U.S. Department
of Transportation
**Research and
Special Programs
Administration**

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

OCT 30 2002

DOT-E 12966

EXPIRATION DATE: September 30, 2004

(FOR RENEWAL, SEE 49 CFR § 107.109)

1. GRANTEE: Scientific Cylinder Corporation (SCC)
Denver, CO

2. PURPOSE AND LIMITATION:

a. This exemption authorizes the use of DOT Specification 3AL cylinders, made of aluminum alloy 6351-T6, for the transportation in commerce of the compressed gases described in paragraph 6 below, when retested by the nondestructive test methods described herein in lieu of the internal visual and the hydrostatic retest. This exemption provides no relief from the Hazardous Materials Regulations (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.

c. Party status will not be granted to this exemption.

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

4. REGULATIONS FROM WHICH EXEMPTED: 49 CFR §§ 172.203(a) and 172.301(c) in that each shipping paper or cylinder is not required to be marked with the exemption number; §§ 180.205(f)(4), 180.205(g), 180.209(a), in that the ultrasonic examination (UE) and eddy current examination (EE) is performed in lieu of the specified internal visual examination and hydrostatic pressure test on DOT-3AL cylinders made of 6351-T6 aluminum alloy.

NOTE: This does not relieve the holder of this exemption from securing an approval for retesting cylinders from the Associate Administrator for Hazardous Materials Safety.

5. BASIS: This exemption is based on the application of SCC dated February 2, 2002 and supplemental information dated August 23, 2002, 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**
Liquefied or non-liquefied compressed gases, or mixtures of such compressed gases, classed as Division 2.1, (flammable gas) Division 2.2, (nonflammable gas) or Division 2.3, (gases which are Toxic by Inhalation (TIH)) which are authorized in the Hazardous Materials Regulations for transportation in DOT 3AL cylinders.	2.1, 2.2 or 2.3 as appropriate	As appropriate	N/A

7. SAFETY CONTROL MEASURES:

a. PACKAGING - Packaging prescribed is a DOT Specification 3AL cylinder, manufactured from aluminum alloy 6351-T6 that is subjected to periodic retesting, reinspection and marking prescribed in §§ 180.205 and 180.209(a), except that the cylinder's sidewall is examined by ultrasonic and the cylinder's neck is examined by eddy current and enhanced visual inspection in lieu of the hydrostatic pressure test and internal visual inspection. Each cylinder must be subjected to an external visual examination and retested and marked in accordance with the procedure described herein and SCC's application for exemption dated February 2, 2002 and supplemental information dated August 23, 2002, on file with the Office of Hazardous Materials Exemptions and Approvals (OHMEA). A cylinder that has been exposed to fire or to excessive heat may not be retested under the terms of this exemption.

b. Equipment and Performance.

(1) Ultrasonic System - The ultrasonic equipment performance must conform to the SCC application on file with OHMEA and as prescribed in this exemption. The UE equipment incorporates a single channel immersion system arranged to perform straight and angle beam examinations. The ultrasonic pulses must enter into the cylinder wall in both longitudinal and circumferential directions and normal to the cylinder wall to ensure 100 percent coverage of the cylinder wall. All defects (such as isolated pits, line corrosion, sidewall defects (e.g. cracks, folds) and line corrosion side-wall-to-base transition area (SBT)) must be detected. The transducer or cylinder must be arranged so that the ultrasonic beams enter into the cylinder wall and measure thickness and detect the side wall flaws. The immersion UE system must have a high speed board to digitize and capture each A-scan during examination of the cylinder. Gain control accuracy must be checked every six months with equipment that is calibrated in accordance with a nationally recognized standard. Search units of 2.25 to 10 MHZ nominal frequency and 1/4" to a 1" diameter must be used during ultrasonic examination. A manual contact shear or longitudinal search unit may be used for confirmation and sizing of an indicated defect. If manual UE is used, it must be performed under direct supervision of a Senior Review Technologist by a minimum Level II operator and in accordance with American Society of Testing Materials (ASTM) practice E 213.

