September 18, 2025

U.S. Department
of Transportation

**Pipeline and Hazardous
Materials Safety
Administration**

1200 New Jersey Avenue, SE
Washington, DC 20590

DOT-SP 14951
(ELEVENTH REVISION)

EXPIRATION DATE: 2029-03-31

(FOR RENEWAL, SEE 49 CFR 107.109)

1. GRANTEE: Hexagon Lincoln, LLC.
Lincoln, NE

2. PURPOSE AND LIMITATIONS:

a. This special permit authorizes the manufacture, marking, sale, and use of a non-DOT specification fully wrapped fiber reinforced composite gas cylinder with a non-load sharing plastic liner that meets the ISO 11119-3 Standard except for the design water capacity. 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 173.301(f) in that a fire protection system is used in lieu of a pressure relief valve and § 173.302(a) in that the use of a non-DOT specification cylinder is not authorized, except as specified herein.

5. BASIS: This special permit is based on the applications of Hexagon Lincoln LLC dated October 10, 2024, and November 26, 2024, and submitted in accordance with § 107.105 and the public proceeding thereon.

Tracking Number: 2024124174

6. HAZARDOUS MATERIALS (49 CFR 172.101):

Hazardous Materials Description			
Proper Shipping Name	**Hazard Class/ Division**	**Identi-fication Number**	**Packing Group**
Argon, compressed	2.2	UN1006	N/A
Helium, compressed	2.2	UN1046	N/A
Hydrogen, compressed	2.1	UN1049	N/A
Neon, compressed	2.2	UN1065	N/A
Nitrogen, compressed	2.2	UN1066	N/A
Methane, compressed *or* Natural gas, compressed *(with high methane content)*	2.1	UN1971	N/A

Note: See paragraph 7.c. for cylinder service limitations.

7. SAFETY CONTROL MEASURES:

a. PACKAGING: Packaging prescribed is a non-DOT specification fully wrapped fiber reinforced composite gas cylinder with a non-metallic and non-load sharing plastic liner as described in the Hexagon Lincoln application on file with the Office of Hazardous Materials Safety (OHMS). Each cylinder must meet all the design and construction requirements for UN composite cylinders specified in § 178.71(l) and of ISO Standard 11119-3 (Gas Cylinders of Composite Construction – Specification and Test Methods – Part 3: Fully wrapped fiber reinforced composite gas cylinders with non-metallic and non-load-sharing metallic liners), except as follows:

(1) Scope § 1: Cylinders made under this special permit are limited to a minimum water volume of 450 liters and a maximum water volume of 12,000 liters, and a working pressure up to 250 bar (3625 psi), see operational controls for maximum internal pressure at 55 °C (130 °F).

(2) Batch of non-metallic liners § 3.4: A batch of non-metallic liners is the quantity of liners of the same nominal diameter, length, thickness and design, made successively from the same materials, and subjected to the same manufacturing process.

(3) Design (General Requirement) § 7.1.4: The minimum fiber stress ratio for carbon fiber must be 2.40.

(4) Type approval procedure (General Requirement) § 8.1

(i) A DOT Independent Inspection Agency (IIA) approved in writing by the Associate Administrator for Hazardous Materials Safety (AAHMS) in accordance with 49 CFR Part 107, Subpart I must review the results of 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 testing 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 production of cylinders, the IIA's verification of the cylinder design must be submitted to and acknowledged in writing by the OHMS.

(ii) Prior to any manufacture of cylinders 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.

