U.S. Department
of Transportation

**Research and
Special Programs
Administration**

NOV 22 1999

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

DOT-E 10944
(THIRD REVISION)

EXPIRATION DATE: October 31, 2001

(FOR RENEWAL, SEE 49 CFR § 107.109)

1. GRANTEE: Pacific Scientific, HTL/Kin-Tech Division, Duarte, California

2. PURPOSE AND LIMITATIONS:

   a. This exemption authorizes the manufacture, mark, sale and use of a non-DOT specification cylinder conforming with all regulations applicable to a DOT specification 4DS cylinder, except as specified herein, for the transportation in commerce of the materials authorized by this exemption. This exemption provides no relief from any Hazardous Materials Regulation (HMR) other than as specifically stated herein.

   b. The safety analyses performed in development of this exemption only considered the hazards and risks associated with transportation in commerce.

3. REGULATORY SYSTEM AFFECTED: 49 CFR Parts 106, 107 and 171- 180.

4. REGULATIONS FROM WHICH EXEMPTED: 49 CFR §§ 173.302(a) and 175.3 in so far as non-DOT packagings are not authorized.

5. BASIS: This exemption is based on the application of Pacific Scientific dated September 27, 1999, submitted in accordance with § 107.109.

6. HAZARDOUS MATERIALS (49 CFR § 172.101):

Proper Shipping Name/ Hazardous Material Description	Hazard Class/ Division	Identi-fication Number	Packing Group
Compressed gas, n.o.s. (containing Bromotrifluoromethane)	2.2	UN1956	n/a

7. SAFETY CONTROL MEASURES:

a. PACKAGING - Packaging prescribed is a non-DOT specification sphere made from welded seamless hemispherical domes, and having a configuration conforming to Pacific Scientific drawing number 34600033 REV.D, dated November 13, 1992, drawing number 34200400 REV.C, dated August 18, 1992, and in accordance with other drawings and procedures and a quality assurance plan specified in their application on file with the Office of Hazardous Materials Exemption and Approvals (OHMEA). The spheres must be in conformance with DOT Specification 4DS (§§ 178.35 and 178.47), except as follows:

§ 178.35(a) *Compliance.*

(1) Required in all details except as amended herein.

(2) Lot definition. In this exemption, a "lot" means a group of spheres successively produced and having the same:

(i) Size and configuration;

(ii) Specified material of construction;

(iii) Process of manufacture and heat treatment;

(iv) Equipment of manufacture and heat treatment;

(v) Conditions of time, temperature and atmosphere during heat treatment.

The lot size may not exceed 200 spheres, but any sphere processed for use in the required destructive testing need not be counted as being one of the 200.

§ 178.35(c) *Duties of inspector.*

The inspector must determine that each cylinder made is in conformance with the applicable specification and verify that material and design qualification tests prescribed in this exemption have been performed and modify reports as appropriate. Except as otherwise specified, the inspector must perform the following:

(1) through (4) * * *

§ 178.35(e) *Safety relief devices.*

* * *

§ 178.35(f) *Marking.*

Applies, except that:

(i) Instead of DOT-4DS, spheres must be marked "DOT-E 10944" followed by the service pressure.

(ii) Marking by low stress type method such as electro-chemical etching, vibro -pen or laser marking, which does not decrease the integrity of the pressure vessel, is authorized.

(iii) Stamping of elastic expansion is not required.

(iv) The Test Pressure marking, (TP-_____) followed by the pressure at which the sphere was tested, for example, "TP-3,000" must precede or be located immediately above the test date.

§ 178.35(g) *Inspector's Report.*

Applies except that the inspector's report must be appropriately modified to reflect identification and conformance with this exemption.

§ 178.47(a) *Type, size, service and pressure.*

(1) Type and size. Fusion welded Titanium-15-3-3-3 alloy sphere as shown in the drawings referenced in paragraph 7(a) of this exemption. Water capacity not to exceed 100 pounds.

(2) Service pressure at 70°F is at least 500 pounds per square inch gauge, and not over 80 percent of the vapor pressure of the contents at 130°F in pounds per square inch gauge.

§ 178.47(b) *Authorized Material.*

(1) Type Titanium alloy 15V-3Cr-3Sn-3Al (Ti 15-3-3-3 alloy) conforming to the Aerospace Materials Specification (AMS) 4914, having a chemical composition as follows:

Element	Percent by weight Min		Max
Vanadium	14.0	-	16.0
Chromium	2.5	-	3.5
Tin	2.5	-	3.5
Aluminum	2.5	-	3.5
Iron	--	-	0.25
Oxygen	--	-	0.13
Carbon	--	-	0.05
Nitrogen	--	-	0.05 (500 ppm)
Hydrogen	--	-	0.015(150 ppm)
Residual Elements, each	--	-	0.10
Residual Elements, total	--	-	0.40
Titanium remainder			

§ 178.47(d) *Manufacture.*

(Add) The design and manufacturing process for the vessel and attachments must be as described in the HTL's application, and in conformance with the procedure used in the prototype vessel fabrication.

§ 178.47(e) *Welding or brazing.*

Welding procedures must be as described in the HTL's application.

§ 178.47(f) *Wall thickness.*

The minimum wall thickness for any sphere must be no less than 0.069 inches.

(1) Minimum wall thickness must be such that the wall stress at minimum specified design pressure must not exceed 50 percent of the minimum tensile strength of the material as determined from the physical tests prescribed in § 178.47(m) as modified in this exemption and the maximum wall stress must not be greater than 85,000 pounds per square inch.

The minimum design pressure is twice the service pressure.

