



U.S. Department
of Transportation

**Pipeline and Hazardous
Materials Safety
Administration**

September 29, 2023

1200 New Jersey Avenue, SE
Washington, DC 20590

DOT-SP 21463
(FIRST REVISION)

EXPIRATION DATE: 2025-03-31

(FOR RENEWAL, SEE 49 CFR 107.109)

1. GRANTEE: Mission Systems Orchard Park Inc.
Westminster, MD
2. PURPOSE AND LIMITATIONS:
 - a. This special permit authorizes the manufacture, mark, sale, and use of non-DOT specification composite overwrapped cylinders similar to ISO 11119-2 for use in space applications. 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 § 173.302(a)(1) in that a non-DOT specification cylinder is authorized and §180 in that periodic inspection and testing is not required.
5. BASIS: This special permit is based on the application of Mission Systems Orchard Park Inc. dated October 12, 2022, submitted in accordance with § 107.105, the public proceeding thereon, and additional information submitted September 22, 2023.

Tracking Number: 2023095037

6. HAZARDOUS MATERIALS (49 CFR 172.101):

Hazardous Material Description			
Proper Shipping Name	Hazard Class/ Division	Identification Number	Packing Group
Air, compressed	2.2	UN1002	N/A
Carbon dioxide	2.2	UN1013	N/A
Compressed gas, n.o.s	2.2	UN1956	N/A
Compressed gas, oxidizing, n.o.s.	2.2	UN3156	N/A
Helium, compressed	2.2	UN1046	N/A
Nitrogen, compressed	2.2	UN1066	N/A
Krypton, compressed	2.2	UN1056	N/A
Xenon, compressed	2.2	UN2036	N/A
Argon, compressed	2.2	UN1006	N/A
Hydrogen, compressed	2.1	UN1049	N/A
Nitrous oxide	2.2	UN1070	N/A
Oxygen, compressed	2.2	UN1072	N/A

7. SAFETY CONTROL MEASURES: Prescribed packagings are non-DOT specification composite overwrapped pressure vessels (COPV) based on ISO 11119-2 with variations due to their space application. Variations from ISO 11119-2 will conform with ANSI/AIAA S-081B-2018 (American Institute of Aeronautics and Astronautics) or AFSPCMAN 91-710 (Air Force Space Command Range Safety). Cylinders must be in accordance with drawings and tests results on file with Office of Hazardous Materials Safety (OHMS). The cylinder has a Maximum Expected Operating Pressure (MEOP) of 4,500 psig and a maximum volume of 12.6 L. The packagings must conform to ISO 11119-2 2012 except as follows:

Section 1: Scope * * *

Section 2: Normative References (delete)

Section 3: Terms and definitions

Add: Damage control plan (DCP) a plan that identifies the damage threats to a cylinder throughout the service life and documents the steps taken to reduce the possibility of damage due to these threats. The DCP also identifies the inspection points.

Add: Environmental correction factor (ECF) a multiplying factor applied to account for the change in material properties associated with the difference between the test temperature and the maximum operating temperature. The ECF shall be determined to account for any material property difference between the temperature at which the test pressure testing is performed and the worst case temperature as specified by the thermal environment

Section 4: Symbols

Add: Pmax: maximum developed pressure at the maximum operating temperature for the given application. Also known as Maximum Expected Operating Pressure (MEOP).

Section 5: (delete) and replace with

INSPECTION BY WHOM AND WHERE: Inspection and verification must be performed by an independent inspection agency approved in writing by the Associate Administrator for Hazardous Materials Safety (AAHMS) in accordance with the Code of Federal Regulations, 49 CFR 173.300a. Chemical analysis must be approved for each procurement batch in accordance with 49 CFR Subchapter C Section 173.300b.

DUTIES OF INSPECTOR: Must be in accordance with 49 CFR § 178.70 (e) and (g)

Section 6: Materials

6.1 Liner Materials: (delete) and replace:

6.1.1 The Liner materials shall conform in all relevant respects as follows:

(a) Liner: The liner must be a seamless cylinder made of aluminum alloy 6061 of T-6 temper.

(i) The liner may be produced by cold or hot backward extrusion; cold drawing; or from an extruded tube with spun ends.