(5) Prototype tests § 8.2.1, § 8.2.2: The cylinders required to be manufactured for prototype testing must be representative of production units. A sufficient number of tubes shall be made available to complete the prototype testing or testing of the design variant. Subscale units are permitted as follows:

(i) Ambient cycling: One test unit must be full scale, additional unit must be full diameter, shorter length;

(ii) LBB: test unit must be full diameter and may be shorter length;

(iii) Environmental fluid: test unit may be smaller diameter and shorter length;

(iv) Environmental cycle: test unit may be smaller diameter and shorter length;

(v) High temperature creep and accelerated stress rupture – test unit may be smaller diameter and shorter length;

(vi) Flaw: test unit must be full diameter and may be shorter length;

(vii) Gunfire: test unit must be full diameter and may be shorter length;

(viii) Permeability: test unit may be smaller diameter and shorter length;

(ix) Torque: test unit must be full diameter and may be shorter length.

(6) Inspector § 8.2.7: The IIA must witness all testing as specified in this special permit (see Table 2).

(7) Drop test § 8.2.7h, § 8.5.9: Cylinders made under this special permit are not authorized for shipment unless mounted in a frame and must be handled in accordance with the operational controls listed in this special permit therefore, they are exempt from drop test requirement of § 8.2.7h.

(8) Saltwater immersion test § 8.2.7m, § 8.5.14 – Cylinders made under this special permit are not authorized for underwater use therefore cylinders are exempt from saltwater immersion testing.

(9) New design § 8.3.2(d): A minor change to a resin component that is within the same specification (i.e., from one epoxy to another) may be qualified as a design variant.

(10) Design Variant § 8.4 - Attached Table 2 (qualification tests) may be used in lieu of Table 2 of ISO 11119-3.

Table 2. Qualification tests for cylinders with maximum test pressure ≤ 375 bars, water volume greater than 450 liters and less than or equal to 12,000 liters.

Qualification for Design Variants															
Test	New Design	Length <= 50%	Length >50%	Diameter <=20%	Diameter >20% <= 50%	Liner thickness >20% or manufacturing	Liner material	Equivalent fiber	Test Pressure <=20%	Test pressure >20% <=60%	Composite thickness or pattern	Boss-to-liner interface	Equivalent resin matrix	Resin Matrix	Pressure Relief Device
Liner material test							X								
Composite material test								X			X[1]		X[1]		
Hydraulic pressure	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Hydraulic burst	X	X[1]	X[1]	X[1]	X	X[1]	X[1]	X	X[1]	X	X	X[1]	X[1]	X[1]	
Ambient cycle	X			X[1]	X		X	X[1]	X[1]	X	X	X[1]			
Environmental cycle	X													X	

Qualification for Design Variants															
Test	New Design	Length <= 50%	Length >50%	Diameter <=20%	Diameter >20% <= 50%	Liner thickness >20% or manufacturing	Liner material	Equivalent fiber	Test Pressure <=20%	Test pressure >20% <=60%	Composite thickness or pattern	Boss-to-liner interface	Equivalent resin matrix	Resin Matrix	Pressure Relief Device
High temperature creep[1]	X				X[1]		X			X[1][a]	X[1][a]	X[a]	X[a]	X[a]	
Flaw tolerance[1]	X				X									X	
High velocity impact (gunfire)	X				X[2]				X[1]	X[1]	X[1]			X	
Fire resistance	X		X[1][b]		X[1][b]					X					X
Permeability	X				X[2];	X	X			X[1]					
Torque	X						X					X		X	
Leak	X			X	X		X		X	X		X			
Pneumatic cycle	X				X[1]	1	X					X			

Notes:

1. For a new design of a cylinder with water volume larger than 450 L, a minimum of 1 cylinder may be used for each design change. For a change of boss-liner interface column, a leak check of the liner interface would be accepted. The pneumatic cycle test is not required if the boss- liner interface does not change.

   a. Where the design variant's burst pressure to test pressure ratio, is over 20% greater than the same ratio for the approved design.

   b. When length increases up to 50% and/or diameter increases up to 20%, Bonfire test may not be required if the volume stays the same or decreases and the same PRD system is used.

