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Transport
Dangerous Goods
Directorate

Direction générale du
transport des marchandises
dangereuses

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344, rue Slater
Ottawa (Ontario)
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Your file Votre référence

Our file Notre référence
ASD4067-26-2-26

DEC 18 1990

Mr. J. Dimmick
Pressed Steel Tank Co., Inc.
1445 South 66 Street
West Allis, Wisconsin
USA 53214

Dear Mr. Dimmick:

Please refer to recent requests and enquiries with this Directorate regarding the renewal of Special Permits 1880 and 3232 and approval for the manufacturing of compressed gas cylinders of specification CTC 3A, 3AA, 3HT, 4AA, 4B and 4BA.

After careful review of our files and related correspondence, and in accordance with the new procedures in place at Transport Canada, a Certificate of Registration has been issued to your company. This certificate covers all previously authorized designs and is deemed to supersede any previous letters, Orders or Special Permits issued by Transport Canada or the Canadian Transport Commission.

Please confirm your understanding and concurrence with the terms of the certificate by return letter.

Should you have any further questions on this matter, please write or call me at (613) 990-1167.

Yours truly,

Don Yamasaki
Interpretation Officer
Regulatory Affairs Branch

attach.

c.c.: P. Harris, T.H. Cochrane Lab. Ltd.

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Certificate of Registration

This is to certify that: Pressed Steel Tank Co., Inc., 1445 South 66 Street West, Allis, Wisconsin, U.S.A. pursuant to its application on file with Transport Canada has been granted the registration No. M26 in accordance with the provisions of Special Permit No. 3263 and section 25 of CAN/CSA B339-88 for the purpose of manufacturing compressed gas cylinders under the following limitations:

Provided:

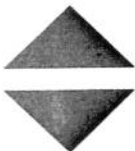
- 1) Specification 3A, 3AA, 3HT, 4AA, 4B and 4BA cylinders shall be manufactured in accordance with
 - a) CTC Regulations for the transportation of Dangerous Commodities by Rail",
 - b) drawings submitted with letter dated May 12, 1981 and
 - c) additional requirements set out in Appendix A.
- 2) The non-specification fibre reinforced plastic (FRP) hoop wrapped and high strength steel cylinders shall be manufactured in accordance with the requirements set out in Appendix B and C respectively.
- 3) Cylinders shall conform with the additional information on file with this Directorate.
- 4) The manufacturing must be supervised by a duly authorized Independent Inspection Agency under an inspection procedure conforming to the requirements set out in the Specifications, Appendices B or C to this certificate, and filed with this Directorate.
- 5) Within two years after the Registration date of this certificate, a quality assurance manual shall be submitted to the Director. The manual shall indicate that the operations in the plant are in accordance with CAN3-Z299.3-85 standard or equivalent.

Not later than 20 days after any changes occur in the information submitted in support of the application, the holder shall advise this Directorate of any such changes.

Failure to comply with the above mentioned requirements or any applicable regulations may result in the suspension or revocation of this certificate of registration.

This Certificate of Registration shall expire on: Dec 6 1995 or on such previous date as this Directorate may decide.

Registration Date: Dec 6/90 Signed: Xan Bonnard for JRM
 Director, Regulatory Requirements
 Transport Dangerous Goods Directorate



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APPENDIX "A" TO CERTIFICATE OF REGISTRATION NO. M26

- (1) Carbon-boron steel with the following analysis (%) is authorized for specification 3AA cylinder carbon 0.27 to 0.37, manganese 0.80 to 1.40; phosphorus 0.035 max., sulphur 0.045 max., silicon 0.3 max., boron 0.0005 to 0.0030. The hardness after quenching of the steel from the first and last ingot of each heat shall be Rc. 33 to 53.

