**September 30, 2025**

U.S. Department
of Transportation

**Pipeline and Hazardous
Materials Safety
Administration**

1200 New Jersey Avenue, SE
Washington, DC 20590

DOT-SP 21935
(SECOND REVISION)

**EXPIRATION DATE: 2029-04-30**

(FOR RENEWAL, SEE 49 CFR 107.109)

1. GRANTEE: Umoe Advanced Composites
Kristianssand, Norway

US AGENT: Celly H2
Missouri City, TX

2. PURPOSE AND LIMITATIONS:

a. This special permit authorizes the manufacture, mark, sale, and use of a non-DOT specification fully wrapped fiber reinforced composite gas cylinder with a non-load sharing plastic liner. Except as specified, the cylinder is designed in accordance with the ISO 11515:2022 Standard for the transportation in commerce of the hazardous materials authorized herein. 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 special 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 § 173.302(a)(1) in that a non-

DOT specification is authorized, as specified herein.

5. BASIS: This special permit is based on the application of Umoe Advanced Composites dated May 19, 2025, 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** | **Identi-fication Number** | **Packing Group** |
| Natural gas, compressed | 2.1 | UN1971 | N/A |
| Helium, compressed | 2.2 | UN1046 | N/A |
| Hydrogen, compressed | 2.1 | UN1049 | N/A |
| Nitrogen, compressed | 2.2 | UN1066 | N/A |

7. SAFETY CONTROL MEASURES:

a. PACKAGING: Packaging prescribed is a non-DOT specification fully wrapped S2 high strength glass fiber reinforced composite cylinder (tube) with a non-load sharing plastic liner as described in Umoe Advanced Composites' application on file with the Office of Hazardous Materials Safety (OHMS). The cylinder is designed and tested in accordance with ISO 11515:2022 (Gas Cylinders – Refillable composite reinforced tubes of water capacity between 1,666 L and 2,600 L – Design, construction and testing) for type IV composite cylinder (the Standard), except as follows:

(1) § 1 Scope: Cylinders manufactured under this special permit are limited to a maximum water volume of 2,600 Liters and a maximum working pressure of 350 bar (5,076psi).

(2) § 8.1 Type approval procedure, General requirements:

(i) A DOT Independent Inspection Agency (IIA) approved in writing by the Associate Administrator for Hazardous Materials Safety (AAHMS) must, in accordance with 49 CFR Part 107, Subpart I, review the results of the design qualification testing that was submitted in the application for special permit. The IIA must either verify that the cylinder design meets

the requirements of the special permit based on the test results and other documentation submitted in the application for special permit, or the IIA may require additional testing and/or information from the manufacturer to verify the cylinder design meets all requirements of the special permit. Prior to cylinder production, the IIA's verification of the cylinder design must be submitted to and acknowledged in writing by the OHMS.

(ii) Prior to marking any cylinder under this special permit, an IIA approved in writing by the AAHMS, must provide inspections and verifications of all batch testing and all new design qualification testing in accordance with the requirements of this special permit.

(3) § 8.5 Type approval test procedures and criteria:

(i) § 8.5.2.1 Hydraulic proof pressure test, Procedure: The test pressure shall be held for at least 30 seconds with the tube isolated from the pressure source, during which time there shall be no decrease in the recorded pressure or evidence of any leakage.

(ii) § 8.5.4 Liner burst test is not required for Type 4 cylinders.

(iii) § 8.5.5.2.2 Tube burst test, Criteria: The burst pressure, $p_b$, or pressure at failure shall not be less than 2.0 times the test pressure, $p_h$ , of the composite cylinder.

(iv) § 8.5.6 Ambient cycle test: The cylinders must be cycled from a maximum of 30 bar to 525bar for 12,000 cycles with no leakage or burst or for 24,000 cycles from 30bar to maximum developed pressure at 65 °C. Cylinders shall then burst a pressure not less than 1.25 times the test pressure.

(v) § 8.5.7 Environment cycle test: The cylinder must be tested as specified in the Standard.

(vi) § 8.5.8 Flaw test: The cylinder must be tested as specified in the Standard.

