



U.S. Department  
of Transportation

**Pipeline and Hazardous  
Materials Safety  
Administration**

**January 05, 2022**

1200 New Jersey Avenue, SE  
Washington, DC 20590

DOT-SP 12706  
(FOURTEENTH REVISION)

**EXPIRATION DATE: 2025-11-30**

(FOR RENEWAL, SEE 49 CFR 107.109)

1. GRANTEE: Hexagon Ragasco AS  
Raufoss, Norway  
  
US AGENT: Hexagon Ragasco North America  
Lincoln, NE
2. PURPOSE AND LIMITATIONS:
  - a. This special permit authorizes the manufacture, mark, 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 special permit. This special permit provides no relief from the Hazardous Materials Regulations (HMR) other than as specifically stated herein. The most recent revision supersedes all previous revisions.
  - b. The safety analyses performed in development of this special permit 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.
  - c. In accordance with 49 CFR 107.107(a), party status may not be granted to a manufacturing permit. These packagings may be used in accordance with 49 CFR 173.22a.
3. REGULATORY SYSTEM AFFECTED: 49 CFR Parts 106, 107 and 171- 180.

4. REGULATIONS FROM WHICH EXEMPTED: 49 CFR §§ 173.304(a) and 173.335(a) in that the use of a non-DOT specification packaging is not authorized, except as specified herein.
5. BASIS: This special permit is based on the application of Hexagon Ragasco AS dated November 9, 2021, submitted in accordance with § 107.109.
6. HAZARDOUS MATERIALS (49 CFR 172.101):

<b>Hazardous Materials Description</b>			
<b>Proper Shipping Name</b>	<b>Hazard Class/ Division</b>	<b>Identification Number</b>	<b>Packing Group</b>
Butane <i>see also</i> Petroleum gases, liquefied	2.1	UN1011	N/A
Hydrocarbon gas mixture, liquefied n.o.s.	2.1	UN1965	N/A
Petroleum gases, liquefied <i>or</i> Liquefied petroleum gas	2.1	UN1075	N/A
Propane <i>see also</i> Petroleum gases, liquefied	2.1	UN1978	N/A
Compressed gas, n.o.s. ( <i>Nitrogen</i> )	2.2	UN1956	N/A
Chemical under pressure, n.o.s.*	2.2	UN3500	N/A

\*Only ammonium chloride dissolved in water may be shipped under this proper shipping name.

7. SAFETY CONTROL MEASURES:

- a. PACKAGING: Packaging prescribed is a non-DOT specification fully-wrapped fiberglass composite cylinder with a one-piece 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. 0110262-1200 "LPG Quality Assurance Program Plan", and drawings on file with the Office of Hazardous Materials Safety Approvals (OHMS). Additionally, cylinders must be in conformance with the following:

(1) Type size and service pressure.

Maximum Volume: 34 Liters

Maximum service pressure: 294 psi (20 bars)

Minimum test pressure: 441 psi (30 bars)

Minimum burst pressure: 882 psi (60 bars)

(2) Inspection. Inspections and verifications required by this special permit must be performed by an independent inspection agency approved in writing by the Associate Administrator for Hazardous Materials Safety in accordance with 49 CFR Part 107, Subpart I.

(3) Duties of the inspector.

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

(ii) For each raw material batch, verify liner material to be within the specification in this special permit 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 special permit.

(iii) Prior to the initial shipment of any specific cylinder design, verify that the design qualification tests prescribed in this special permit 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 molded 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/cm<sup>2</sup>; 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 OHMS. 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 13.8 MPa (2,029 psi).

(iv) Threaded brass insert shall conform to the EN12165 standard or an equivalent ISO Standard. Cylinders used to transport ammonium chloride must have inserts constructed of either stainless steel or nickel coated carbon steel.

(5) Manufacture.

(i) The thermoplastic liner shall be homogeneous, clean and correctly dimensioned. No defect that is likely to weaken the finished 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). 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 special permit 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 OHMS 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 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 1,000 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 shall 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 5,000 cycles, while the other cylinder shall withstand the burst test to at least 4/3 times the test pressure.

