepared from material having the same material specification and mill heat numbers as used in the shell or main heads of the inner container. After welding is completed, the test plate shall be radiographed, and the standards of judgment of weld acceptability as set forth in Par. 10.74-1 of AAR Specifications for Tank Cars, Appendix W, shall be followed.

(c) *Test specimens.* The following test specimens shall be removed from the welded test plate and subjected to tests prescribed below:

(1) *Bend test.* Four transverse bend test specimens shall be removed from the welded test plate transverse to the welded joint of the test plate. The specimens shall be of rectangular cross section 1½ inches wide and the full thickness of the test plate. Weld reinforcements on each side of each test specimen shall be removed flush with the plane of the plate surface. Specimens shall be saw-cut from the test plate. Removal of test specimens from the test plate by means of flame cutting is prohibited. The specimens shall be subjected to a guided bend test, and two transverse face bend tests and two transverse root bend tests shall be performed. A bend test specimen that reveals no cracks or other open defects exceeding ⅛ inch measured in any direction on the convex surface of the specimen shall be considered to have passed the bend test. Cracks occurring on the corners of the specimen during the test shall not be considered as cause for rejection, unless there is definite evidence that they are the result of slag inclusions in the weld or other internal defects.

(2) *Impact tests.* Three sets of three impact test specimens shall be saw-cut from the welded test plate. These specimens shall be used for determining the impact properties of the plate material, weld zone and heat-affected zone. Impact test specimens shall be of the Charpy type, keyhole or milled U-notch, with the base of the notch normal to the plate surface, and shall conform in all respects to Figure 3 of ASTM Specification E-23-60-T. Impact test specimens shall be cooled in liquid nitrogen (-320 F). The apparatus for testing the specimens shall be in accordance with the requirements of ASTM Specification E-23-60-T. The test piece and handling tongs shall be cooled for a length of time sufficient to reach the temperature of liquid nitrogen. The specimen shall be quickly transferred from the cooling device to the anvil of the testing machine and broken within a time lapse of not more than six seconds.

(3) *Impact properties.* The impact properties of each set of impact specimens shall be not less than the values listed below:

Size of specimen	Minimum impact value required for average of 3 specimens	Minimum impact value permitted on 1 specimen only of each set of 3 specimens
	Feet-Pound	Feet-Pound
55 mm x 10 mm x 10 mm...	15	10
55 mm x 10 mm x 7.5 mm...	12.5	8.5
55 mm x 10 mm x 5 mm...	10	7
55 mm x 10 mm x 2.5 mm...	5	3.5

When the average value of the three specimens equals or exceeds the minimum value permitted for a single specimen, and the value for more than one specimen is less than the minimum value required for the average of the three specimens, or when the impact

value of one specimen is below the minimum value permitted for a single specimen, a retest of three additional specimens shall be made. The value from each retest specimen shall equal or exceed the minimum value required for the average of three specimens given above. When an erratic result is caused by a defective specimen or there is uncertainty in the test procedure, a retest is authorized.

§ 79.400-9 Stress relieving.

(a) Stress relieving of the inner container is not a requirement of this specification.

§ 79.400-10 Cleaning interior container.

(a) The interior of the tank and all lines connecting to it shall be thoroughly cleaned. Proper precautions shall be taken to avoid subsequent recontamination of the system after cleaning.

§ 79.400-11 Test of inner container.

(a) After all items to be welded to the inner container have been welded in place, the inner container shall be pressurized hydrostatically or pneumatically to the test pressure prescribed in § 79.401. The temperature of the pressurizing medium shall not exceed 100 F during the test. The container shall hold the prescribed pressure for a period of not less than ten minutes without leakage or evidence of distress. Due regard should be taken of the potential hazard involved in a pneumatic test. After the container has passed the pressure test, the container and piping shall be emptied of all water and purged of all water vapor if water is used for testing.

(b) Calking of welded joints to stop leaks developed during the foregoing test is prohibited. Repairs to welded joints shall be made as prescribed in § 79.400-8.

§ 79.400-12 Radiography.

(a) All longitudinal and circumferential double-butt, fusion-welded joints of the inner container and outer shell shall be examined throughout their entire length by the X-ray or gamma-ray method of radiography. The standards of judgment for acceptability of welds examined by radiography shall be in accordance with Par. 10.74-1 of AAR Specifications for Tank Cars, Appendix W.

§ 79.400-13 Support system for inner container.

(a) The inner container shall be supported within the outer shell by a support system of adequate strength and ductility at its operating temperature to support the inner container when filled with liquid lading to any level incidental to operation of the complete unit as a railway tank car. The support system shall be designed to be capable of supporting, without yielding, impact loads producing accelerations of the following magnitudes and directions when the inner container is fully loaded, and the car is equipped with a conventional AAR Specification M-901 draft gear:

Longitudinal.....	7G
Transverse.....	3G
Vertical.....	3G

The longitudinal acceleration may be reduced to 3G where a cushioning device of approved design, which has been tested to demonstrate its ability to limit body forces to 400,000 pounds maximum at 10 miles per hour, is used between the coupler and the tank structure. The support system shall be of an approved design and such that the inner container shall be thermally isolated from the outer shell to the best practical extent.

§ 79.400-14 Access to inner container.