(vii) § 8.5.9 Blunt impact test: The cylinder shall be subjected to two impacts. The first impact shall be delivered to the cylinder sidewall, midway between the ends, with a minimum energy of 1,20 Joules; the second at an angle of 45° in order to strike the shoulder of the cylinder with a minimum energy of 1,200 Joules. The cylinder shall then be subjected to the Ambient cycle test (§8.5.6) for 3,000 cycles at the maximum developed pressure, $p_{max}$ without failure by burst or leakage.

The test must then continue to 12,000 cycles, or until the or until the cylinder fails by leakage, whichever is sooner. In either case, the tube shall be deemed to have passed the test. However, if failure during this second part of the test is by burst, then the tube shall have failed the test. If the tube does not pass the test, a second cylinder shall be tested at an energy level of 488 Joules, as specified in the Standard. The cylinder shall then burst at a pressure not less than 1.25 times the test pressure.

(viii) § 8.5.10 Fire Resistance Test: One cylinder shall be charged with air, nitrogen, or hydrogen to the working pressure. The cylinder must be tested as specified in the procedure in §8.5.10.2.2 of the Standard. The cylinder shall not rupture for a minimum of 5 minutes from the start of the fire.

(ix) § 8.5.11 Neck Strength Test: The cylinder must be tested as specified in the Standard.

(x) § 8.5.12 Leak Test: The cylinder must be tested as specified in the Standard.

(xi) § 8.5.13 Accelerated Stress Rupture Test: The cylinder shall be hydraulically pressurized to test pressure at 85 °C, and shall be maintained at this pressure and at a temperature of 65 °C for 2,000hrs. The cylinder shall then be subjected to the burst test (§8.5.5).

(xii) § 8.5.14 Permeability Test: The cylinder must be pressurized with hydrogen gas and tested as specified in the Standard.

(xiii) § 8.5.15 Gas Cycle Test: The cylinders must be tested as specified in the Standard

(xiv) § 8.5.16 Coatings Test: Not required.

(xv) § 8.5.17 Salt Spray Test: Not required.

(xvi) § 8.5.18 Acid Environment Test: The cylinder must be tested as specified in the Standard.

(xvii) § 8.5.19 Vacuum Test: When this test is not carried out, a warning shall be permanently marked on the cylinder label to indicate that use under a vacuum is not permitted.

(xviii) § 8.5.20 High Velocity Impact Test: The cylinder must be tested as specified in the Standard.

(xix) § 8.5.21 Glass Transition Temperature Test: The cylinder must be tested as specified in the Standard.

(xx) § 8.5.22 Resin Shear Strength Test: The cylinder must be tested as specified in the Standard.

(4) § 9 Inspection and testing at time of manufacture

(i) 9.3.2 Liners for Type 4 tubes, Boss: The supplier's certification of the metal boss properties may serve as verification of compliance with the design specifications.

(ii) § 9.3.3 Liners for Type 4 tubes, Liner: The supplier's certification of the liner properties may serve as verification of compliance with the design specifications.

(iii) 9.5.1 Overwrap materials: The supplier's certification of the fiber and resin matrix properties may serve as verification of compliance with the ISO 11515 Standard.

(iv) § 9.6.6 Batch cycle testing, Procedure: One cylinder for every five batches shall be subject to the ambient cycle test (§8.5.6).

(v) § 9.6.7 Batch burst testing, Criteria: One cylinder per batch shall be subject to a burst test in accordance with §8.5.5.

(5) § 10 Cylinder marking: The marking must contain the following:

(i) The DOT special permit number followed by working pressure expressed in bar (psig). The marking may be on a label permanently attached to the outside of the cylinder.

(ii) A serial number and the manufacturer's identification number or a symbol as obtained from the AAHMS, located just below or immediately following the DOT marking. The serial number and the manufacturer's identification number may be placed on the boss provided the markings are accessible for inspection.

(iii) The DOT IIA official mark must be placed near the serial number. The marking must contain date the (month and year) of the initial hydraulic proof pressure test for that cylinder.