(v) Drop Test. Two cylinders 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:

(A) Pressure Cycling Tests (Ambient, Environmental, and Thermal).

(B) Hydraulic Burst Test, except that the burst may initiate as prescribed in paragraph 7.a.(10)(iii) of this special permit.

(C) Gunfire Test.

(D) Bonfire Test, except that venting may occur other than through the pressure relief device.

b. REQUALIFICATION TESTING: At least every 10 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 special permit.

(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 the Appendix of this special permit. 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), (e), and (f). 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.

(5) Alternatively, cylinders may be requalified every 5 years using external visual inspection in accordance with paragraph 7.b.(2) of this special permit in lieu of the pressure testing of paragraph 7.b.(1) of this special permit under the following conditions:



(i) Cylinders must be used exclusively in service that is commercially free from corroding components; or

(ii) Cylinders used in LPG gas service must meet the requirement limits in Table 1 of ASTM 1835, Standard Specification for Liquefied Petroleum (LP) Gases or an equivalent standard containing the same limits.

c. OPERATIONAL CONTROLS:

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

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

(3) 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 special permit must follow manufacturer's recommendations for pre-fill inspections.

(4) 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-SP 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 special permit for the transportation of the hazardous materials specified in paragraph 6, only in conformance with the terms of this special permit.

b. A person who is not a holder of this special permit, but receives a package covered by this special permit, may reoffer it for transportation provided no modification

or change is made to the package and it is offered for transportation in conformance with this special permit and the HMR.

- c. A current copy of this special permit must be maintained at each facility where the package is offered or reoffered for transportation.
  - d. Each packaging manufactured under the authority of this special permit 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 Safety Approvals and Permits Division for a specific manufacturing facility.
  - e. A current copy of this special permit must be maintained at each facility where the package is manufactured under this special permit. It must be made available to a DOT representative upon request.
  - f. The cylinders described in this special permit 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 its manufacture which would affect the performance of the pressure vessel or its compliance with the requirements of this special permit until such modifications have been reviewed, tested and certified by an Independent Inspector as meeting the requirements of this special permit.
9. MODES OF TRANSPORTATION AUTHORIZED: Motor vehicle, rail freight, cargo vessel, and cargo-only aircraft.
  10. MODAL REQUIREMENTS: A current copy of this special permit must be carried aboard each cargo vessel or aircraft used to transport packages covered by this special permit. The shipper must furnish a current copy of this special permit 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 special permit and penalties prescribed by the Federal hazardous materials transportation law, 49 U.S.C. 5101 et seq:
    - All terms and conditions prescribed in this special permit and the Hazardous Materials Regulations, 49 CFR Parts 171-180.
    - Persons operating under the terms of this special permit must comply with the security plan requirement in Subpart I of Part 172 of the HMR, when applicable.

- Registration required by § 107.601 et seq., when applicable.

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

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

Under Title VII of the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) — “The Hazardous Materials Safety and Security Reauthorization Act of 2005” (Pub. L. 109-59), 119 Stat. 1144 (August 10, 2005), amended the Federal hazardous materials transportation law by changing the term “exemption” to “special permit” and authorizes a special permit to be granted up to two years for new special permits and up to four years for renewals.

12. **REPORTING REQUIREMENTS:** Shipments or operations conducted under this special permit are subject to the Hazardous Materials Incident Reporting requirements specified in 49 CFR §§ 171.15 - Immediate notice of certain hazardous materials incidents, and 171.16 - Detailed hazardous materials incident reports. In addition, the grantee(s) of this special permit must notify the Associate Administrator for Hazardous Materials Safety, in writing, of any incident involving a package, shipment or operation conducted under terms of this special permit.

Issued in Washington, D.C.:



for William Schoonover  
Associate Administrator for Hazardous Materials Safety

Address all inquiries to: Associate Administrator for Hazardous Materials Safety, Pipeline and Hazardous Materials Safety Administration, U.S. Department of Transportation, East Building PHH-13, 1200 New Jersey Avenue, Southeast, Washington, D.C. 20590.