(a) The inner container shall be provided with a means of access having a minimum inside diameter of 16 inches and having a welded closure so designed as to allow it to be reopened by grinding or chipping and to be closed again by rewelding without a need for new parts. A cutting torch shall not be used. The closure and the reinforcement of the opening in the container shall be of approved design and made of the same material as is used in the container. Consideration must be given in the design to minimizing contamination of the container and the vacuum space when the closure is opened and closed. The outer shell shall be provided with an access opening of sufficient size (and aligned with the container access opening) to permit removal of the container closure and access into the container. The closure and the reinforcement of the opening in the outer shell shall be of approved design and made of the same material as is used in the outer shell. The closure shall preferably be so designed as to allow it to be reopened by grinding or chipping and to be closed again by rewelding without a need for new parts. A passageway connecting the inner container with the outer shell is not a specification requirement.

§ 79.400-15 Outer shell.

(a) *Design.* The outer shell shall be designed to withstand an external pressure of one atmosphere.

(b) *Thickness of plates.* The wall thickness of steel plates in the cylindrical portion of the outer shell shall be not less than ⅛ inch.

(c) *Material.* All plate material in the outer shell shall be flange quality or firebox quality steel, made to an approved specification, the carbon content of which shall not exceed 0.31 percent. Steel plate materials in accordance with material specifications listed in Group 1, Table A of AAR Specifications for Tank Cars, Appendix W, are approved for use in the outer shell of tanks built to this specification.

(1) All steel castings, steel forgings and steel structural shapes shall be of material to an approved specification.

(2) Rivets, when used, shall be of steel to an approved specification.

(d) *Heads.* The formed heads at each end of the outer shell preferably shall be an ellipsoid of revolution in which the major axis shall equal the inside diameter of the shell and the minor axis shall be one-half of the major axis. Formed heads of other approved contours may be used, but in no case shall the wall thickness be less than ⅛ inch.

(e) *Stiffening rings.* If stiffening rings are used in designing the cylindrical portion of the outer shell for external pressure, they shall be attached to the shell by means of fillet welds on each side of the ring. Outside stiffening ring attachment welds shall be continuous. Inside ring attachment welds may be intermittent. When intermittent welds are used, the total length of welds on each side of the ring shall not be less than one-third of the circumference of the outer shell. Where a closed section is used, it shall be continuously welded on the outside of each leg. A portion of the outer shell may be included when calculating the moment of inertia of the ring. The effective width of shell plate, W , on each side of the attachment of the stiffening ring is given by:

$$W = 0.78\sqrt{Rt}$$

where:

- W = width of shell effective on each side of the stiffener—*inches*;
- R = outside radius of the outer shell—*inches*;
- t = plate thickness of the outer shell—*inches*.

Where a stiffener is used which consists of a closed section having two webs attached to the outer shell, the shell plate between the webs shall be included up to the limit of twice the value of W defined above. The outer "flange" of the section shall be subject to the same limitation with W based on the R and t of the flange. Where two separate members, such as two angles, are located less than $2W$ apart they may be treated as a single stiffening member. (The maximum length of shell plate which may be considered effective is $4W$.)

(1) The stiffener rings shall have a moment of inertia large enough to support an external pressure of 37.5 psig as determined by either of the following formulae:

$$I = \frac{0.035D^3LP_c}{E}$$

$$I = \frac{0.046D^3LP_c}{E}$$

where:

- I = required moment of inertia of stiffener about centroidal axis parallel to vessel axis—*inches⁴*;
- I' = required moment of inertia of combined section of stiffener and effective width of shell plate, about centroidal axis parallel to vessel axis—*inches⁴*;
- D = outside diameter of outer shell—*inches*;
- L = one-half of the distance from the centerline of the stiffening ring to the next line of support on one side, plus one-half of the centerline distance to the next line of support, if any, on the other side of the stiffening ring, both measured parallel to the axis of the vessel—*inches*. (A line of support is: (1) a stiffening ring which meets the requirements of this paragraph, or (2) a circumferential line on a head at one-third the depth of the head from the head tangent line.);

- P_c = critical collapsing pressure (37.5 psig minimum);
- E = modulus of elasticity of stiffener material—*psi*.

(2) The cylindrical portion of the outer shell between stiffening rings shall

be stiff enough to withstand an external pressure of 37.5 psig (critical collapsing pressure) as determined by the following formula:

$$P_c = \frac{2.6E(t/D)^{2.5}}{L/D - 0.45(t/D)^{0.5}}$$

where:

- P_c = critical collapsing pressure (37.5 psig minimum);
- E = modulus of elasticity of shell material—*lb/sq. inch*;
- t = minimum thickness of shell material—*inches*;
- D = outside diameter of shell—*inches*;
- L = distance between stiffening ring centers—*inches*. (The heads may be considered as stiffening rings located one-third of the head depth from the head tangent line.)

(3) The permissible out-of-roundness of the cylindrical portion of the outer shell shall be no greater than that permitted in Section VIII for out-of-roundness for external pressure of the ASME Boiler and Pressure Vessel Code.

(4) Where loads are applied to the outer shell or to the stiffening rings from the support system used to support the inner container within the outer shell, additional stiffener rings or an increased moment of inertia of stiffening rings designed for the external pressure will have to be provided to carry the support loads.

(f) *Welding.* All joints shall be fusion-welded in compliance with the requirements of AAR Specifications for Tank Cars, Appendix W. Welding procedures, welders and fabricators shall be approved. No more than two circumferential closing joints in the cylindrical portion of the outer shell, including head to shell joints, shall be single-welded butt joints using a backing strip on the inside of the joint. If the interior of the outer shell is divided into compartments, the compartment heads shall be attached inside the shell by fillet welding.