APPENDIX B TO CERTIFICATE OF REGISTRATION NO. M26

The non-specification fibre reinforced plastic (FRP) hoop wrapped seamless steel cylinder shall comply with the following requirements:

- a) The design and construction must be in accordance with Pressed Steel Tank Co.'s application of June 25, 1987 and drawings 1271102, 1271202, 1271302, 1272502, 1271402, 1271502, 1271602, 1271902, 1272202, 1274902, 1278802, 1276202, 1278902, 1274802 and 1278602 and additional design and performance data on file with the Directorate.
- b) In addition, the cylinders shall be in full compliance with DOT FRP-2 Standard dated January 15, 1982 (178.BB) except as follows:
 - i) 178.BB-2 Type size and service pressure. Type 3HW cylinder consisting of resin impregnated continuous filament windings in the circumferential direction only over a seamless steel liner made in compliance with 178.BB-6(a); not over 350 pounds water capacity; and service pressure at least 900 PSI but not greater than 5000 PSI.
 - ii) 178.BB-4 Duties of Inspector
 - a) ***
 - b) Verify compliance of steel liner with 178.BB-6(a). Verify compliance of filament and resin system components with the requirements specified in 178-BB-5.
 - c) ***
 - d) ***
 - e) ***
 - f) ***
 - g) Furnish complete inspector's report (178.BB-16) to the maker of the cylinder, to the Directorate and upon request; to the purchaser (see 178.BB-17).
 - iii) 178.BB-5 Authorized material and identification of material
 - a) Liner material must be as prescribed in Specification 3AA or in Appendix A.

*** **

iv) 178.BB-6 Manufacture

- a) Liner. Liner without overwrap must be suitable for a marked service pressure of at least 50 percent of the service pressure marked on the composite cylinder, and must be full compliance with Specification 3AA except as follows:

*** **

- b) Composite Cylinder. The composite cylinder must be fabricated from a steel liner circumferentially wrapped over the entire cylindrical portion with resin impregnated, continuous filament windings. Winding pattern to be "hoop" wrapped, applied under controlled tension to develop the design composite thickness. After winding is complete, the composite must be cured by a controlled temperature profile, and autofrettaged by pressurizing to not less than 105 and not greater than 115 percent of the prescribed minimum test pressure. No defect is acceptable that is likely to weaken the finished cylinder appreciably.

*** **

v) 178.BB-7 Wall thickness

- a) Minimum thickness of the liner must be at least equal to the minimum design thickness 178.BB-18 (h) and be such that after autofrettage, the compressive stress in the sidewall of the liner at zero pressure will not exceed 50 percent of the minimum yield strength of the steel as determined in the S178.37-16 or 50 percent of the minimum design yield strength shown in 178.BB-18 (h). The maximum tensile stress of the liner at operating pressure must not exceed 60% of the yield strength.

vi) 178.BB-8 Openings

- a) ***
b) ***

- c) Taper threads when used must comply with one of the following:

(1) American Standard Pipe Thread (NPT) standard must comply with the requirements of Federal Standard H 28/7 (1978).

(2) National Gas Taper Thread (NGT) standard must comply with the requirements of Federal Standard H 28/7 and H 28/9 (1978).

vii) 178.BB-12 Destructive tests

- a) ***

1) ***Except cycling rate is changed to "10 cycles per minute".

viii) 178.BB-13 Acceptable results of tests

- a) ***

- b) Physical test applies to steel liner only.

1) Elongation must be at least 20 percent for 2 inch gauge length or at least 10 percent in other cases.

- 2) ***

- 3) ***

- c) Cycling test.

1) Each test cylinder must withstand at least 10,000 pressurizations between approximately zero and service pressure, without evidence of distortion or failure.

ix) 178.BB-14 Rejected liners and cylinders

Change "aluminum" to "steel" whenever the word aluminum is found in these paragraphs.

x) 178.BB-15 Marking

- a) ***

- b) Required markings are as follows:

1) TC SP 3263-M26B-YYYY (where Y=service pressure in psig)

2) A serial number and an identifying symbol (letters); location of number to be just below or immediately following the TC mark; location of symbol to be just below or immediately following the number. The symbol and numbers must be those of the maker. The symbol must be registered with the Director, Regulatory Requirements.

