



U.S. Department
of Transportation

**Research and
Special Programs
Administration**

400 Seventh Street, S.W.
Washington, D.C. 20590

MAY 11 2004

DOT-E 12706
(FIRST REVISION)

EXPIRATION DATE: September 30, 2005

(FOR RENEWAL, SEE 49 CFR § 107.109)

1. GRANTEE: RAGASCO AS
Raufoss, Norway

(U.S. Agent: John Neumann, Hilton Head Island, SC)
2. PURPOSE AND LIMITATIONS:
 - a. This exemption authorizes the manufacture, marking, sale and use of a non-DOT specification fully-wrapped fiberglass composite cylinder with seamless, non-load sharing blow-molded thermoplastic liner for the transportation in commerce of the materials authorized by this exemption. This exemption provides no relief from the Hazardous Materials Regulations (HMR) other than as specifically stated herein.
 - b. The safety analyses performed in development of this exemption only considered the hazards and risks associated with transportation in commerce. The safety analyses did not consider the hazards and risks associated with consumer use, use as a component of a transport vehicle or other device, or other uses not associated with transportation in commerce.
3. REGULATORY SYSTEM AFFECTED: 49 CFR Parts 106, 107 and 171-180.
4. REGULATIONS FROM WHICH EXEMPTED: 49 CFR §§ 173.304a(a)(1) and 175.3 in that the use of a non-DOT specification packaging is not authorized therein except as specified

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packaging is not authorized therein except as specified herein.

5. BASIS: This exemption is based on the application of RAGASCO Composites AS dated October 3, 2003 and additional information dated January 15, 2004 and March 11, 2004, submitted in accordance with § 107.105 and the public proceeding thereon.
6. HAZARDOUS MATERIALS (49 CFR § 172.101):

Hazardous Material Description			
Proper Shipping Name	Hazard Class/ Division	Identification Number	Packing Group
Butane	2.1	UN1011	N/A
Hydrocarbon gas mixture, liquefied n.o.s.	2.1	UN1965	N/A
Petroleum gases, liquefied	2.1	UN1075	N/A
Propane	2.1	UN1978	N/A

7. SAFETY CONTROL MEASURES:

a. PACKAGING - Packaging prescribed is a non-DOT specification fully-wrapped fiberglass composite cylinder with a thermoplastic liner. The cylinder has a permanently attached outer casing made of injection molded high density polyethylene (HDPE). Cylinders must be designed, manufactured, and tested in conformance with the following documents: RAC doc. 0141295-1200 "LPG Quality Assurance Program Plan", RAC doc. 0147230-900 rev B "List of drawings LPG 10kg Gas Container" and related drawings, on file with the Office of Hazardous Materials Exemptions and Approvals (OHMEA). Additionally, cylinders must be in conformance with the following:

- (1) Type size and service pressure.

Maximum Volume: 24 Liters
 Maximum service pressure: 294 psi (20 bars)
 Minimum test pressure: 441 psi (30 bars)
 Minimum burst pressure: 882 psi (60 bars)

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(2) Inspection. Inspections and verifications required by this exemption must be performed by an independent inspection agency approved in writing by the Associate Administrator for Hazardous Materials Safety in accordance with Title 49, Code of Federal regulations, Subpart I.

(3) Duties of the inspector.

(i) Determine that all materials conform to the provisions of this exemption.

(ii) For each raw material batch, verify liner material to be within the specification in this exemption by analysis or obtaining the manufacturer's certified analyses. A certification from the manufacturer is acceptable when verified by check analyses on a sample from every raw material batch. Verify conformance of filament and resin system components with the requirements in the exemption.

(iii) Prior to the initial shipment of any specific cylinder design, verify that the design qualification tests prescribed in this exemption have been performed with acceptable results.

(iv) Verify conformance of the completed cylinder with all requirements, including marking, condition of inside, threads and relevant process parameters.