(g) *Stress relieving.* The cylindrical portion of the outer shell with the exception of the circumferential closing seams shall be stress relieved in accordance with the requirements of Par. W-15.01 of the AAR Specifications for Tank Cars, Appendix W. All items welded to the shell shall be attached before stress relieving. Welds securing the inner container support system to the outer shell which cannot feasibly be made before final assembly and the tank heads at each end of the shell need not be stress relieved.

(h) *Tests of outer shell.* Pressure testing of outer shell is not a specification requirement.

§ 79.400-16 Insulation.

(a) The annular space between the two shells shall contain an approved insulating system so installed as to insure against excessive settling and the creation of voids in the insulation when the car is in service. The material shall not burn or spark when touched with a glowing platinum wire in an atmosphere of air or lading. The insulation shall be such that the total heat transfer from the atmosphere at ambient temperature to the hydrogen at atmospheric pressure will not vaporize more than 5.2 pounds of liquefied hydrogen per hour (1000 scfh at 60 F) when the car is stationary.

(b) *Annular space.* The distance between the outside wall of the inner container and the inside wall of the outside shell shall be not less than two inches.

§ 79.400-17 Piping, vacuum line, vapor phase line, loading and unloading lines.

(a) *Vacuum lines.* The outer shell shall be provided with fittings to permit effective evacuation of the annular space between the outer shell and inner container.

(b) *Product lines.* The piping systems for vapor and liquid phase transfer and venting shall be made from materials compatible with the product and having satisfactory properties at minus 423° F. All valves, gages, and closures shall be mounted within suitable protective housings. The outlets of all vapor phase and liquid phase lines shall be so located that accidental discharge from these lines will not impinge on any metal of the outer shell, car structure, trucks or safety appliances.

(c) *Vapor phase line.* Vapor phase line of sufficient size to permit safety devices covered in § 79.400-18(c) (1) and (2) connected to this line to operate at their designed capacity without excessive pressure buildup in the tank shall connect to the inner container. The vapor phase line shall have a manually operated shut-off valve located as close as possible to the outer shell and shall have a closure that is liquid and gas tight.

(d) *Vapor phase blow-down line.* A blow-down line shall be provided and it may be attached to the vapor phase line specified in § 79.400-17(c) and ahead of the shut-off valve in that line. It shall have a manually operated shut-off valve located as close as possible to the outer shell. The outlet from this line shall be outside its housing and positioned so that the discharge will be directed upward and away from operating personnel.

(e) *Pressure building system.* Not a specification requirement. If a pressure building system is provided for the purpose of pressurizing the vapor space of the inner container to facilitate unloading the liquid lading, the system shall be of approved design.

(f) *Loading and unloading line.* A liquid phase transfer line shall be provided and shall have a manually operated, vacuum jacketed, shut-off valve located as close as possible to the outer shell. The section of line between the outer shell and the valve shall be vacuum jacketed. A vapor trap shall be incorporated in the line and shall be located as close as possible to the inner shell.

§ 79.400-18 Safety relief devices.

(a) The tank shall be provided with safety relief devices for the protection of the tank assembly and piping systems. The discharge from these devices shall be directed away from operating personnel, principal load bearing members of the outer shell, car structure, trucks and safety appliances. Vent or weep holes in safety devices are prohibited. All main safety relief devices shall discharge to the outside of protective housings in which they are mounted. This provision does not apply to small safety relief

valves installed to protect isolated short sections of lines between the final valve and end closure.

(b) *Materials.* Materials used in safety relief devices shall be suitable for use at minus 423 F and otherwise compatible with hydrogen in the liquid or vapor phase.

(c) *Inner container.* Safety relief devices for the inner container shall be attached to piping connected to the vapor phase of the inner container and mounted so as to remain in ambient temperature prior to operation. Additional requirements are as follows:

(1) *Safety vent.* The inner container shall be equipped with a safety vent without an intervening shut-off valve and designed to function at a pressure less than the test pressure of the inner container. The safety vent capacity shall be sufficient to limit the pressure within the inner container to not over the test pressure during all conditions of operation, both normal and abnormal, including fire with loss of vacuum, when the insulation space is filled with gaseous hydrogen at atmospheric pressure. The discharge shall be directed upward.

(2) *Safety relief valve.* The inner container shall be equipped with a safety relief valve without an intervening shut-off valve and set to start to discharge at a pressure not greater than 75 percent of the test pressure prescribed in § 79.401, less 15 psi. Safety relief valve capacity shall be sufficient to limit the pressure within the inner container to 85 percent of the test pressure, less 15 psi, even when the insulation space is filled with gaseous hydrogen at atmospheric pressure (no vacuum) and the outer shell is at 130 F. The minimum size relief valve body shall be 3/4 inch IPS. The discharge shall be directed upward. See AAR Specifications for Tank Cars, Appendix A, for formula for calculating discharge capacity.

(3) *Pressure control device.* The inner container shall be equipped with an approved device to prevent the discharge of a mixture exceeding 50 percent of the lower flammable limit to the atmosphere under normal conditions of storage and transport of lading. This device shall be set to start to discharge at a pressure not greater than 17 psig and shall have sufficient capacity to limit the pressure within the inner container to 17 psig when the discharge is equal to twice the normal venting rate during transportation with normal vacuum and the outer shell at 130 F.