3) the Inspector's official mark must be placed near the serial number.

c) ***

d) Change "aluminum" to "steel".

e) ***

xi) 178.BB-16 Inspector's report

Change "aluminum" to "steel" whenever the word aluminum is found in these paragraphs.

xii) 178.BB-18 Design qualification tests

a) General - Except as authorized in 178.BB-10(a), qualification tests as prescribed in this paragraph shall have been performed on representative cylinders of each specific design prior to the initial shipment. All cylinders used for design qualification tests must be fabricated on the same equipment and subjected to the same processes as is used to produce cylinders intended for charging and shipment. All tests must be witnessed by an independent inspector. Test reports must be kept on file by the cylinder maker and made available to the independent inspector and the Director, Regulatory Requirements upon request.

b) Revoked.

c) Revoked.

d) *** Except that cycling rate is changed to "10 cycles per minute".

e) ***

f) Not required.

g) ***

- h) Qualification test results - A report of all tests for each design describing test setup, procedure and results must be submitted to the Director, Regulatory Requirements. This report must include at least the following basic information on each cylinder tested: ***

c) SPECIAL REQUIREMENTS

- a) The cylinder shall be maintained and used in accordance with applicable sections of the CTC regulations and filled only with methane or natural gas, compressed (UN 1971) or air, compressed (UN 1002).
- b) Shippers may use the packaging covered by this exemption pursuant to section 73.22(a) of the CTC regulations.
- c) Cylinder service life shall not exceed 15 years.
- d) Use of these cylinders for underwater breathing is not authorized.
- e) Each cylinder must be reinspected and hydrostatically retested every three years in accordance with section 73.34(e) of the CTC regulations as prescribed for specification 3HT cylinders, except that the rejection elastic expansion criteria does not apply, permanent volumetric expansion must not exceed 5 percent of total volumetric expansion at test pressure and retest dates must be imbedded in the epoxy coating in a permanent manner other than stamping. Retest dates may be still stamped on the shoulder of the top head in accordance with 178.BB-15(d). Reheat treatment or repair of rejected cylinders not authorized.
- f) A cylinder which has been subjected to the action of fire shall not be returned to service.
- g) The special filling provisions of section 73.302(c) of the CTC regulations is not allowed.
- h) The Director, Regulatory Requirements shall be advised of any change in design of its cylinder.
- i) The Director, Regulatory Requirements shall be advised of any incident involving loss of contents and shall be provided with a summary of experience on a yearly basis.

APPENDIX C TO CERTIFICATE OF REGISTRATION M26

The non-specification high strength steel cylinder shall comply with the following requirements.

A) The design and construction must be in accordance with Pressed Steel Tank Co. Inc.'s Drawings 1280204/4, 1280230 1/2 and 1280250 1/3 on file with the Directorate and in compliance with Specification 3AA of the CTC Regulation for the Transportation of Dangerous Commodities by Rail except as follows:

(1) Compliance and Lot Definition.

(a) Compliance required in all details.

(b) Lot definition. In this Appendix, a "lot" means a group of cylinders successively produced and having the same:

- (1) Size and configuration;
- (2) Specified material of construction;
- (3) Process of manufacture and heat treatment;
- (4) Equipment of manufacture and heat treatment;
- (5) Conditions of time, temperature and atmosphere during heat treatment.

In no case may the lot size exceed 200 cylinders, but any cylinder processed for use in the required destructive testing need not be counted as being one of the 200.

(2) Type, Size and Service Pressure.

(a) Seamless, 6.875 inches nominal inside diameter, 0.179 minimum wall thickness, 50 pounds maximum water capacity, 3500 psig maximum service pressure.

(b) Not applicable.

(4) Duties of Inspector

(e) Verify that prescribed design qualification tests have been performed with satisfactory results.

(5) Authorized steel.