2. Test to be conducted for reduction in diameter only.

(11) Cylinder burst test § 8.5.3.1: Two cylinders are required for the burst test. Pressurization rate is limited to 14 bar/sec at pressures above 80% of the minimum burst pressure. If the rate exceeds 3.5 bar/sec above 80% of the minimum burst pressure, then either the cylinder must be placed schematically between the pressure source and the pressure measurement device, or there must be a 5 second hold at the minimum design burst pressure.

(12) Burst test criteria § 8.5.3.2: The burst pressure or pressure at failure, P_b, must be not less than 1.6 times the test pressure, P_h, of the composite cylinder.

(13) Ambient cycle test procedure § 8.5.4.1.1: The cylinders must be cycled to 130 % of the working pressure or higher. At least one of these cylinders must be a full-scale cylinder. One of these cylinders may be a subscale with full diameter, but shorter length. The cylinder must pass the LBB test, 8.5.19, with no leakage. Temperature monitoring of cylinder not required if temperature is maintained below 85 °C.

(14) Ambient cycle test criteria § 8.5.4.1.2: The cylinder shall withstand a number of cycles equal to 750 times the design service life in years without leakage. The cylinder shall continue cycling until it leaks or reaches a total of 2250 times the service life in years. However, should failure during this second part of the test be by burst, then the cylinder shall have failed the test.

(15) Environmental cycle test procedure § 8.5.6.2: The cylinder shall have an internal pressure of 10% of the working pressure during the temperature conditioning. The cylinder shall be pressure cycled between 10% and 100% of the working pressure during the extreme temperature exposure. Following the cycle testing at designated temperature (60-70 °C), the cylinder shall be subjected to 30 cycles from 10% of working pressure to the test pressure at a rate not to exceed 10 cycles per minute.

(16) Environmental cycle test criteria § 8.5.6.3: The burst pressure, p_b, must be not less than 1.4 times the test pressure, p_h.

(17) High temperature creep test procedure § 8.5.7.1, 8.5.7.2: One cylinder shall be hydrostatically pressurized to test pressure at 65 °C. The cylinder shall be held at this pressure and temperature for 1,000 hours. The cylinder shall then be pressurized to burst in accordance with the procedure described in 8.5.3, except that the burst pressure shall exceed 100% of the minimum design burst pressure (1.6 times the test pressure, P_h). A second cylinder shall be pressurized to test pressure and held at a temperature of 100 °C for not less than 200 hours. Following the test, the cylinder shall meet the requirements of the hydrostatic expansion test (8.5.2) and the burst test (8.5.3), with the minimum burst being 1.6 times the test pressure, P_h, of the composite cylinder.

(18) Flaw test criteria § 8.5.8.1: One cylinder must be tested. A subscale tank with full diameter and shorter length may be used for the test.

(19) Flaw test criteria § 8.5.8.3: The cylinder must not leak or rupture within the first 3,000 cycles, but may fail by leakage during the remainder of the cycles.

(20) Drop test § 8.5.9: The drop test is not required. (See operational controls).

(21) High velocity impact test procedure § 8.5.10.1: The cylinder may be filled with air, nitrogen, or the gas to be contained. If a single 7.62 mm (30 caliber) round will not penetrate the wall, additional rounds may be used, or a larger diameter round may be used.

(22) Fire resistance test § 8.5.11.2: The cylinder (tube) assembly must be tested in a horizontal position. The bonfire test is designed to demonstrate that finished tubes, complete with the fire protection system (e.g., valve, pressure relief devices and/or integral thermal insulation) specified in the design, will prevent the rupture of the tube when tested under the specified fire conditions. A uniform fire source of a minimum 1.65 m length must provide direct flame impingement on the cylinder surface. Any failure during the test of a valve, fitting or tubing that is not part of the intended protection system for the design shall invalidate the result. Direct flame impingement is not permitted on valves, fittings, and/or pressure relief devices. The fire and its position relative to the transport frame must be approved by the Inspector. Precautions shall be taken during fire testing in the event that tube rupture occurs.