(4) *Safety interlock.* Not a specification requirement. If a safety interlock is provided for the purpose of allowing transfer of the lading at a pressure higher than the pressure control device setting but less than the safety relief valve setting, the design shall be as follows:

(1) The safety interlock shall not affect the discharge path of the safety relief valve or safety vent at any time. The safety interlock shall automatically provide an unrestricted discharge path for the pressure control device at all times except when the inner container is being pressurized through the vapor vent line shut-off valve for the transfer

of lading. The safety interlock shall automatically prevent operation of the pressure control device only when the inner container is being pressurized through the vapor vent line shut-off valve for transfer of lading. Automatic operation shall be assured by a mechanical interlock of approved design between the vapor vent line shut-off valve and a pressure control device shut-off valve.

(d) *Outer shell.* The outer shell shall be provided with a suitable relief device to prevent build up of internal pressure in excess of 16 psig. The discharge capacity of the relieving device shall be sufficient to vent pressure accumulating within the annular space. Safety vent, if used, shall be designed to prevent distortion of the frangible disc when the annular space is evacuated.

(e) *Piping system.* Additional safety relief valves shall be installed in each piping circuit where the system can be isolated by closing the shut-off valves so that a dangerous pressure can be built up. These safety relief valves shall be designed to open at a pressure sufficiently low to prevent damage to the component or system affected.

§ 79.400-19 Tests of safety relief valves.

(a) Each valve shall be tested by air or gas for compliance with § 79.401 before being put into service.

§ 79.400-20 Control valves and gages.

(a) *Control valves.* (1) Manually-operated shut-off valves and control valves shall be provided wherever needed for control of the vapor phase pressure, vapor phase venting, liquid transfer and liquid flow rates.

(2) Control valves and shut-off valves shall be designed and constructed to provide positive shut-off, and to provide minimum resistance to flow when open. These valves shall be so constructed that the packing glands and control handles are separated from the valve bodies by a sufficient length of low conductivity material to reduce to minimum the collection of frost on the control handles when low temperature gas or liquid is passing through or in contact with the valve parts.

(3) Control valve and shut-off valves shall be of approved design and fabricated from materials not adversely affected by extended periods of contact with the lading in the liquid or vapor phase, or moist air and water.

(4) Packing, if used in these valves, shall be satisfactory for use in contact with the lading in the liquid or vapor phase and shall be of approved materials which will effectively seal the valve stem without causing difficulty of operation.

(5) Control valves and shut-off valves shall be so installed that they can be readily operated and their control handles will be readily accessible to the operator. These valves shall be so mounted that operation of the valves will not transmit excessive forces to the piping system.

(b) Instruments necessary to the effective and safe operation of the tank when transporting, transferring or storing the liquid commodities for which the car is designed shall be provided. In-

struments, except portable instruments, shall be securely mounted on panels within suitable protective housings and shall include the following:

(1) *Liquid level gage.* Connections shall be provided for a liquid level gage of approved design to indicate the quantity of liquefied hydrogen within the inner container. The gage, if not portable, shall be mounted in a position where it will be readily visible to an operator during transfer operations or storage. The connection for a portable gage must be readily accessible.

(2) *Fixed dip tube.* A fixed length dip tube shall be provided with a manually operated shut-off valve located as close as possible to the outer shell and within a suitable housing. It shall be so installed as to indicate the maximum liquid level for the allowable filling density at 1 psig.

(3) *Vapor phase pressure gage.* A vapor phase pressure gage of approved design shall be provided to indicate the vapor pressure within the inner container. The gages shall be mounted so as to be readily visible to an operator.

(4) *Vacuum gage.* Connections shall be provided for a vacuum gage of approved design to indicate the absolute pressure in the annular space between the outer shell and the inner container. The gage, if not portable, must be mounted in a position where it will be readily visible to an operator. The connection for a portable gage must be readily accessible.

§ 79.400-21 Protective housings.

(a) The protective housings specified for all valves, gages, and closures shall be designed to protect the enclosed components from direct solar radiation, mud, sand, adverse environmental exposure, and mechanical damage. The housings shall be so designed as to provide reasonable access to the enclosed components for operation, inspection, and maintenance, and so that vapor concentration cannot build up to a dangerous level inside the housings in the event of valve leakage or pop safety valve operation. The closure shall be operable by personnel wearing heavy gloves and shall incorporate provisions for locks or seals.

§ 79.400-22 Operating instructions.

(a) *Identification.* All valves and gages shall be clearly identified with corrosion-resistant name plates. A plate of corrosion-resistant material bearing directions and precautionary instructions for the safe operation of this equipment during storage and transfer operations shall be securely mounted so as to be readily visible to an operator. This instruction plate shall be mounted in each housing containing operating equipment and controls for product handling. The instructions shall be clear, concise and adequate in the description of the operations to be performed by the operator during storage or transfer operations. These instructions shall include a diagram of the tank and its piping system, with the various gages, control valves, and safety relief devices clearly identified and located. The operating instructions

for the vacuum system may be on a separate plate which is installed only in the housing containing vacuum controls and gages.

§ 79.400-23 Stamping.

(a) Each tank shall be marked certifying that the tank complies with all requirements of this specification. These marks shall be as follows:

(1) ICC----- (insert applicable number per § 79.401) in letters and figures at least 3/8 inch high stamped plainly and permanently into the metal near the center of the main head of the outer shell at the "B" end of the car by the tank builder or the party assembling the complete tank unit. This mark must also be stenciled on the outer shell in letters and figures at least 1 1/2 inches high by the party assembling the complete car.