Copies of this special permit may be obtained by accessing the Hazardous Materials Safety Homepage at <https://www.phmsa.dot.gov/approvals-and-permits/hazmat/special-permits-search>. Photo reproductions and legible reductions of this special permit are permitted. Any alteration of this special permit is prohibited.

PO: TG

**Appendix****Visual Inspection Acceptance/Rejection Criteria**

Note: Repair of the cylinder is not authorized. Cylinders meeting the criteria for rejection must be scrapped. Removal or replacement of the outer casing must only be performed by personnel authorized by the manufacturer.

<b>Type of damage</b>	<b>Description</b>	<b>Rejection limits</b>
Abrasion damage or damage from cuts	<p>Abrasion damage is caused by wearing, grinding or rubbing material away by friction.</p> <p>Cuts or gouges are caused by contact with sharp objects in such a way as to cut into the composite, reducing its thickness at that point.</p>	<p>Depth: more than 10% of composite overwrap thickness or</p> <p>Total length of cut(s): more than 50% of the diameter of the cylinder or</p> <p>Damaged area: maximum diameter more than 50% of the diameter of the cylinder.</p> <p>Note 1: The maximum diameter of the damage area is the diameter of the smallest circle which includes the damaged area.</p> <p>Note 2: Intra-laminar hairline cracks (between fibers, typically on the circumference after proof testing) is allowed if not in combination with impact damage.</p> <p>Note 3: Scratches that do not sever a fiber are not included in the above.</p>

<p>Delamination and impact damage</p>	<p>An Inter-laminar delamination is a separation of layers of strands.</p> <p>An Intra-laminar delamination is a separation between strands within the same layer. It may appear as a whitish patch like a blister or an air bubble beneath the surface.</p> <p>Impact damage may appear as hairline cracks in the resin or delamination or cuts of the composite.</p>	<p>Impact damage that has caused surface damage including delamination, is not acceptable.</p> <p>Impact damage made by a pointed object that has caused delamination and surface damage is not acceptable.</p> <p>A delamination that runs through more than one layer is not acceptable.</p> <p>For a bulge (cavity) internally in the composite overwrap, the maximum diameter of the bulge shall not exceed 10% of the composite thickness. Any bulge in combination with outer damage is not acceptable.</p> <p>A delamination that is not in combination with outer damage and not covering more than 30% of the cylinder is acceptable. No fiber strands shall be cut. Areas with no adhesion between liner and overwrap are not to be regarded as delaminated.</p>
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<b>Type of damage</b>	<b>Description</b>	<b>Rejection limits</b>
Chemical damage	Chemical attack would appear as the dissolution of the resin matrix surrounding the fibers, the cylinder surface feeling sticky when touched. The cylinder shall be rendered unserviceable.	Chemical attack resulting in damage to the resin matrix surrounding the fibers is not acceptable.
Damage of casing	The casing shall be inspected in order to determine that it is intact. A cylinder with a casing that is broken or damaged in such a way that it will not be able to protect the cylinder satisfactorily shall be put aside for maintenance. Examples of such damage are broken foot rings, broken handles, etc.	<p>Minor damage that does not affect the protecting function of the casing is acceptable. Acceptable damage can be, for example, small cracks. If it cannot be established that the cylinder is unaffected, the cylinder shall be put aside for further investigation.</p> <p>Unacceptable damage is, for example, a broken casing. The casing is then to be removed and the cylinder inspected underneath. A damaged cylinder is unacceptable. If the cylinder is not damaged, a new casing can be assembled.</p>
Heat/fire damage of the casing or cylinder	Heat or fire damage may be evident by discoloration, scarring or burning of the	Visible damage from heat and/or fire is unacceptable.

<b>Type of damage</b>	<b>Description</b>	<b>Rejection limits</b>
	composite overwrap, casing, labels, and non-metallic components of the valve. Cylinders with this type of damage shall be rendered unserviceable.	