(v) Verify winding process to assure that composite material is uniform, of required thickness and pattern, and in accordance with the composite structure present in cylinders subjected to the design qualification tests.

(vi) Witness all tests and pressurizations, obtain copies of all test results and certifications; report volumetric capacity, and completed composite cylinder weight.

(vii) Furnish completed inspector's report to the manufacturer of the cylinder and upon request, to the purchaser.

(4) Authorized materials and identification of materials.

(i) Inner liner must be non-load sharing, seamless, blow moulded quality high density polyethylene (HDPE). The mass density at 23°C (73.4°F) must be per ISO 1133/ASTM D1505-85: 0.942 - 0.948 g/cm³; min/max. The melt flow rate (MFR) at a material temperature of 190°C with a driving force of 21.6kg, must be 5.3 - 8.0 g /10 minute; min/max.

(ii) Filament material must be commercial Type E-fiberglass. Filaments must be tested in accordance with ASTM D-2343-79 and have minimum strand strength of 200,000 psi.

(iii) Resin system must be thermoset vinyl ester based resin as described in the material specifications on file with the OHMEA. Resin system must be tested on sample coupons representative of the composite overwrap in accordance with ASTM D-2344-67 for water boil test, and have minimum shear strength of 13.8MPa (2029 psi).

(iv) Threaded brass insert shall conform to the following chemical analysis (by weight %):

Cu:	57.0 - 59.0, min/max
Pb:	1.5 - 2.0, min/max
Fe:	0.4, max
Ni:	0.4, max
Sn:	0.3, max
Al:	0.9, max
Others:	0.2, max
Zn:	Remainder

(5) Manufacture.

(i) The thermoplastic liner shall be homogeneous, clean and correctly dimensioned. No defect that is likely to weaken the finisher liner function is authorized.

(ii) The composite cylinder must be manufactured from a thermoplastic liner fully overwrapped with resin impregnated continuous filament windings. The winding pattern must be "helical" or "in place and hoop" wrap, applied under controlled tension to develop the design composite thickness. After winding is complete, the composite must be cured by a controlled temperature profile. No defect that is likely to weaken the finished cylinder appreciably is acceptable.

(iii) Welding or brazing for any purpose whatsoever is prohibited.

(6) Lot size. A cylinder lot means a group of cylinders successively produced from qualified liners, having the same size and configuration, the same specified materials of construction, and the same process of manufacture to the same cylinder specification. In no case may the lot size exceed 200 cylinders; however, any cylinder processed for use in the required destructive tests need not be counted as one of the 200, but must have been processed with the lot.

(7) Wall thickness. Liner wall thickness shall be within tolerances specified in drawings on file. The minimum fiber stress ratio (fiber stress at design minimum burst pressure divided by the fiber stress at service pressure) must be 3.4.

(8) Openings. Openings are permitted on the heads only. The center line of openings must coincide with the longitudinal axis of the cylinder. Threads must be clean cut, even, without checks and to gauge.

(9) Pressure relief devices and valve protection. Cylinder must be equipped with a pressure relief device in accordance with § 173.301(f). Protection for valves and other connections must be in accordance with § 173.301(h).

(10) Production testing

(i) Each cylinder must be hydrostatically or pneumatically pressure tested to a pressure of at least 441 psig (30 bar) without measurement of expansion. The cylinder test pressure must be maintained for a sufficiently long period (at least 30 seconds) to ascertain that there are no leaks and no failure. The cylinder shall be rejected if there are leaks, failure to hold pressure, or visible permanent deformation after the cylinder is depressurized. (Note: Cracking of resin is not necessarily a sign of permanent deformation.) If leakage occurs in the piping or fittings, the cylinder may be retested after repairing such leakages. Only two such retests are authorized. The pressure gauge must permit reading to an accuracy of 1 percent in the range of 80 percent to 120 percent of test pressure. Cylinders rejected by the pressure test must not be placed in service.