(2) Initials of the builder of the inner container, together with information as to the material used for the shell and heads of the inner container, shell thickness, head thickness and inside diameter of the inner container, shall be stamped in letters and figures at least 3/8 inch high into the metal immediately below the marks specified in § 79.400-23(a) (1).

(3) Initials of builder of the outer shell in letters and figures at least 3/8 inch high stamped plainly and permanently into the metal immediately below the marks specified in subparagraph (2) of this paragraph.

(4) Date of original test of inner container and initials of party conducting the test in letters and figures at least 3/8 inch high plainly and permanently stamped immediately below the marks specified in subparagraph (3) of this paragraph. Any marking, stenciling or stamping on the shell or heads of the inner container is prohibited. These markings must also be stenciled on the outer shell in letters and figures at least 1 1/2 inches high.

(5) Initials of company assembling the complete car in letters and figures at least 3/8 inch high plainly and permanently stamped immediately below the marks specified in subparagraph (4) of this paragraph. These marks shall also be stenciled on the outer shell in letters and figures at least 1 1/2 inches high.

(6) In lieu of stamping required in subparagraphs (1), (2), (3), (4), and (5) of this paragraph, the markings specified by these paragraphs may be incorporated on a data plate of corrosion-resistant metal fillet welded in place on the main head of the outer shell of the "B" end of the car.

§ 79.400-24 Stenciling.

(a) The outer shell of the tank shall be stenciled in compliance with the requirements of AAR Specifications for Tank Cars, Appendix C.

(1) Date on which the principal safety relief valves were tested, pressure at which tested, place where tested and initials of party making test shall be stenciled on the outer shell in letters and figures at least 1 inch high.

(2) The date on which the frangible disc was replaced and the initials of the

party making the replacement shall be stenciled on the outer shell in letters and figures 1 inch high. The identification of the manufacturer, the type of frangible disc installed, and the rated rupture pressure is normally shown on the tab of the disc. If it is not given thereon, this information shall also be stenciled on the outer shell in letters and figures 1 inch high.

(3) Tank cars of approved design built to this specification are authorized for the transportation of "LIQUEFIED HYDROGEN ONLY" and shall be stenciled in letters at least 2 inches high on the outer shell immediately above the marks specified in paragraph 79.400-23(a) (1).

§ 79.400-25 Reports.

(a) Certificate of Construction, see § 79.5.

§ 79.401 Individual specification requirements for liquefied hydrogen tank car tanks.

(a) In addition to § 79.400 the individual specification requirements are as follows:

ICC specification	113A60-W	113A175-W
Material (see § 79.400-6)-----	Stainless steel.	Stainless steel.
Bursting pressure, psi (see § 79.400-4)-----	240	440
Minimum thickness, inches, shell, and head-----	3/16	5/16
Test pressure, psi (see § 79.400-11)-----	60	175
Safety relief devices:		
Safety vent, maximum bursting pressure, psi-----	60	175
Tolerance, psi-----	+0, -10	+0, -22
Safety relief valve:		
Start-to-discharge-----	30	115
Start-to-discharge tolerance-----	±2.0	±4.0
Vapor-tight, minimum-----	24	95
Pressure control device:		
Start-to-vent, psi maximum-----	17	17
Outer shell safety vent, psi maximum-----	16	16

§ 79.500 Specification ICC-107A****, seamless steel tank car tanks.

§ 79.500-1 Tanks built under these specifications shall meet the requirements of § 79.500.

§ 79.500-2 Approval.

(a) For procedure for securing approval, see § 79.3.

§ 79.500-3 Type and general requirements.

(a) Tanks built under this specification shall be hollow forged or drawn in one piece. Forged tanks shall be machined inside and outside before ends are necked-down and, after necking-down, the ends shall be machined to size on the ends and outside diameter. Machining not necessary on inside or outside of seamless steel tubing, but required on ends after necking-down.

(b) For tanks made in foreign countries, chemical analysis of material and all tests as specified must be carried out within the limits of the United States under supervision of a competent and disinterested inspector; in addition to which, provisions in § 79.500-18 (b) and (c) shall be carried out at the point of manufacture by a recognized inspection bureau with principal office in the United States.

(c) The terms "marked end" and "marked test pressure" used throughout this specification are defined as follows:

(1) "Marked end" is that end of the tank on which marks prescribed in § 79.500-17 are stamped.

(2) "Marked test pressure" is that pressure in pounds per square inch which is indicated by the figures substituted for the **** in the marking ICC-107A **** stamped on the marked end of tank.

(d) The gas pressure at 130 F in the tank shall not exceed 1/10 of the marked test pressure of the tank.

§ 79.500-4 Thickness of wall.

(a) Minimum thickness of wall of each finished tank shall be such that at a pressure equal to 7/10 of the marked test pressure of the tank, the calculated fiber stress in pounds per square inch at inner wall of tank multiplied by 3.0 will not exceed the tensile strength of any specimen taken from the tank and tested as prescribed in § 79.500-7(b). Minimum wall thickness shall be 1/4 inch.

(b) Calculations to determine the maximum marked test pressure permitted to be marked on the tank shall be made by the formula:

$$P = \frac{10S(D^2 - d^2)}{7(D^2 + d^2)}$$

where:

P = Maximum marked test pressure permitted;

$$S = \frac{U}{3.0}$$

where:

U = Tensile strength of that specimen which shows the lower tensile strength of the two specimens taken from the tank and tested as prescribed in § 79.500-7(b).

3 = Factor of safety.