(a) Electric furnace or equivalent steel of uniform quality is authorized. The steel analysis must be in conformance with the following:

CHEMICAL COMPOSITION IN WEIGHT PERCENT

<u>Element</u>	<u>Ladle Analysis</u>	<u>Check Analysis Tolerance</u>	
		<u>Under</u>	<u>Over</u>
Carbon	.31/.35	0.01	0.02
Manganese	.60/.90	0.03	0.03
Phosphorus	.025 Max.	--	0.01
Sulphur	.010 Max.	--	0.00
Silicon	.15/.35	0.02	0.03
Chromium	.80/1.10	0.03	0.03
Molybdenum	.15/.25	0.01	0.01
Vanadium	.07/.100	0.01	0.01
Aluminum	.01/.05	--	0.00
Copper	.20/Max.	--	0.00

Note 1: Steel shall be treated with calcium to provide the following J-K microcleanliness rating per ASTM Standard E-45, Method D.

<u>A (Sulfides)</u>		<u>B (Alumina)</u>		<u>C (Silicates)</u>		<u>D (Oxides)</u>	
<u>Thin</u>	<u>Heavy</u>	<u>Thin</u>	<u>Heavy</u>	<u>Thin</u>	<u>Heavy</u>	<u>Thin</u>	<u>Heavy</u>
2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0

Certificate from the material manufacturer must certify that the material was calcium treated and must include in such certification the J-K microcleanliness rating for each heat of steel.

Note 2: Steel shall be aluminum killed and made by a fine grain deoxidation practice.

(8) Manufacture

- (a) ***. Metal removal for any purpose other than removal of isolated defects and threading must be done prior to hydrostatic test. The thickness of treated areas must be measured and may not be less than the minimum prescribed thickness. The general surface finish shall not exceed a roughness of 250 r.m.s. Individual irregularities such as draw marks, scratches, pits etc. should be held to a minimum. Surfaces may be machined or otherwise treated to eliminate these defects.
- (b) Each cylinder must be of seamless construction manufactured by the deep drawing method with integrally formed heads and bottoms.
- (c) The thickness of the bottoms of cylinders is, under no condition, to be less than the side wall thickness of the cylindrical shell.

- (d) Shape and thickness of the cylinder bottom and sidewall adjacent to the bottom must be such that failure during the cyclic pressure test occurs in the sidewall of the cylinder.
- (e) The design authorized herein must be qualified for production by subjecting prototype samples to tests as follows:
- (1) Burst Test. Three cylinders must be hydrostatically pressurized to destruction. The rate of pressurization must not exceed 200 psi per second. Cylinders subjected to the burst test must withstand a pressure of at least 2.25 times the service pressure without failure. Failure must initiate in the sidewall in a longitudinal direction, and the cylinder must remain in one piece.
 - (2) Flattening Test. Three cylinders must be flattened to eight times the wall thickness without cracking. Between knife edges, wedge-shaped, 60-degree angle, rounded to 1/2 inch radius. Longitudinal axis of the cylinder must be at approximately a 90 degree angle to the knife edges.
 - (3) Cycle Test. Three cylinders must be cycle tested to destruction to an upper cyclic pressure of 1.5 times service pressure. The successive hydrostatic pressurizations from the lower cyclic pressure to the upper cyclic pressure must not exceed a rate of ten cycles per minute. Adequate recording instrumentation must be provided if equipment is to be left unattended for any period of time. Lower cyclic pressure must not exceed 10 percent of the upper cyclic pressure. Cylinders must withstand at least 10,000 cyclic pressurizations without distortion or failure. The failure must occur in the sidewall and the failure mode must be leak before burst (LBB). At least one cylinder must be cycled using water as the pressurizing medium.
 - (4) Flawed Burst Test. One cylinder must be cycle tested as (3) above to destruction at an upper cyclic pressure of 1.25 times the service pressure. This test must be performed after three flaws (slots) are machined into the upper sidewall of the cylinder. The flaws must have a minimum length of 6 ft and be located at 120° intervals. The flaws must be introduced into the cylinder by a means that will not affect the mechanical or metallurgical properties of the cylinder. The failure mode must be LBB. Examination of the failed cylinder must show evidence of fatigue crack propagation prior to leakage.
- (9) Welding or Brazing

Welding or brazing for any purpose whatsoever is prohibited.