(23) Fire resistance test criteria § 8.5.11.3: The cylinder must vent through a pressure relief device, and without rupturing.

(24) Permeability test procedure § 8.5.12.2: One cylinder must be tested. This may be the full-scale cylinder or a subscale (shorter length with same diameter) using the same liner material. Pressure cycling prior to permeation testing is not required. The cylinder must be filled with the intended lading or suitable trace gas to working pressure, placed in an enclosed sealed chamber at ambient temperature, and monitored for leakage for 500 hours.

(25) Permeability test criteria § 8.5.12.3: The measured permeation rate must be reported. If a trace gas is used, correlation between the trace gas and intended lading must be provided. If permeation exceeds the allowable rate of § 8.5.12.3, the cylinder must be sectioned and the internal surfaces inspected for any evidence of cracking or deterioration.

(26) Torque test on cylinder neck boss § 8.5.13.1: The body of the cylinder must be restrained against rotation and a torque of twice the valve or PRD installation torque specified by the manufacturer must be applied to each end boss of the cylinder. The torque must be applied first in the direction of tightening a threaded connection, then in the un-tightening direction, and finally again in the tightening direction.

(27) Torque test criteria § 8.5.13.2: Upon completion of all applied torques, the cylinder must be subjected to a leak test to confirm that no leakage occurred as a result of applied torque.

(28) Salt water immersion test § 8.5.14: The salt water immersion test is not required, as the cylinder is not authorized for underwater applications.

(29) Leak test § 8.5.15: An acceptable procedure for leak testing is to pressurize the cylinders with suitable fluid to working pressure and, with the cylinder having been pressurized for at least 15 minutes, carefully examine for signs of leakage (e.g., a visual indication or decrease in pressure).

(30) Pneumatic cycle test procedure § 8.5.16.1: One finished cylinder shall be cycle tested as follows. Temperature monitoring of the cylinder is not required if the temperature is maintained below 85 °C:

(i) Fill the cylinder to be tested with a non-corrosive fluid such as oil, inhibited water or glycol;

(ii) Cycle the pressure in the cylinder for 1,000 cycles, between 10% of working pressure and working pressure. The pressure cycling rate shall not exceed 10 cycles per minute;

(iii) Release the pressure, drain the fluid, and dry the interior of the cylinder;

(iv) Cycle the pressure in the cylinder for 5 cycles, between 10% of working pressure and working pressure, with air, nitrogen or other gas determined by the inspector. The pressure cycling rate must provide at least a 2 hour hold at the high-pressure portion of the cycle;

(v) Following the high pressure hold of the final cycle, the gas shall be released freely to atmosphere.

The cylinder must then be subjected to a leak test. Following the completion of the test, the cylinder must be sectioned and the liner and liner/end boss interface inspected for evidence of any deterioration, such as fatigue cracking or electrostatic discharge.

(31) Pneumatic cycle test criteria § 8.5.16.2: The cylinder must have no signs of leakage or deterioration.

(32) Water boil test § 8.5.17: The water boil test is not required.

(33) Batch inspection and testing sampling § 9.1.3: Supplier's certification of the material properties may serve as verification of compliance.

(34) Batch inspection and testing criteria § 9.1.4: Supplier's certification of the liner boss properties may serve as verification of compliance.

(35) Overwrap materials § 9.3: Supplier's certification of the fiber properties may serve as verification of compliance.

(36) Batch testing procedure § 9.4.5: One cylinder (tube) out of 5 batches or one year of cylinder production, whichever comes first. A batch here is defined to be production quantity of up to 200 finished cylinders (tubes) successively produced (plus finished cylinders required for destructive testing), of the same nominal diameter, length, thickness and design. The batch of finished tubes may contain different batches of liners, fibers and matrix materials.