(iv) The size of the letters and numbers used must be at least 0.64 cm (1/4 inch) high if space permits.

(v) The following are examples of an authorized format for marking:

DOT-SP AAAAA-YYYY, (Where AAAAA is the special permit number and YYYY is the working pressure)

CCCC MMI, (Where CCCC is the serial number and MMI is the manufacturer's mark or symbol)

DDD - MM/YY, (Where DDD is the inspector's mark and MM/YY is the month and year of the hydraulic proof pressure test).

(vii) Additional markings are permitted, provided the additional markings do not obscure the required marking and are not detrimental to the integrity of the cylinder. Provisions for marking of the required requalification dates and RIN information must be made near the cylinder markings.

b. ADDITIONAL REQUIREMENTS FOR EACH NEW DESIGN: Each cylinder/tube assembly must meet the follow requirements:

(1) One cylinder (tube) must be subjected to a full engulfment fire resistance test for a minimum of 15 minutes without rupture, measured from the onset of direct flame impingement. Testing shall be conducted in accordance with the procedure described in ISO standard 11515: 2022.

(2) Each design must incorporate a fire protection system that includes thermally activated pressure relief devices (TPRDs). TPRDs shall be installed in the valve connection cabinet. Distribution of TPRDs along the full cylinder (tube) length is not required.

(3) TPRDs shall be configured to minimize the risk of unintended activation due to mechanical failure. A TPRD or TRPDs shall be installed for each cylinder (tube), or alternatively for each cylinder bank not exceeding 5,000 liters capacity. TPRDs may be installed in series to enhance fault tolerance. There is no requirement for redundancy of the TPRDs .

(4) The TPRD vent line design shall prevent gas accumulating in any enclosed or semi-enclosed areas. The vent line must direct the released gas upwards and outside of the frame system. Standard Operating Procedures (SOP) for the fire protection system must include inspection of the entire system, all gauges, fittings, valves, and vent system. The fire protection system design, test results, and

relevant SOPs must be submitted to and acknowledged in writing by OHMS before deployment of the first production of the tube assembly.

c. REQUALIFICATION: Each cylinder must be requalified once every 5 years by using one of the two methods described in this special permit. The Facility that performs requalification of these composite cylinders (tubes) must be a RIN holder for requalification of this type of composite cylinder (tubes) as described in § 180.205(b) or have this type of composite cylinders/tubes using Modal Acoustic Emission (MAE) testing.

(1) Hydraulic Proof Pressure Testing and Visual Inspections: The requalification facility seeking RIN for Hydraulic Proof Pressure Testing and Visual Inspections must meet and prove the following requirements:

(i) Knowledge, documentation, equipment, and instrumentation for performing the external and internal visual inspection of cylinders manufactured in accordance with the provisions of DOT-SP 21935;

(ii) Knowledge, documentation, and equipment for performing the proof-pressure testing of cylinders manufactured in accordance with the provisions of DOT-SP 21935;

(iii) Adequate facilities, handling equipment, and skills to ensure cylinders manufactured in accordance with the provisions of DOT-SP 21935 will not be subject to impact or other damage during disassembling and reassembling;

(iv) Acknowledgment that the requalifier understands the specific operational controls of paragraph 7.d.(4) of DOT-SP 21935 that states the cylinder must be rejected if it drops from a height greater than 2 ft during the manufacturing and/or prior to being mounted into the framing.

(v) Availability to document that during the requalification process, the structural integrity of frame design is not compromised and remains the equal to or greater than the requirements specified in paragraph 7.d.(3) of DOT-SP 21935;

(vi) Visual Inspections: The external and internal visual inspection must be in accordance with CGA pamphlet C-6.2; and

(vii) Hydraulic proof pressure test as described in CGA Pamphlet C.1 which the test pressure is equal to 1.5 times the marked working pressure and hold the pressure for a minimum of 3 minutes without a loss of pressure. The testing facility for proof pressure test must be equipped with

protection system (e.g., water jacket well or concrete barrier) to avoid injury during requalification process.