(ii) One cylinder taken at random from each lot of 1,000 or less cylinders must be subjected to cycle testing in accordance with DOT FRP-1 §178.AA-12(b) (See Appendix B of this exemption). Acceptable results must be in accordance with §178.AA-13(c) and §178.AA-14(c).

(iii) One cylinder taken at random from each lot of 200 or less cylinders must be hydrostatically burst tested in accordance with DOT FRP-1 § 178.AA-12(c). Acceptable results must be in accordance with § 178.AA-13(d) and § 178.AA-14(d), except that the burst may initiate anywhere on the cylinder (dome or sidewall). The cylinder must remain in one piece. Leakage through the boss fusion joint is permitted, provided that the pressure at failure is at least 4 times the design service pressure.

(11) Inspector's reports & retention of report.

(i) The inspector must prepare a report that is clear, legible, and in accordance with DOT FRP-1 § 178.AA-16 except that testing and criteria relevant to aluminum liners must be replaced with

that relevant to thermoplastic liners, and references to FRP-1 must be replaced with this exemption number.

(ii) The inspector's report must be retained for 15 years from the original test date on the cylinder by the manufacturer and by the inspector.

(12) Design qualification tests. Prior to initial shipment of any specific cylinder design, qualification tests must have been performed on representative cylinders with satisfactory results. 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 manufacturer and made available to the independent inspector and the OHMT upon request. Design changes must be as defined in DOT FRP-1 § 178.AA-18(b). Required testing for design changes must be as specified in DOT FRP-1 § 178.AA-18(c). The following design qualification tests must be performed:

(i) Vacuum Test. One cylinder shall be subjected to a vacuum test prior to the environmental cycle test. The cylinder shall be subjected to a series of cycles from atmospheric pressure to a vacuum. The contents (inert gas or air) shall be reduced from atmospheric pressure to a pressure of 0.2 bar absolute at ambient temperature. The vacuum shall be maintained at this level for at least one minute. The pressure in the cylinder shall be returned to atmospheric pressure. The total number of cycles shall be 50. After cycling, the interior of the liner shall be inspected for damage. Any evidence of disbonding, folding, or other damage shall be noted. If the cylinder then passes the environmental cycle test, it shall also be deemed to have passed the vacuum test.

(ii) High Temperature Creep. Two cylinders shall be hydraulically pressurized to test pressure and shall be maintained at this pressure for at least 1,000 hours. The test shall be conducted at a minimum temperature of 70°C and a relative humidity of less than 50%. After this test, the

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cylinders shall be subjected to the leak test and the burst test. The cylinder shall not exhibit any visible deformation or loose (unravelling) fibers. The cylinder shall pass the leak test and the burst pressure shall be equal to or greater than 2 times the test pressure. Leak test. Acceptable methods for leakage testing include bubble testing using dry air or gas or measurement of trace gases using a mass spectrometer. Leak testing must be performed at service pressure. No leakage in excess of the permeation rate of 0.25 (ml/h/L water capacity) shall be permitted.

(iii) Permeability Test. Two cylinders shall be hydraulically pressure cycled 1000 cycles from zero to service pressure, and then weighed empty. The cylinders shall then be filled to service pressure with LPG at a temperature of 15°C. The cylinders shall be weighed after 1, 7, 14, 21, and 28 days, emptied and weighed empty after testing. Requirement: Maximum loss of weight rate $q < 0.25$ (ml/h/L water capacity). The calculation should be modified so that the difference between empty weight before and after the test is not integrated in the loss of weight rate.

(iv) Flawed Cylinder Test. Two cylinders shall be prepared with cuts into the composite approximately in the following manner: Two flaws on each cylinder: Width = 1mm, length = 5 times the composite thickness, depth = at least 40% of the composite thickness. One cut shall be longitudinal and the other transverse in the cylindrical part along two planes forming an angle of 120 degrees. One cylinder shall withstand the ambient pressure cycling test to 5000 cycles, while the other cylinder shall withstand the burst test to at least 4/3 times the test pressure.