(37) Batch testing criteria § 9.4.6: The burst test may be conducted on the first unit of the batch. After reaching the minimum required burst pressure, and holding for 5 seconds, the cylinder shall have passed the test.

(38) Marking § 10.1 & 10.2: Marking must contain the following:

(i) DOT special permit number followed by working pressure expressed in bar (psig). 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 Associate Administrator for Hazardous Materials Safety, 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 Independent Inspector Agency (IIA) official mark must be placed near the serial number. The marking must contain the date (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 inspectors mark and MM/YY is the month and year of the hydraulic proof pressure test).

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.

(39) Additional requirements for each new design:

(i) Fire Protection System (FPS): Each tube assembly must be equipped with a Fire Protection System (FPS) as described in the Hexagon Lincoln. application on file with the OHSM. The FPS consists of:

(A) Plastic sensor lines that are energized from a low-pressure reservoir, a pressure release mechanism, and vent lines. There are multiple sensor lines, and they run the length of the frame system. When the sensor lines are exposed to a fire, they melt or rupture, causing the air pressure inside the reservoir of the FPS system to drop. The pressure drop in the FPS reservoir activates the tube assembly pressure release mechanism, which vents all tubes; or

(B) FPS system that uses a shape memory metal material as a trigger the vent valve during a fire scenario as specified in the Hexagon Lincoln patent application on file in the OHMS.

(C) The vent lines direct the released gas upwards and outside of the frame system.

(ii) Environmental fluids test**:** One finished cylinder including coating if applicable must be tested in accordance with procedures described in the Hexagon Lincoln application on file with the OHMS.

(iii) Leak Before Burst (LBB) Test**:** Two finished cylinders, of full scale diameter but may be shorter length, must be pressure cycled in accordance with the following procedure:

(A) Fill the cylinder to be tested with a non-corrosive fluid such as oil, inhibited water or glycol;

(B) Cycle the pressure in the cylinder between 25 bar and 375 bar at a rate not exceeding 10 cycles per minute;

(C) The number of cycles to failure must be reported, along with the location and description of the failure initiation; and

(D) All cylinders must either fail by leakage or exceed three times the design number of filling cycles.

(iv) Resin Shear Strength**:** Resin materials must be tested in accordance with procedures described in the Hexagon Lincoln. application on file with OHMS.

(v) Ultraviolet (UV) Testing**:** One finished cylinder including coating if applicable must be UV tested in accordance with procedures described in the Hexagon Lincoln. application on file with OHMS.

b. 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 a valid special permit for requalification of this type of composite cylinders/tubes using Modal Acoustic Emission (MAE) testing.

(1) Method 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 14951;

(ii) Knowledge, documentation and equipment for performing the proof-pressure testing of cylinders manufactured in accordance with the provisions of DOT-SP 14951;

(iii) Adequate facilities, handling equipment, and skills to ensure cylinders manufactured in accordance with the provisions of DOT-SP 14951 will not be subject to impact or other damage during disassembling and reassembling.

(iv) Acknowledgment the requalifier understands the specific operational controls of DOT-SP 14951, paragraph 7.c.(4) that states "cylinder must be rejected if it dropped or impacted during requalification".

(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 DOT-SP 14951, paragraph 7.c.(3).

(vi) Visual Inspections: The external and internal visual inspection must be in accordance with CGA pamphlet C-6.2 and with Hexagon Lincoln, LLC Service Bulletin 10-01-002, Hexagon Lincoln, LLC CNG Bulk Hauling TITAN® Module Inspection Manual on file with the OHMS 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 and the additional procedure provided by Hexagon Lincoln, LLC Bulletin 17-05-001 on file with the Office of Hazardous Materials Safety (OHMS).