- (ii) The material composition of the alloy used must be within the limits prescribed herein:
- (iii) The liner interior surface shall be smooth. Any fold in the neck region due to the forming or spinning process must not be sharp or deep or detrimental to the integrity of the cylinder. Inner surface defects may be removed by machining or other method, provided the metal loss is minimal and the minimum required wall thickness is maintained.
- (iv) Liner ends must be concave to pressure.
- (v) Prior to any test, all cylinders must be subjected to a solution heat treatment and aging heat treatment appropriate for aluminum alloy 6061. The process must produce liners of uniform temper and properties.
- (vi) The limits for the mechanical properties of alloy 6061 T6 temper prior to filament winding shall be as follows: 6061-T6 Yield Strength (Min) 241,316 kPa (35,000 psi) Tensile Strength (Min) 262,001 kPa (38,000 psi) Elongation 5.1 cm (2" gage)(Min) 14% Elongation (24t X 6t) 10%.
- (vii) The outer surface of each liner must be protected from any galvanic corrosion that may occur due to dissimilar materials (aluminum and carbon fibers) in contact. This coating is unnecessary if aramid fibers are used. A suitable polymer coating or glass-fiber/epoxy composite layer may be used for this purpose.
- (viii) Physical tests. To determine yield strength, tensile strength and elongation of the aluminum liner material. Applies to aluminum liner only.
 - (A) Required on 2 specimens cut from one liner taken at random out of each lot of 200 liners or less. A "lot" means a group of cylindrical liners successively produced having the same: size and configuration, specified material of construction, process of manufacture and heat treatment process conditions.
 - (B) Specimens must be: Gauge length of 5.1 cm (2 inches) with width not over 3.8 cm (1-1/2 inches); or gauge length of 4 times the specimen diameter (4D bar); a specimen with gauge length at least 24 times the thickness with the width not over 6 times the thickness is also authorized when the liner wall is not over 0.48 cm (3/16 inch) thick. The specimen, exclusive of grip ends, must not be flattened. Grip ends may be flattened to within 2.5 cm (one inch) of each end of the reduced section. When the size of the liner does not permit securing straight specimens, the

specimens may be taken in any location or direction and may be straightened or flattened cold and by pressure only, not by blows. When such specimens are used, the inspector's report must show that the specimens were so taken and prepared. Heating of specimens for any purpose is not authorized.

(C) The yield strength in tension shall be the stress corresponding to a permanent strain of 0.2 percent of the gauge length.

(1) The yield strength shall be determined by the "offset" method as prescribed by ASTM Standard E8-78.

(2) For the purpose of strain measurement, the initial strain shall be set while the specimen is under a stress of 41,369 kPa (6,000 psi), the strain indicator reading being set at the calculated corresponding strain.

(3) Cross-head speed of the testing machine shall not exceed 0.32 cm (1/8 inch) per minute during yield strength determination.

Section 7: Design and manufacture

7.2 Design submission

7.2.1 (delete) and replace:

The design submission, must be made to the Independent Inspection Agency for each new design of cylinder and shall include a detailed drawing, along with documentation of the design, if not included on the drawing, including manufacturing and inspection particulars as detailed in 7.2.2, 7.2.3, 7.2.4 and 7.2.5.

7.2.3 Documentation for the composite overwrap * * *

7.2.4 Documentation for the composite cylinder shall include:

a) (delete) and replace with: nominal water capacity under ambient conditions

b) through e) * * *

f) (delete) and replace with: maximum developed pressure at the maximum operating temperature for the given application. Also known as Maximum Expected Operating Pressure (MEOP)

g) * * *

h) (delete) and replace with: design life in years

i) through k) * * *

7.3 Manufacturing

7.3.1 (delete) and replace with: The liner shall be manufactured in accordance with the manufacturer's design and sections 6.1.1 and 7.2.2

7.3.2 through 7.3.5 * * *

7.3.6 manufacturing, inspection, acceptance, testing and shipping operations shall follow provisions in the damage control plan (DCP) that must be created for the cylinder in accordance with the ANSI/AIAA S-081B-2018 Standard.

Section 8: Type approval procedure

8.2 Prototype tests

8.2.1 (delete) and replace with: A minimum of 2 cylinders per batch representative of the new design as required by ANSI/AIAA S-081B-2018 shall be made available for prototype testing. Spares may be included in a lot at the manufacturer's discretion. Upon successful completion of all prototype tests, the remaining untested cylinders from the prototype qualification batch can be used for service.