(2) Method 2: Modal Acoustic Emission (MAE) Testing and External Visual Inspection: Each organization seeking a RIN for requalification for performing MAE and external Visual Inspection must meet and prove the following requirements:

(i) Holder of a special permit in performing MAE testing on composite cylinders (tubes).

(ii) MAE testing must be in accordance with the Modal Acoustic Emission (MAE) Examination Procedure for Requalification of Composite Overwrapped Pressure Vessels (Cylinders and tubes) posted on PHMSA website, https://www.phmsa.dot.gov/technical-resources/hazmat-technical-resources/technical-reports..

(iii) External visual inspection must be in accordance with CGA pamphlet C-6.2.

(iv) Tubes with severe impact damage from rollover accident: For tubes that were subjected to severe impact damage from an event such as tube trailer collision or rollover accident, the pressurization of the MAE testing must be by hydraulic medium (e.g., water) rather than gaseous medium.

(3) Requalification Marking: Date (month/year) must be permanently marked on the cylinder as specified in paragraph § 180.213. The marking of the RIN symbol on the cylinder certifies compliance with all the terms and conditions of this special permit.

d. OPERATIONAL CONTROLS:

(1) Cylinders manufactured under this special permit are not authorized for use 15 years from the date of manufacture, except as specified under paragraph 8.a. of this special permit.

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

(3) Manifolding of cylinders must be in accordance with the requirements of § 173.301(g).

(4) Cylinder (tube) handling: The cylinder/tube must be rejected if it drops from a height greater than 2 ft during the manufacturing and/or prior to being mounted into the framing.

(5) Transportation of Division 2.1 (flammable gas) materials is not authorized aboard cargo vessel and aircraft unless specifically authorized in the Hazardous Materials Table (§ 172.101).

(6) The cylinders (tubes) manufactured under this special permit must be permanently mounted inside of framing (e.g., tube trailer, MEGC or ISO Frame) for transportation in commerce, and the framing design and testing must meet the following requirements:

(i) All requirements of § 173.301(i).

(ii) Framing and containers must be designed, marked (approval plate), and approved in accordance with the requirements of 49 CFR Part 451 of International Convention for Safe Containers (CSC), ISO 1496-3: 1995/ Amd: 2006 standard in accordance with the design qualification described in the Umoe Advanced Composites As. application dated December 30, 2024, on file with OHMS, and the following:

(A) ISO 1496-3:1995: Test No 4 – External Restraint (longitudinal).

(B) ISO 1496-3:1995: Test No 5 – Internal Restraint (longitudinal).

(C) ISO 1496-3:1995: Test No 6 – Internal Restraint (lateral);

(D) All requirements of CGA Pamphlet C-29. Finite Element Analysis (FEA) shall demonstrate the ability of the frame assembly (FA) to meet all g-loading requirements of CGA C-29.

(7) Cabinet Flammability Limit: The Lower Flammability Limit (LEL) of each gas or gas mixtures must be calculated for the highest pressure and temperature to ensure the cabinet of the cylinder assembly is equipped with proper ventilation to avoid a fire or explosion during transportation or normal usage.

(8) Low pressure/temperature prior to filling: If the pressure in the cylinder (tube) drops below 100 psig (7 bar) while the ambient temperature is below -12 °C, then, prior to filling, either the tube must be held at or above 16 °C for

8 hours, or the tube must be filled to 435 psig (30 +/- 3 bar) from a compressor and held for one hour before returning to normal fill procedures.

(9) Any changes or modification to the Fire Protection System (FPS) must be recorded; including the SOPs that governs the inspection of the FPS, gauges, fittings, valves, and vent. The document must be submitted to the OHMS before the deployment of the production unit.

(10) The special permit holder must provide a detailed manual for the usage, inspection, and maintenance of components of the cylinder/tube assembly. The manual includes a Standard Operating Procedure (SOP) for each component of the assembly such as valves, fittings, Pressure Relieve Devices (PRD) or Fire Protection System (FPS), piping, venting devices, and other equipment used during charging and discharging of gases. All changes to the SOP must be clearly identified and recorded. The revised SOP, as well as the record of specific changes, must be submitted to OHMS and made available to each of the end users. Filling and discharge operations must be carried out in accordance with the SOP.