(iii) External visual inspection must be in accordance with CGA pamphlet C-6.2 and with Hexagon Lincoln, LLC Service Bulletin 10-01-002, Hexagon Lincoln, LLC CNG Bulk Hauling TITAN® Module Inspection Manual on file with OHMS**.**

(iv) Tubes involved in a tip over or rollover accident**:** For tubes that were possibly subjected to 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.

c. 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) Cylinders are permanently mounted:

(i) Inside of framework that is designed, marked (approval plate) and approved in accordance with the International Convention for Safe Containers (CSC) (49 CFR Part 451) as described in the Hexagon Lincoln application on file with the OHMS. The structural framework shall be evaluated by Finite Element Analysis (FEA) and the report shall be kept on file with OHMS. The FEA shall demonstrate the framework's ability to protect the tubes from damage due to front, rear, or side impact, and rollover. The framework design shall meet the following:

(A) All requirements of § 173.301(i).

(B) All requirements of CGA Pamphlet C-29.

(C) The frame must be tested in accordance with ISO 1496-3: 1995(E) per the following sections:

(1) Section 6.5: Test No 4 – External Restraint (longitudinal).

(2) Section 6.5: Test No 5 – Internal Restraint (longitudinal).

(3) Section 6.5: Test No 6 – Internal Restraint (lateral); or,

(ii) In a semitrailer, or a trailer, permanently mounted on wheel axles. The trailer, and/or trailer structure(s), must be designed and analyzed using Finite Element Analysis (FEA) software, and the analysis must demonstrate the trailer structure's ability to protect the tubes from damage due to front, rear, or side impact, and rollover. The Finite Element Analysis (FEA) report shall be kept on file with the OHMS. All testing of the framework shall be witnessed by the IIA. Applicable CFR requirements for the trailer chassis design and testing are not waived. This trailer design shall meet the following:

(A) All requirements of § 173.301(i) with the exception of the 4g rail impact test described in §178.75(i)(4). A framework that has not completed the Rail Impact Test shall not be transported by rail.

(B) All requirements of CGA Pamphlet C-29.

(C) Except for the requirements for length, width, height, and ISO/CSC markings, the frame is also tested in accordance with ISO 1496-3: 1995(E) per the following sections:

(1) Section 6.5: Test No 4 – External Restraint (longitudinal).

(2) Section 6.5: Test No 5 – Internal Restraint (longitudinal).

(3) Section 6.5: Test No 6 – Internal Restraint (lateral); or,

(iii) Non-prismatic frame designs (frames without a single, clearly defined length and width) or frame designs with a footprint of less than $7m^2$ shall be analyzed using Finite Element Analysis (FEA). The structural framework shall be evaluated \by Finite Element Analysis (FEA) and the report kept on file with the OHMS. All testing shall be witnessed by the IIA. The FEA shall demonstrate the framework's ability to protect the tubes from damage due to front, rear, or side impact, and rollover. The frame design shall meet the following:

(A) All requirements of § 173.301(i) with the exception of the 4g rail impact test described in §178.75(i)(4). A framework that has not completed the Rail Impact Test shall not be transported by rail.

(B) All requirements of CGA Pamphlet C-29.

(C) Except for the requirements for length, width, height, and ISO/CSC markings, the frame is also tested in accordance with ISO 1496-3: 1995(E) per the following sections:

(1) Section 6.5: Test No 4 – External Restraint (longitudinal).

(2) Section 6.5: Test No 5 – Internal Restraint (longitudinal).

(3) Section 6.5: Test No 6 – Internal Restraint (lateral).

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

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

(6) 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).

(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) Fire protection System (FPS) Inspection: The FPS must be inspected annually in accordance with Hexagon Lincoln, bulletin SB 16-04-002–Titan Venting System and Fire Protection System and Maintenance Check manuals. During cold temperature, where freezing may occur, all vent lines must be inspected each week to make sure they are free from debris and the vent caps O-rings are attached to prevent water into to the vent lines. The annual inspection and maintenance of the FPS and its operation must be in accordance with the following Hexagon Lincoln product operational manuals on file with OHMS:

(i) TITAN® IV Normally Open FPS: SB 12-09-001;

(ii) TITAN® IV Normally Closed FPS: SB 14-02-005;

(iii) TITAN® IV BAV FPS: SB 15-01-002;

(iv) TITAN® XL: SB 15-10-001.

