



SPECIAL PERMIT NO. 3232

This Special Permit is issued pursuant to the terms of Section 71.6(a) of the "Regulations for the Transportation of Dangerous Commodities by Rail" to authorize the shipment of compressed gases in non-CTC Specification cylinders by rail in Canada, under conditions prescribed herein, and does not relieve any shipper or carrier from compliance with any requirement of the Commission's said except as specifically stated.

1. BASIS

Letter dated June 1, 1988 from Pressed Steel Tank Co. Inc.,  
1445 South 66 Street, West Allis, WI 53214.

2. COMMODITY CLASSIFICATION

Non flammable, non liquified compressed gases 2.2.

3. COMMODITY NAME

Air, Argon, Helium, Oxygen and Nitrogen.

4. IDENTIFICATION NUMBERS

1003, 1006, 1046, 1072, and 1066.

5. REGULATION AFFECTED

73.34 (a)(1), 73.301(h), 73.302, and CTC Specification 3AA.

6. AUTHORIZED SHIPPER

Pressed Steel Tank Co. Inc., its agents, distributors and customers.

7. PACKAGING DESCRIPTION

Packaging prescribed is a non CTC Specification steel cylinder made in accordance with Pressed Steel Tank Co. Inc.'s Drawings 1280204/4, 1280230 1/2 and 1280250 1/3 on file with the Director of Operation and in compliance with CTC Specification 3AA except as follows:

- (1) Compliance and Lot Definition.
- (a) Compliance required in all details.

(b) Lot definition. In this Special Permit, 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<br/>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 eliminated 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  $6t$  and be located at  $120^\circ$  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 ( $A_{c3}$ ) 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 in compliance with other recognized standards may be used provided that the requirements in (3) below are met.
  - (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 tested 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<br/>(mm)</u> | <u>Avg. value for<br/>acceptance 3<br/>specimens</u> | <u>Min. value<br/>1 specimen only<br/>of the three</u> | <u>Lateral<br/>Expansion<br/>inches</u> | <u>Percent<br/>Fibrous<br/>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) "CTC SP 3232" or "CTC/DOT-E 9791 in lieu of "CTC-3AA" followed by the service pressure. Test pressure "TP5250" must be marked following or near the service pressure.
- (2) Not applicable
- (3) \* \* \*
- (4) \* \* \*

8. SPECIAL REQUIREMENTS

(a) 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 of Operation.
  - (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.
- (b) Shippers may use the packagings covered by this exemption pursuant to Section 73.22(a).
- (c) These cylinders may not be used for carriage of gases that would cause hydrogen embrittlement of the steel.
- (d) 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.
- (e) A copy of the Inspector's report for each lot produced, shall be submitted to the Director of Operation.
- (f) Each cylinder must be requalified for use every five years in accordance with Section 73.34 as prescribed for CTC Specification 3AA. Cylinders requalified after having been subjected to the action of fire, must be reported to the Director of Operation prior to being placed back in service.
- (g) Each shipping document issued in connection with any shipment made under this Special Permit shall bear the notation "CTC Special Permit No. 3232".

9. REPORTING REQUIREMENTS

The Director of Operation 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.



10. EXPIRY DATE

This Special Permit shall remain in effect until November 30, 1989 and may be revoked at any time by the Director of Operation prior to this date.



Director of Operation  
Rail Safety Branch

Issued at Hull, Quebec  
this 30th day of November, 1988

Address all inquiries to:

Director of Operation, Rail Safety Branch  
National Transportation Agency  
25 Eddy Street, 14th Floor  
Hull, Quebec  
K1A 0N9