(v) Drop Test. Two cylinder shall be filled with water to the weight equal to maximal service content. The cylinders shall be dropped from the height of 1.2m onto a smooth, un-yielding surface (steel, concrete, etc.) twice in the following five positions, giving a total of ten drops: (1) vertically onto the bottom end, (2) 45 degrees onto the bottom end, (3) horizontally, (4) 45 degrees onto the valve end, and (5) vertically

onto the valve end. Visual damage shall be noted after each drop. After dropping, one cylinder shall withstand the ambient pressure cycling test, while the other cylinder shall withstand the burst test.

(vi) Torque test on cylinder neck boss. The cylinder shall be fitted with a valve and tightened to 150% of the maximum torque recommended by the manufacturer. The valve shall be removed after the first installation and the neck thread and boss inspected. The procedure shall then be repeated. A test for leaks in the cylinder neck or the permeability test shall be conducted at service pressure for at least 10 minutes. The neck thread and boss shall show no significant deformation and shall remain within drawing and gauge tolerance. Leakage greater than 1 bubble in 2 minutes in the bubble leak test or failure of the permeability test shall constitute a failure of the test.

(vii) The following design qualification tests must be performed in accordance with the procedures and accept/reject criteria of §178.AA-18 of the DOT FRP-1 Standard (See Appendix B of this exemption):

- Pressure Cycling Tests (Ambient, Environmental, and Thermal)
- Hydraulic Burst Test, except that the burst may initiate as prescribed in 7.a.(10)(iii) of this exemption
- Gunfire Test
- Bonfire Test

b. REQUALIFICATION TESTING - At least every 5 years, each cylinder must be visually inspected and proof pressure tested. The retest and inspection must be performed with the outer casing in place. Persons performing requalification functions must comply with § 180.205(b).

(1) Proof pressure testing must be to at least 30 bars test pressure in accordance with paragraph 7.a.(10)(i) of this exemption.

(2) Visual inspection must be performed on the outer casing and the non-protected composite areas only. A strong backlight shall be used. Visual inspection and acceptance criteria must be in accordance with Appendix A of this exemption. Repair of the cylinder is not authorized. Cylinders meeting the criteria for rejection must be scrapped.

(3) Removal or replacement of the outer casing may only be performed by personnel authorized by the manufacturer.

(4) Retest markings must be in accordance with 49 CFR 180.213(d) and (e). Retest markings must be applied on a label securely affixed to the exposed dome of the cylinder and overcoated with epoxy, near the original test date which is marked on the face of the cylinder boss. Metal stamping of the composite surface or the metal boss is prohibited.

c. OPERATIONAL CONTROLS -

(1) A cylinder that has been subjected to fire may not be returned to service.

(2) Cylinders must be packaged in accordance with the requirements in § 173.301(a)(9).

(3) Cylinder service life may not exceed 15 years from the date of manufacture as marked on the cylinder.

(4) Filling requirements are subject to all terms contained in §§ 173.304 and 173.304a for DOT 4BA specification cylinders. Person refilling cylinders authorized by this exemption must follow manufacturer's recommendations for pre-fill inspections.

(5) Cylinders must be transported in well-ventilated motor vehicles.

d. MARKING -

(1) Each cylinder must be permanently marked as prescribed in DOT FRP-1 Standard "Basic Requirements for Fiber Reinforced Plastic (FRP) Type 3FC Composite Cylinders §178.AA-15, except that the markings must be made on the top face of the cylinder boss by laser etching or by engraving, and the size of the markings must be at least 1/8 inch in height.

(2) Each cylinder must be marked "DOT-E 12706".

(3) Each cylinder must be permanently and legibly marked "CYLINDER MUST NOT BE STORED IN AN UNVENTILATED SPACE".