(11) Cylinder (tube) exhibiting liner bulging: Liner bulge must be fixed as follows:

(i) Pressurize the tube to 10% of its marked working (service) pressure and hold for a minimum of 4 hours. Then depressurize the tube, perform an internal visual inspection and ensure no liner bulge is exhibited.

(ii) If a liner bulge is still present after the first pressurization described above, take the following actions:

(A) Pressurize the tube to its marked working (service) pressure and hold for a minimum of 1 hour. Then depressurize the tube, perform an internal visual inspection and ensure no bulge is exhibited in the liner.

(B) If a liner bulge is still present after the second pressurization as described above, the tube must be rejected.

(C) For the rejected tube, contact the tube manufacturer for obtaining additional guidance in fixing the liner bulge prior to completing the requalification process and placing the requalification marking such as re-test date and RIN.

(12) Any semi-tractor used for the transport of tube trailer modules transporting the gases authorized under the terms of this special permit must be equipped with electronic roll stability control (RSC). The RSC powered switch must be on and activated during transportation.

(13) All new trailer modules (COPV frame assembly and chassis) transporting the gases authorized under the terms of this special permit must have a minimum rigid body Static Rollover Threshold (SRT) of 0.375. The SRT calculation must be submitted to OHMS. The SRT calculation must account for susceptibility to rollover accident and the vehicle dynamics during transportation.

(14) The design and fabrication of external piping and valves connecting the cylinders must be such that damage to a valve or to the piping does not result in discharge of the contents through piping, tubing, valve, or other components. Failure of one or more of these components, must result in no excess flow from the cylinder.

8. SPECIAL PROVISIONS:

a. Service Life Extension Program:

(1) Cylinders manufactured under this special permit are authorized for a maximum service life of 15 years from the date of manufacture unless a service life extension program from Umoe Advanced Composites As is approved by OHMS. A service life extension program must be implemented for each design type that is intended for additional service life beyond 15 years to determine the additional years of service life. If cylinders are authorized for extended service life, the maximum service life of each cylinder under this special permit is limited to 30 years from the date of manufacture.

(2) Under the service life extension program, the grantee must randomly recall a minimum of thirty (30) cylinders of each design type that have been in service for 10 and 13 years. Cylinders recalled after 10 years shall be designated “Group A” and cylinders recalled after 13 years shall be designated “Group B”. All recalled cylinders must be subjected to design requalification as specified. Sections 8.5.5, 8.5.6, and 8.5.8 of ISO 11515:2022. Out of the 30 cylinders, 15 will be used for burst test, 10 will be used for cycle test, and 5 will be used for flaw tolerance test. Acceptance criteria shall be as defined in ISO 11515 except Pb=2.0Ph and the design life (y) must be greater than or equal to 20 years. All cylinders that fail to meet the requalification requirements must be condemned, removed from service, and rendered incapable of retaining pressure. In the case that some units from the initial minimum lot size are condemned, an additional 30 cylinders must be selected and subjected to the same design requalification as

specified above (Sections 8.5.5, 8.5.6, and 8.5.8 of ISO 11515:2022). An Independent Inspection Agency must witness all testing.

(3) The complete test report including original test data must be submitted to the Associate Administrator for Hazardous Materials Safety for assessment within 30 days of completion. Failure to meet the acceptance criteria specified in this paragraph 8.a. shall result in the design being restricted to a maximum life of 15 years.

b. 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.

c. 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.

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

e. 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 for a specific manufacturing facility.

f. A current copy of this special permit must be maintained at each facility where the packaging is manufactured under this special permit. It must be made available to a DOT representative upon request.

9. MODES OF TRANSPORTATION AUTHORIZED: Motor vehicle, rail freight, and cargo vessel.

10. MODAL REQUIREMENTS: A current copy of this special permit must be carried aboard each motor vehicle and cargo vessel used to transport packages covered by this special permit.

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 Quade
Acting 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: AS/TG