$\frac{D^2 - d^2}{D^2 + d^2}$ = The smaller value obtained for this factor by the operations specified in § 79.500-4(c).

(c) Measure at one end, in a plane perpendicular to the longitudinal axis of the tank and at least 18 inches from that end before necking-down:

d = Maximum inside diameter (inches) for the location under consideration; to be determined by direct measurement to an accuracy of 0.05 inch.

t = Minimum thickness of wall for the location under consideration; to be determined by direct measurement to an accuracy of 0.001 inch.

Take $D = d + 2t$.

Calculate the value of $\frac{D^2 - d^2}{D^2 + d^2}$

(1) Make similar measurements and calculation for a corresponding location at the other end of the tank.

(2) Use the smaller result obtained, from the foregoing, in making calculations prescribed in paragraph (b) of this section.

§ 79.500-5 Material.

(a) Tanks shall be made from open-hearth or electric steel of uniform quality. Material shall be free from seams, cracks, laminations, or other defects injurious to finished tank. If not free from such defects, the surface may be machined or ground to eliminate these defects. Forgings and seamless tubing

for bodies of tanks shall be stamped with heat numbers.

(b) Steel (see Note 1) must conform to the following requirements as to chemical composition:

Designation	Class I (percent)	Class II (percent)	Class III (percent)
Carbon, maximum.....	0.50	0.50	0.53
Manganese, maximum.....	1.65	1.65	1.85
Phosphorus, maximum.....	.05	.05	.05
Sulphur, maximum.....	.06	.05	.05
Silicon, maximum.....	.35	.30	.37
Molybdenum, maximum.....		.25	.30
Chromium, maximum.....		.30	.30
Sum of manganese and carbon not over.....	2.10	2.10	

NOTE 1: Alternate steel containing other alloying elements may be used if approved.

(1) For instructions as to the obtaining and checking of chemical analysis, see § 79.500-18(b)(3).

§ 79.500-6 Heat treatment.

(a) Each necked-down tank shall be uniformly heat treated. Heat treatment shall consist of annealing or normalizing and tempering for Class I, Class II and Class III steel or oil quenching and tempering for Class III steel. Tempering temperatures shall not be less than 1000° F. Heat treatment of alternate steels shall be approved. All scale shall be removed from outside of tank to an extent sufficient to allow proper inspection.

(b) To check uniformity of heat treatment, Brinell hardness tests shall be made at 18 inch intervals on the entire longitudinal axis. The hardness shall not vary more than 35 points in the length of the tank. No hardness tests need be taken within 12 inches from point of head to shell tangency.

(c) A magnetic particle inspection shall be performed after heat treatment on all tanks subjected to a quench and temper treatment to detect the presence of quenching cracks. Cracks shall be removed to sound metal by grinding and

the surface exposed shall be blended smoothly into the surrounding area. A wall thickness check shall then be made of the affected area by ultrasonic equipment or other suitable means acceptable to the inspector and if the remaining wall thickness is less than the minimum recorded thickness as determined by § 79.500-4(b) it shall be used for making the calculation prescribed in (b) of this section.

§ 79.500-7 Physical tests.

(a) Physical tests shall be made on 2 test specimens 0.505 inch in diameter within 2-inch gage length, taken 180 degrees apart, 1 from each ring section cut from each end of each forged or drawn tube before necking-down, or 1 from each prolongation at each end of each necked-down tank. These test specimen ring sections or prolongations shall be heat treated, with the necked-down tank which they represent. The width of the test specimen ring section must be at least its wall thickness. Only when diameters and wall thickness will not permit removal of 0.505 by 2-inch tensile test bar, laid in the transverse direction, may test bar cut in the longitudinal direction be substituted. When the thickness will not permit obtaining a 0.505 specimen, then the largest diameter specimen obtainable in the longitudinal direction shall be used. Specimens shall have bright surface and a reduced section. When 0.505 specimen is not used the gage length shall be a ratio of 4 to 1 length to diameter.

(b) Elastic limit as determined by extensometer, shall not exceed 70 percent of tensile strength for Class I steel or 85 percent of tensile strength for Class II and Class III steel. Determination shall be made at cross head speed of not more than 0.125 inch per minute with an extensometer reading to 0.0002 inch. The extensometer shall be read at increments of stress not exceeding 5,000 pounds per square inch. The stress at which the strain first exceeds

$$\frac{\text{Stress (pounds per square inch)}}{30,000,000 \text{ (pounds per square inch)}} \text{ plus } 0.005 \text{ (inches per inch)}$$

shall be recorded as the elastic limit.

(1) Elongation shall be at least 18 percent and reduction of area at least 35 percent.

NOTE 1: Upon approval, the ratio of elastic limit to ultimate strength may be raised to permit use of special alloy steels of definite composition that will give equal or better physical properties than steels herein specified.

§ 79.500-8 Openings in tanks.

(a) Each end shall be closed by a cover made of forged steel. Covers shall be secured to ends of tank by through bolts or studs not entering interior of tank. Covers shall be of a thickness sufficient to meet test requirements of § 79.500-12 and to compensate for the openings closed by attachments prescribed herein.

(1) It is also provided that each end may be closed by internal threading to accommodate an approved fitting. The internal threads as well as the threads on fittings for these openings shall be

clean cut, even, without checks, and tapped to gage. Taper threads are required and shall be of a length not less than as specified for American Standard taper pipe threads. External threading of an approved type shall be permissible on the internal threaded ends.