8. SPECIAL PROVISIONS:

a. In accordance with the provisions of Paragraph (b) of §173.22a, persons may use the packaging authorized by this exemption for the transportation of the hazardous materials specified in paragraph 6, only in conformance with the terms of this exemption.

b. A person who is not a holder of this exemption, but receives a package covered by this exemption, may reoffer it for transportation provided no modification or change is made to the package or its contents and it is offered for transportation in conformance with this exemption and the HMR.

c. A current copy of this exemption must be maintained at each facility where the package is offered or reoffered for transportation.

d. Each packaging manufactured under the authority of this exemption must be either; (1) marked with the name of the manufacturer and location (city and state) of the facility at which it is manufactured; or (2) marked with a registration symbol designated by the Office of Hazardous Materials Exemptions and Approvals for a specific manufacturing facility.

e. A current copy of this exemption must be maintained at each facility where the package is manufactured under this exemption. It must be made available to a DOT representative upon request.

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f. The cylinders described in this exemption are authorized only for normal transportation as an article of commerce i.e., the movement of hazardous materials packages from consignor to consignee.

g. No modifications may be made to the pressure vessel, or the Quality Assurance Program Plan used for it's manufacture which would affect the performance of the pressure vessel or its compliance with the requirements of this exemption until such modifications have been reviewed, tested and certified by an Independent Inspector as meeting the requirements of this exemption.

9. MODES OF TRANSPORTATION AUTHORIZED: Motor vehicle, rail freight, cargo vessel, and cargo aircraft only.
10. MODAL REQUIREMENTS: A current copy of this exemption must be carried aboard each cargo vessel or aircraft used to transport packages covered by this exemption. The shipper must furnish a copy of this exemption to the air carrier before or at the time the shipment is tendered.
11. COMPLIANCE: Failure by a person to comply with any of the following may result in suspension or revocation of this exemption and penalties prescribed by the Federal hazardous materials transportation law, 49 U.S.C. 5101 et seq:
- o All terms and conditions prescribed in this exemption and the Hazardous Materials Regulations, 49 CFR Parts 171-180.
 - o Persons operating under the terms of this exemption must comply with the security plan requirement in Subpart I of Part 172 of the HMR, when applicable.
 - o Registration required by § 107.601 et seq., when applicable.

Each "Hazmat employee", as defined in § 171.8, who performs a function subject to this exemption must receive training on the requirements and conditions of this exemption in addition to the training required by §§ 172.700 through 172.704.

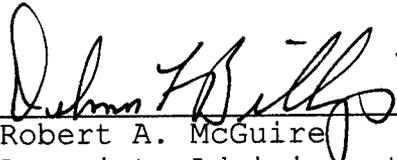
No person may use or apply this exemption, including display of its number, when this exemption has expired or is otherwise no longer in effect.

12. REPORTING REQUIREMENTS: The carrier is required to report any incident involving loss of packaging contents or packaging failure to the Associate Administrator for Hazardous Materials Safety (AAHMS) as soon as practicable. (Sections 171.15 and 171.16 apply to any activity undertaken under the authority of this exemption.) In addition, the holder(s) of this exemption must also inform the AAHMS, in writing, as soon as practicable of any incidents involving the package and shipments made under this exemption.

Issued in Washington, D.C.:

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Date

for 

Robert A. McGuire
Associate Administrator for
Hazardous Materials Safety

Address all inquiries to: Associate Administrator for Hazardous Materials Safety, Research and Special Programs Administration, Department of Transportation, Washington, D.C. 20590.
Attention: DHM-31.

Copies of this exemption may be obtained by accessing the Hazardous Materials Safety Homepage at <http://hazmat.dot.gov/exemptions> Photo reproductions and legible reductions of this exemption are permitted. Any alteration of this exemption is prohibited.

PO: CWFreeman/SStaniszewski