All the inspections documents must be available for review to OHMS per request. Any changes or modifications to the 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 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.

(15) Prior to use in Offshore Service under the terms of this special permit, additional information justifying such use must be submitted to and acknowledged in writing by the AAHMS.

(16) When transported by cargo vessel, the cylinders must be stowed on deck only and are prohibited from passenger ships (Stowage Category D).

(17) Filling procedure for CNG – All cylinders/tubes used for CNG (UN1971) service must meet the procedure and conditions described in Hexagon Composites CNG Bulk Hauling Operation and Inspection Manual, on file with OHMS and the following:

(i) Maximum dew point of the gas -9 °C (15.8 °F);

(ii) Maximum carbon dioxide (CO_2) content 4%;

(iii) Maximum Oxygen (O_2) content 1%;

(iv) Maximum temperature during filling 70 °C (158 °F); and

(v) Maximum pressure during transportation less than or equal to 5/4 times Working pressure.

8. SPECIAL PROVISIONS:

a. SERVICE LIFE EXTENSION PROGRAM (SLEP):

(1) Cylinders manufactured under this special permit are authorized for a maximum service life of 15 years from the date of manufacture unless approved for life extension.

(2) To extend service life beyond 15 years, the Service Life Extension Program (SLEP), defined in par 8.a. of this special permit, must be applied to each specific COPV (cylinder) design type. Based on the results of this program and subject to OHMS approval, the maximum allowable service life for each cylinder may be extended to 30 years from the date of manufacture.

(3) As part of the SLEP, the grantee must compare Modal Acoustic Emission (MAE) data collected from the same 24 full scale Composite Overwrapped Pressure Vessels (COPVs) at their consecutive 5 and 10 year requalifications. The data must show no degradation in the composite laminate.

(4) Two of the 24 COPVs must be randomly selected for confirmation testing, as follows:

(i) The selected COPVs must undergo pressure cycle testing in accordance with the procedure in Section 8.5.4.1.2 of ISO 11119-3. COPVs must be cycled to (12,000 cycles to test pressure or 24, 000 cycles to 1.3 times working pressure, Each COPV must have an MAE test performed before and after cycling to confirm that the composite laminate has not degraded.

(ii) After cycling, the COPVs must be subjected to a burst test in accordance with the procedure in Section 8.5.3.1 of ISO 11119-3. The minimum burst pressure (Pb) of the tested COPVs must be equal to or greater than 1.6 times the test pressure (1.6 × Ph).

(iii) All MAE evaluations, pressure cycling, and burst testing conducted under the SLEP must be witnessed and verified by a DOT-Authorized Independent Inspection Agency (IIA). Upon completion, a comprehensive report must be submitted to OHMS.

(iv) Frames included in the life extension program must be demonstrated to maintain the same structural integrity as required by the original qualification tests. Repairs and upgrades may be implemented to preserve the integrity of the frames and associated components. The fire protection systems shall be upgraded to the most current systems. The evaluation, repair, and upgrade procedures are documented in Hexagon Lincoln Report 22089**.**

(v) An extension of service life to up to 30 years must be authorized in writing by OHMS.

(vi) If extended life is authorized for a given COPV design, MAE Method A of the DOT/PHMSA MAE Examination Specification for Requalification of Composite Overwrapped Pressure Vessels (Cylinders and Tubes) must be the method of requalification at the 15 year requalification and for the remainder of the service life of each COPV.

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

f. 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 for a specific manufacturing facility.

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 cargo vessel or motor vehicle used to transport packages covered by this special permit. For transportation by cargo vessel, see paragraphs 7.c.(12) and 7.c.(13).

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.

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