(2) * * *

§ 178.47(g) *Heat treatment.*

Seamless hemispheres are cold formed from stress relieved or annealed sheet stock. The welded vessel must be solution heat treated and aged before hydrostatic test, per the following schedule:

* Solution treat and age in a vacuum furnace at 1450 +/- 25°F for 10 +/- 2 minutes;

* Quench in Argon to below 200°F;

* Re-heat to 800 +/- 10°F for 4 hours +/- 10 minutes;

* Ramp at 40°F per minute to 1080 +/- 25°F, hold for 8 hours +/- 10 minutes;

* Quench in Argon to below 200°F.

§ 178.47(h) *Openings in container.*

(1) Each fitting, boss, or pad attached to the container must be by fusion welding and must be of Titanium 15-3-3-3 alloy.

(2) * * *

§ 178.47(i) *Process treatment.*

Process treatment not required.

§ 178.47(j) *Hydrostatic test.*

(1) and (5) * * *

§ 178.47(k) *Radiographic inspection.*

Hundred percent radiographic inspection required on all welded joints. Specific acceptance rejection criteria must be clearly stated and approved by the inspector.

§ 178.47(l) *Burst test.*

One container from each lot of 200 or less, must be hydrostatically tested to destruction. The burst pressure must be recorded in the inspectors report.

§ 178.47(m) *Flattening test.*

Not required. However, the following is required:

(1) Prior to the initial shipment, each design must be qualified by a cycling test which must be performed on at least three representative samples as follows:

(i) Each pressure vessel must be cycled by pressurization with water from zero to service pressure at a rate not exceeding 10 cycles per minute, and for a minimum of 10,000 cycles. Adequate recording instrumentation must be provided if the test equipment is operated unattended for periods of time. All spheres cycle tested must be condemned.

(ii) One pressure vessel taken at random from each lot must pass the test described in paragraph (a)(1) above for lot acceptance. The pressure vessel that was cycle tested may be used for burst test.

(2) Physical test. Physical tests may be performed on specimens taken from the production sheet stock used in production, and must be subjected to the heat treatment process identical to the process used in the production of spheres.

(i) To determine yield strength, tensile strength, elongation, and reduction of area of material. Required on at least 2 specimens taken form the test sheet stock.

(ii) Specimens must be: Gauge length at least 24 times thickness with width not over six times thickness.

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

(iv) The yield strength must be determined by either the "off set" method or the "extension under load" method as prescribed in ASTM Standard E8-78.

(v) In using the "extension under load" method, the total strain corresponding to the stress at which the 0.2 percent permanent strain occurs may be determined with sufficient accuracy by calculating the elastic extension under appropriate load and adding thereto 0.2 percent of the gauge length.

(vi) For the purpose of strain measurement, the initial strain must be set while the specimen is under a stress of 12,000 pounds per square inch, the strain indicator being set at the calculated corresponding strain.

(vii) Cross-head speed of the testing machine must not exceed 1/8 inch per minute during yield strength determination.

§ 178.47(n) *Acceptable results of tests.*

(1) Not applicable

(2) The burst pressure must be at least 2700 pounds per square inch gauge.

(3) Physical tests.

(i) Elongation at least 8 % for gauge length 24 times the thickness.

(ii) Tensile strength not to exceed 170,000 pounds per square inch; yield strength is 150,000 pounds per square inch nominal.

(4) Cycling tests.

(i) Must pass the cycling tests prescribed in § 178.47(m) of this exemption, without failure by fracture, leakage or distortion.

§ 178.47(o) *Rejected spheres.*

Repair of welds is authorized after which reheat treatment is required, subsequent thereto acceptable spheres must pass all prescribed tests.

b. TESTING - Each cylinder must be reinspected and hydrostatically retested in accordance with § 173.34(e) as prescribed for DOT-4DS cylinders, except that the retest pressure must be that stamped on the sphere.

8. SPECIAL PROVISIONS:

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

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

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

d. Each packaging manufactured under the authority of this exemption must be marked with a registration symbol designated by the Office of Hazardous Materials

Exemptions and Approvals for a specific manufacturing facility.

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

f. Spheres are for aircraft use only.

g. The spheres must be shipped in strong outside packaging in conformance with 49 CFR 173.301(k). The spheres may contain properly approved actuating cartridges installed in the discharge outlet.

9. MODES OF TRANSPORTATION AUTHORIZED: Motor vehicle, rail freight, cargo aircraft only, and passenger-carrying aircraft.

10. MODAL REQUIREMENTS: A current copy of this exemption must be carried aboard each aircraft used to transport packages covered by this exemption. The shipper must furnish a copy of this exemption to the air carrier before or at the time the shipment is tendered.

11. COMPLIANCE: Failure by a person to comply with any of the following may result in suspension or revocation of this exemption and penalties prescribed by the Federal hazardous materials transportation law, 49 U.S.C. 5101 et seq:

- All terms and conditions prescribed in this exemption and the Hazardous Materials Regulations, Parts 171-180.
- Registration required by § 107.601 et seq., when applicable.

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

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

NOV 22 1999

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

Issued at Washington, D.C.

Alan I. Roberts
Associate Administrator for
Hazardous Materials Safety

11/22/99
(DATE)

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

The original of this exemption is on file at the above office. Photo reproductions and legible reductions of this exemption are permitted. Any alteration of this exemption is prohibited.

Copies of exemptions may be obtained from the AAHMS, U.S. Department of Transportation, 400 7th Street, S.W., Washington, DC 20590-0001, Attention: Records Center, 202-366-5046.

Dist: FHWA, FRA and FAA
PO: KFW