8.2.2 (delete)

8.2.3 and 8.2. * * *

8.2.5 (delete) and replace with: Tests for a new cylinder design shall be supervised by an inspector and shall consist of:

- a) Proof pressure test or Hydraulic volumetric expansion test in accordance with 8.5.1 or 8.5.2 of this special permit. * * *
- b) Liner burst test – not required
- c) Cylinder burst test in accordance with 8.5.4 of this special permit
- d) Ambient cycle test in accordance with 8.5.5 of this special permit

- e) Environmental cycle test – not required
- f) Flaw test – not required. Damage Tolerance test in accordance with 8.5.7 of this special permit must be performed.
- g) Drop test – not required
- h) High velocity impact (gunfire) test – not required
- i) Torque test * * *

8.2.6 (delete)

8.2.7 through 8.2.10 * * *

8.5 Type approval test procedures and criteria

8.5.1 Proof pressure test * * * except that the test pressure must be held for at least 5 minutes in lieu of 30 seconds. Pneumatic pressure test is not authorized.

8.5.1.2 * * *

8.5.2 Hydraulic volumetric expansion test * * * except that the test pressure must be held for at least 5 minutes in lieu of 30 seconds.

8.5.2.2 * * *

8.5.3 Liner burst test: Not required.

8.5.4 Cylinder burst test * * * except delete 8.5.4.1 (c). Design Burst Pressure must be determined from the burst factor (BF), environmental correction factor (ECF), and MEOP in accordance with the following equation:

$$\text{Design Burst Pressure} = BF \times ECF \times \text{MEOP}$$

Where $BF \geq 1.50$

ECF= 1.05

MEOP= 4500psi

Design Burst Pressure $\geq 7087.5\text{psi}$

8.5.5 Ambient cycle test

8.5.5.1 * * *

8.5.5.1.1 General * * *

8.5.5.1.2 (delete) and replace with: Procedure

Pressure cycle testing shall be performed on one cylinder. The test pressures shall be adjusted to account for the worst case temperature effects on static strength and/or fracture properties of the structural materials. This will be accommodated by the use of the Environmental Correction Factor (ECF).

The value of the lower cyclic pressure shall not exceed 10% of the upper cyclic pressure, but shall have an absolute maximum of 30 bar (435 psi). The frequency of reversals of pressure shall not exceed 0.25 Hz (15 cycle/min).

The parameters that shall be monitored and recorded are:

- a) Number of cycles achieving upper cyclic pressure;
- b) Minimum and maximum cyclic pressures
- c) Test medium used
- d) Mode of failure if appropriate

8.5.5.3 (delete) and replace with: Criteria

The cylinder shall withstand N1 pressurization cycles to Ph (test pressure) and N2 pressurization cycles to Pmax without failure by burst or leakage, where:

$N1 = 4 \times \text{the maximum number of test pressure cycles (2)} = 8$

$N2 = 4 \times \text{the maximum number of service pressure cycles (13)} = 52$

The test shall continue until the cylinder fails (leakage is observed or rupture occurs) or the number of cycles is achieved. In addition to fully achieving the cycles without leaking, a passing result is contingent upon subsequently passing a burst test (section 8.5.4).

8.5.6 (delete)

8.5.7 (delete) and replace with: Damage Tolerance Test

8.5.7.1 (delete) and replace with: Procedure (consistent with AFSPCMAN 91-710)

A worst-case impact damage survey shall be performed for all manufacturing, inspection, assembly, and test operations until the cylinder is secured for final shipment. The worst-case credible impact energy shall be established. For purposes of testing, the impact energy shall be multiplied by 1.25. This value (Impact energy maximum credible threat) shall be recorded as Imct (where $Imct = \text{worst case impact energy} \times 1.25$). Visual damage threshold (VDT) shall also be established. A 0.5-inch diameter hemispherical steel impactor shall be used for all damage tolerance testing. The impactor shall be used to establish the lowest impact energy level that creates an indication on the composite outer diameter that is detectable by a trained inspector using an unaided visual inspection technique. Typically, low level impacts will be repeated at greater and greater energy values until damage is detected. Each impact should be at a new location. The establishment of VDT can be performed on a development unit or a qualification unit. If a development unit is used it must be of the same design as the cylinder being qualified. The impact energy for the VDT shall be recorded as Ivdt. If $Imct > Ivdt$, the qualification test shall be to Imct. If $Imct < Ivdt$, the test shall be to Ivdt. The qualification cylinder shall be impacted with the established test impact energy (maximum of Imct and Ivdt). The cylinder shall be impacted a minimum of once on the sidewall and once on the dome at the location where the composite is at a minimum thickness (normally close to the hoop tangency on the dome). Following the impact test, the unit must be subject to hydrostatic burst testing from Section 8.5.4.