(b) Joints between covers and ends and between cover and attachments shall be of approved form and made tight against vapor or liquid leakage by means of a confined gasket of suitable material.

§ 79.500-9 Tank mounting.

(a) For tank mounting, see § 79.10.

§ 79.500-10 Protective housing.

(a) Safety devices, and loading and unloading valves on tanks shall be protected from accidental injury by approved metal housing, arranged so it may be readily opened to permit inspection and adjustment of safety relief devices and valves, and securely locked in closed position. Housing shall be provided with

opening having an opening equal to twice the total discharge area of safety relief device enclosed.

§ 79.500-11 Loading and unloading valves.

(a) Loading and unloading valve or valves shall be mounted on the cover or threaded into the marked end of tank. These valves shall be of approved type, made of metal not subject to rapid deterioration by lading or in service, and shall withstand without leakage a pressure equal to the marked test pressure of tank. Provision shall be made for closing service outlet of valves.

§ 79.500-12 Safety relief devices.

(a) Tank shall be equipped with one or more safety relief devices of approved type and discharge area, mounted on the cover or threaded into the non-marked end of the tank. If fittings are mounted on a cover, they shall be of the flanged type, made of metal not subject to rapid deterioration by lading or in service. Total flow capacity shall be such that, with tank filled with air at pressure equal to 70 percent of the marked test pressure of tank, flow capacity will be sufficient to reduce air pressure to 30 percent of the marked test pressure within 3 minutes after safety relief device opens.

(b) Safety safety devices shall open at pressure not exceeding the marked test pressure of tank and not less than $\frac{7}{10}$ of marked test pressure. (For tolerance for safety relief valves, see § 79.500-16(a).)

(c) Cars used for the transportation of flammable gases shall have the safety devices equipped with an approved ignition device.

§ 79.500-13 Fixtures.

(a) Attachments, other than those mounted on tank covers or serving as threaded closures for the ends of the tank, are prohibited.

§ 79.500-14 Test of tanks.

(a) After heat-treatment, tanks shall be subjected to hydrostatic tests in a water jacket, or by other accurate method, operated so as to obtain reliable data. No tank shall have been subjected previously to internal pressure greater than 90 percent of the marked test pressure. Each tank shall be tested to a pressure at least equal to the marked test pressure of the tank. Pressure shall be maintained for 30 seconds, and sufficiently longer to insure complete expansion of tank. Pressure gage shall permit reading to accuracy of one percent. Expansion gage shall permit reading of total expansion to accuracy of one percent. Expansion shall be recorded in cubic centimeters.

(b) No leaks shall appear and permanent volumetric expansion shall not exceed 10 percent of the total volumetric expansion at test pressure.

§ 79.500-15 Handling of tanks failing in tests.

(a) Tanks rejected for failure in any of the tests prescribed may be reheated, and will be acceptable if subsequent to reheat-treatment they are subjected to and pass all of the tests.

§ 79.500-16 Tests of safety relief devices.

(a) Safety relief valves shall be tested by air or gas before being put into service. Valve shall open at pressure not exceeding the marked test pressure of tank and shall be vapor-tight at 80 percent of the marked test pressure.

(b) For safety relief devices of frangible disc type, samples of discs used shall burst at a pressure not exceeding the marked test pressure of tank and not less than 7/10 of marked test pressure.

§ 79.500-17 Marking.

(a) Each tank shall be plainly and permanently marked, thus certifying that tank complies with all requirements of this specification. These marks shall be stamped into the metal of necked-down section of tank at marked end, in letters and figures at least 1/4 inch high, as follows:

(1) Spec. ICC-107A****, the **** to be replaced by figures indicating marked test pressure of the tank. This pressure shall not exceed the calculated maximum marked test pressure permitted, as determined by the formula in § 79.500-4(b).

(2) Serial number immediately below the stamped mark specified in paragraph (a)(1) of this section.

(3) Inspector's official mark immediately below the stamped mark specified in paragraph (a)(1) of this section.

(4) Name, mark (other than trademark), or initials of company or person for whose use tank is being made, which shall be recorded with the Bureau of Explosives.

(5) Date (such as 1-62, for January 1962) of tank test, so placed that dates of subsequent tests may easily be added thereto.

(6) Date (such as 1-62, for January 1962) of latest test of safety relief valve or of frangible disc, required only when tank is used for transportation of flammable gases.

(7) Name of gas for which tank car is being used, stenciled in letters at least 2 inches high on each side of car where they are clearly visible.

§ 79.500-18 Inspection and reports.

(a) Before a tank car is placed in service, the party assembling the completed car shall furnish to car owner, Bureau of Explosives, and the Secretary, Mechanical Division, Association of American Railroads, a report in proper form certifying that tanks and their equipment comply with all the requirements of this specification and including information as to serial numbers, dates of tests, and ownership marks on tanks mounted on car structure.

(b) Purchaser of tanks shall provide for inspection by a competent inspector as follows:

(1) Inspector shall carefully inspect all material and reject that not complying with § 79.500-5.

(2) Inspector shall stamp his official mark on each forging or seamless tube accepted by him for use in making tanks, and shall verify proper application of heat number to such material by occasional inspections at steel manufacturer's plant.

(3) Inspector shall obtain certified chemical analysis of each heat of material.

(4) Inspector shall make inspection of inside surface of tanks before necking-down, to insure that no seams, cracks, laminations, or other defects exist.