(10) Wall Thickness

- (a) The minimum wall thickness must be such that the wall stress at the minimum specified test pressure does not exceed 67 percent of the minimum tensile strength of the steel as determined by the prescribed mechanical tests. A wall stress of more than 90,500 psi is not permitted. In no case may wall thickness be less than 0.179 inch.
- (b) Calculation must be made by the formula:

$$S = P(1.3D^2 + 0.4d^2)/(D^2 - d^2)$$

where

S = wall stress in pounds per square inch;
P = minimum test pressure, at least 3/2 service pressure;
D = outside diameter in inches;
d = inside diameter in inches.

(11) Heat Treatment

- (a) The completed cylinders must be uniformly and properly heat treated prior to tests. Heat treatment of cylinders shall be as follows:
- (1) Each cylinder must be heated and held above the upper critical temperature (Ac3) for at least one hour per inch of thickness based on the maximum thickness of the cylinder and then quenched in a suitable liquid medium having a cooling rate not in excess of 80 percent of water. The steel temperature on quenching must be above the Ac3 temperature, but not higher than 1700°F.
 - (2) After quenching, each cylinder must be reheated to a temperature below the transformation range but not less than 1000°F, and must be held at this temperature for at least one hour per inch of thickness based on the maximum thickness of the cylinder. Each cylinder must then be air cooled.

(12) Openings

- (a) Openings are permitted in cylinder head only.
- (b) All openings must be threaded. Threads must be in compliance with the following:
- (1) Each thread must be clean cut, even, without checks, and to gauge.

- (2) Straight threads must be used and must be in compliance with one of the following:
 - (i) National Gas Straight Thread (NGS) type must be in compliance with the requirements of Federal Standard H-28, (1978), Sections 7 and 9.
 - (ii) Unified Thread (UN) type must be in compliance with the requirements of Federal Standard H-28 (1978), Section 2.
 - (iii) Controlled Radius Root Thread (UNJ) type must be in compliance with the requirements of Federal Standard H-28 (1978), Section 4.
 - (iv) Other straight threads must have at least six engaged threads, a tight fit, and a factor of safety in shear of at least 10 at the test pressure of the cylinder. shear stress must be calculated by using the appropriate thread shear area in accordance with Federal Standard H-28 (1978), Appendix A5, Section 3.
- (3) All straight threads must have at least six engaged threads, a tight fit, and a factor of safety in shear of at least 10 at the test pressure of the cylinder. shear stress must be calculated by using the appropriate thread shear area in accordance with Federal Standard H-28 (1978), Appendix A5, Section 3.
- (4) Gaskets are required to prevent leakage.
- (13) Pressure relief devices and protection for valves and pressure relief devices.
 - (a) Must be as required by Sections 73.34(d).
 - (b) Pressure relief devices must be in compliance with Section 73.302(c)(1).
- (14) Hydrostatic test.
 - (a) Applies except water jacket method only is authorized.
 - (b) ***
 - (c) ***
 - (d) Each cylinder must be tested to at least $3/2$ times service pressure.

(15) Toughness and ductility tests

- (a) Flattening test. One cylinder out of each lot of 200 or less is to be tested as described in 8(e) above.
- (b) Impact tests. For each lot of 200 or less cylinders, three subsize Charpy V-notch specimens must be taken from the lower sidewall of one heat treated test cylinder at approximately evenly spaced (120 degree) intervals and treated at -50°C in accordance with ASTM E-23.
- (c) Flawed Burst Test. For each lot of 200 or less cylinders, one cylinder must be flawed and cycle tested as described in 8(e) above.
- (d) Hardness examination. A hardness measurement must be performed on the cylindrical section of each cylinder after heat treatment.

(16) Physical test.

(a) ***

(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. The specimen, exclusive of grip ends, must not be flattened. ***

(c) ***

(17) Leakage test and magnetic particle examination.

- (a) Leakage test is not required.
- (b) All cylinders must be inspected by the wet magnetic particle method in accordance with ASTM E-709-85 before closing in, and after heat treatment, to detect the presence of quench cracks or other discontinuities.