8.5.7.2 (delete) and replace with: Criteria

The damaged cylinder must meet the minimum burst requirement of the un-impacted unit.

8.5.8 through 8.5.11 (delete)

8.5.12 Torque test * * *

8.5.13 (delete)

8.5.14 Failure of type approval tests * * *

Section 9: Batch inspection and testing

9.1 Liner * * * except that (9.1.2 is deleted)

9.4 Composite cylinder

9.4.1 (Delete) and replace: The inspector shall certify that the design, manufacture, inspection, and testing were carried out in accordance with this special permit.

9.4.2 through 9.4.4 * * *

9.4.5 (delete) and replace with: A pressure cycling test shall be conducted on no fewer than one finished cylinder per batch (a maximum of 200 pieces produced sequentially). The cylinder to be tested shall be selected at random from the batch and tested in accordance with 8.5.5. If the cylinder fails the test then the batch shall not be released until the investigation carried out in accordance with 9.5 is completed.

9.4.6 * * *

9.5 Cylinder failure during type approval or batch testing

9.5.1 and 9.5.2 * * *

9.5.3 (a) * * *

9.5.3 (b) (delete) and replace with: The batch shall be rejected if no root cause is identified, however, at the manufacturer's discretion, when a cylinder fails a test, five additional cylinders selected randomly may be subjected to the same test. If all five cylinders pass, the lot may be accepted. If one or more of the cylinders fails, the lot must be rejected.

9.5.4 through 9.5.6 * * *

Section 10: Cylinder marking (delete) and replace with paragraph 7.a. of this special permit:

a. MARKING: Each cylinder must be permanently marked (other than stamping) on the sidewall. The marking must be easily visible. The marking must contain the following:

- (1) DOT Special Permit number (DOT SP-21463) followed by Pmax (MEOP) expressed in pounds per square inch gauge (psig).
- (2) 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 above.
- (3) The DOT inspector's official mark must be placed near the serial number. The marking must contain date (month and year) of the initial hydrostatic test for that cylinder.

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

(5) The following are the authorized formats for marking: DOT- SP XXXXX-PPPP 1234-MMI (or symbol) II-MM/YY.

(6) Additional markings are permitted on the composite, provided the additional markings do not obscure the required markings and are not detrimental to the integrity of the cylinder.

b. OPERATIONAL CONTROLS:

(1) Cylinders manufactured under this special permit are not authorized for use fifteen (15) years after the date of manufacture.

(2) Cylinders are only authorized for use as part of a vehicle bound for space (rocket, launch vehicle, satellite, capsule, deep space probe, spacecraft, etc.)

(3) The number of cylinder pressurizations are to be recorded. Cylinder pressurizations shall not exceed a total of 13 pressurizations. This includes any pressurizations that exceed 50% of Pmax (MEOP) and all pressurizations to test pressure.

(4) Prior to installation into the space bound vehicle or subassembly, all processing, shipping and storage of the cylinder must be in compliance with the Damage Control Plan for the cylinder on file with OHMS.

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 packaging covered by this special permit, may reoffer it for transportation provided no modification or change is made to the packaging 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 Special Permits and Approvals for a specific manufacturing facility.

- e. 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, cargo-only aircraft, passenger-carrying aircraft, rail freight, cargo vessel.
10. MODAL REQUIREMENTS: A current copy of this special permit must be carried aboard each cargo vessel, aircraft or motor vehicle used to transport packages covered by this special permit. The shipper must furnish a 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:
- o All terms and conditions prescribed in this special permit and the Hazardous Materials Regulations, 49 CFR Parts 171-180.
 - o 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.
 - o Registration required by § 107.601 et seq., when applicable.

Each "Hazmat employee", as defined in § 171.8, who performs a function subject to this 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.:

A handwritten signature in blue ink, appearing to read "W. Schoonover", is written over a faint circular stamp.

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: AS/TG