(5) Inspector shall fully verify compliance with specification, verify heat treatment of tank as proper; obtain samples for all tests and check chemical analyses; witness all tests; and report minimum thickness of tank wall, maximum inside diameter, and calculated value of D, for each end of each tank as prescribed in § 79.500-4(c).

(6) Inspector shall stamp his official mark on each accepted tank immediately below serial number, and make certified report (see paragraph (c) of this section) to builder, to company or person for whose use tanks are being made, to builder of car structure on which tanks are to be mounted, to the Bureau of Explosives, and to the Secretary, Mechanical Division, Association of American Railroads.

(c) Inspector's report required herein shall be in the following form:

(Place) _____
(Date) _____

STEEL TANKS

It is hereby certified that drawings were submitted for these tanks under AAR Application for Approval _____ and approved by the AAR Committee on Tank Cars under date of _____.

Built for _____ Company
Location at _____
Built by _____ Company
Location at _____
Consigned to _____ Company
Location at _____
Quantity _____
Length (inches) _____
Outside diameter (inches) _____
Marks stamped into tank as required in § 79.500-17 are:

ICC-107A****

NOTE 1: The marked test pressure substituted for the **** on each tank is shown on Record of General Data on Tanks attached hereto.

Serial numbers _____ to _____ inclusive
Inspector's mark _____
Owner's mark _____
Test date _____
Water capacity (see Record of Hydrostatic Tests).

Tare weights (yes or no) (see Record of Hydrostatic Tests).

These tanks were made by process of _____

Steel used was identified as indicated by the attached list showing the serial number of each tank, followed by the heat number.

Steel used was verified as to chemical analysis and record thereof is attached hereto. Heat numbers were stamped into metal.

All material was inspected and each tank was inspected both before and after closing in ends; all material accepted was found free from seams, cracks, laminations, and other defects which might prove injurious to strength of tank. Processes of manufacture and heat-treatment of tanks were witnessed and found to be efficient and satisfactory.

Before necking-down ends, each tank was measured at each location prescribed in § 79.500-4(c) and minimum wall thickness in inches at each location was recorded; maximum inside diameter in inches at each location was recorded; value of D in inches at each location was calculated and recorded; maximum fiber stress in wall at location showing larger value for

D^2 + d^2 / D^2 - d^2

was calculated for 7/10 the marked test pressure and recorded. Calculations were made by the formula:

S = 0.7P (D^2 + d^2) / (D^2 - d^2)

Hydrostatic tests, tensile tests of material, and other tests as prescribed in this specification, were made in the presence of the inspector, and all material and tanks accepted were found to be in compliance with the requirements of this specification. Records thereof are attached hereto.

I hereby certify that all of these tanks proved satisfactory in every way and comply with the requirements of Interstate Commerce Commission Specification No. 107A****.

(Signed) _____
(Inspector)

(Place) _____
(Date) _____

RECORD OF CHEMICAL ANALYSIS OF STEEL FOR TANKS

Numbered _____ to _____ inclusive
Size _____ inches outside diameter by _____ inches long
Built by _____ Company
For _____ Company

Table with columns: Heat No., Tanks represented (serial Nos.), Chemical analysis (C, Mn, P, S, Si, Ni, Cr, Mo)

These analyses were made by
(Signed) _____
(Place) _____
(Date) _____

RECORD OF TENSILE TESTS OF MATERIAL IN TANKS

Numbered _____ to _____ inclusive
Size _____ inches outside by _____ inches long
Built by _____ Company
For _____ Company

Table with columns: Heat No., Tanks represented by test (serial Nos.), Elastic limit (pounds per square inch), Tensile strength (pounds per square inch), Elongation (per cent in 2 inches), Reduction of area (per cent)

(Signed) _____

RULES AND REGULATIONS

(Place) -----
(Date) -----

RECORD OF HYDROSTATIC TESTS ON TANKS

Numbered ----- to ----- inclusive
Size ----- inches outside by ----- inches
long
Built by ----- Company
For ----- Company

Serial Nos. of tanks	Actual test pressure (pounds per square inch)	Total expansion (cubic centimeters) ¹	Permanent expansion (cubic centimeters) ¹	Percent ratio of permanent expansion to total expansion ¹	Tare weight (pounds) ²	Capacity in pounds of water at 60 F

¹ If tests are made by method involving measurement of amount of liquid forced into tank by test pressure, then the basic data on which calculations are made, such as pump factors, temperature of liquid, coefficient of compressibility of liquid, etc., must also be given.

² Do not include protective housing, but state whether with or without valves.

(Signed) -----

(Place) -----
(Date) -----

RECORD OF GENERAL DATA ON TANKS

Numbered ----- to ----- inclusive
Built by ----- Company
For ----- Company

Serial No. of tank	Data obtained as prescribed in §79.600-4(c)		Larger value of the factor $\frac{D^2+d^2}{D^2-d^2}$
	Marked end of tank	Other end of tank	
(t) Minimum thickness of wall in inches			(S) Calculated fiber stress in pounds per square inch at 7/10 marked test pressure
(d) Maximum inside diameter in inches			
(D) Calculated value of D in inches $=d+2t$			Marked test pressure in pounds per square inch stamped in tank
(t) Minimum thickness of wall in inches			
(d) Maximum inside diameter in inches			Minimum tensile strength of material in pounds per square inch recorded
(D) Calculated value of D in inches $=d+2t$			

(Signed) -----

PARTS 80-90 [RESERVED]

[SEAL] **HAROLD D. MCCOY,**
Secretary.

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