(18) Acceptable results of tests and inspections.

- (a) Flattening test. Flattening required without cracking to 8 times wall thickness. Maximum degree of flattening attained without cracking must be entered on the inspector's report.
- (b) Impact tests. The Charpy V-notch impact properties for the three impact specimens must not be less than the values shown below:

<u>Size (mm)</u>	<u>Avg. value for acceptance 3 specimens</u>	<u>Min. value 1 specimen only of the three</u>	<u>Lateral Expansion inches</u>	<u>Percent Fibrous fracture</u>
10 X 4	12.0 ft. lbs.	10.0 ft. lbs.	0.012	50

- (c) Hardness measurement. The tensile strength equivalent of the hardness number obtained may not be more than 165,000 psi; Rc 37 (Brinell 342). When the result of a hardness test exceeds the maximum permitted, two or more retests may be made; however, the hardness number obtained in each retest may not exceed the maximum permitted.
- (d) Flawed burst test. The failure must be by leakage originating in the sidewall and before burst.
- (e) Mechanical tests.
- (1) Tensile strength must not exceed 165,000 psi.
 - (2) Elongation at least 16 percent for gauge length 2 inches with width not over 1 1/2 inches.
- (f) Magnetic Particle Inspection. Any cylinder found to have a quenching crack must be rejected and may not be requalified.
- (19) Rejected cylinders.
- (a) Flattening test. Reheat treatment authorized; subsequent thereto, acceptable cylinders must pass all prescribed tests.
 - (b) Impact tests. Reheat treatment authorized; subsequent thereto, acceptable cylinders must pass all prescribed test.
 - (c) Hardness measurement. Reheat treatment authorized; subsequent thereto, acceptable cylinder must pass all prescribed tests.
 - (d) Flawed cylinder pressure test. Reheat treatment authorized; subsequent thereto, acceptable cylinders must pass all prescribed tests.
 - (e) Mechanical tests. Reheat treatment authorized; subsequent thereto acceptable cylinders must pass all prescribed tests.
 - (f) Magnetic particle examination. Rejected cylinders may, when defects are not quench cracks, be reheat treated; subsequent thereto, acceptable cylinders must pass all prescribed tests.

(20) Marking

(a) ***

- (1) TC SP3263-M26C-YYYY (where Y = service pressure in psig.) Test pressure "TP5250" must be marked following or near the service pressure.
- (2) Not applicable.
- (3) ***
- (4) ***

SPECIAL REQUIREMENTS

- (a) The cylinder shall be maintained in accordance with the applicable sections of the CTC regulations and filled only with air (UN 1003) argon (UN 1006), helium (UN 1046), oxygen (UN 1072) or nitrogen (UN 1066).
- (b) Reports:
 - (1) Prior to the initial shipment of cylinders made to any specific design, a report of the qualification test results shall be submitted to the Director, Regulatory Requirements.
 - (2) The maker of the cylinder under this specification must retain the test reports required by this specification indefinitely as long as these cylinders are authorized.
- (c) Shippers may use the packagings covered by this permit pursuant to Section 73.22(a).
- (d) These cylinders may not be used for carriage of gases that would cause hydrogen embrittlement of the steel.
- (e) Filling limits specified in Section 73.302 (c) are not authorized. Under no circumstances are these cylinders to be filled to a pressure exceeding the marked service pressure at 70°F.
- (f) A copy of the Inspector's report for each lot produced shall be submitted to the Directorate.
- (g) Each cylinder must be requalified for use every five years in accordance with Section 73.34 as prescribed for specification 3AA cylinders requalified after having been subjected to the action of fire, must be reported to the directorate prior to being placed back in service.

- (h) Each shipping document issued in connection with any shipment made under this Special Permit shall bear the notation "CTC Special Permit No. 3232".
- (i) The Director, Regulatory Requirements shall be advised of any incident involving loss of contents and shall be provided with a summary of shipping experience before the expiration date of the Special Permit.
- (j) The Director, Regulatory Requirements shall be advised of any change in design of the cylinder.