(2) Eddy Current Equipment - Equipment, such as Visual Plus or Visual Eddy, must be capable of detecting the notches on the standard reference ring.

c. Standard References

(1) UE Reference Cylinder - A cylinder or a cylinder section must be used as a standard reference and must have similar acoustic properties, surface finish and metallurgical condition as the cylinders under test. The standard reference, (reference cylinder) must have a known minimum design wall thickness (t_m) which is less than or equal to the cylinder under test. The standard reference cylinder for cylinders less than or equal to 6-inches in diameter must have the same nominal diameter as the cylinder being tested.

Cylinders greater than 6-inches in diameter must conform to the allowable size ranges shown in the following table:

Standard Reference	Cylinder Size Ranges being retested by UE	
Outside Diameter (OD-inches)	Minimum OD-(inches)	Maximum OD-(inches)
7	6.30	10.50
7.50	6.75	11.25
9.00	8.10	13.50
9.25	8.33	13.88
10.00	9.00	15.00
12.00	10.80	18.00

Prior to placing the simulated defects such as minimum wall thickness, the average minimum wall thickness for the standard reference must be determined by means of an independent method.

(i) The standard reference (reference cylinder) must be prepared to include the following artificial defects:

(A) The artificial defect for area corrosion will be 0.70 square inch (in^2) and the remaining wall thickness must be at least the design minimum wall for a cylinder being tested.

(B) The artificial defect for isolated pits in cylinders less than or equal to 4 inches in diameter consisting of an internal flat bottom hole (FBH) of 1/8 inch diameter and $1/3t_m$ in depth.

(C) The artificial defect for isolated pits in cylinders greater than 4 inches in diameter consisting of an internal FBH of 1/4 inch diameter and $1/3t_m$ in depth.

(D) The artificial defect for line corrosion consisting of two circumferential (one internal and one external) and two longitudinal(one internal and one external)

notches. These notches shall be electro discharge machine (EDM), measuring 0.10 t_m in depth, 1 inch in length and less than or equal to 0.010 inch width.

(ii) A certification statement signed by a SCC senior review engineer (SRE) must be available for all standard references at each site where retesting is performed. The certification statement must include a standard reference drawing for each size of cylinder. A standard reference drawing must include dimensions and the locations of each simulated defect.

(2) Eddy Current Reference Ring - The reference ring must be produced to represent one or more DOT 3AL cylinders. The reference ring must include artificial notches that simulate neck crack (SLC). The size of artificial notch (depth and length) must be obtained from the EE equipment manufacturer. A certification statement signed by a SCC senior review engineer (SRE) must be available for all EE reference rings at each site where retesting is performed. The certification statement must include a standard reference drawing for each reference ring. The standard reference drawing must include the depth of each notch, diameter and type of DOT 3AL cylinder that the reference ring is used for.

d. System Standardization (Calibration)

(1) Ultrasonic Examination (UE) System Standardization. Prior to retesting a cylinder, the cylinder must be identified. The UE system must be standardized for testing the identified cylinder by using a standard reference. Standardization of the UE system must be performed by using a relevant reference cylinder that is described in paragraph 7.c.(1) of this exemption. The standardization of the UE system is as follows:

(i) A reference cylinder with an artificial defect made to represent area corrosion must be placed in the UE system. The UE system must be standardized to indicate rejection for an area equal or greater than the machined surface for the cylinder (0.70 in^2). Where the wall thickness is reduced below t_m, a straight ultrasound beam must be used to measure the wall thickness of the machined area.

(ii) A reference cylinder with a FBH made to represent an isolated pit must be placed in the UE system. The FBH must be detected by a minimum of two shear wave beams that strike the FBH from opposite sides (e.g. the first shear wave direction is from top to bottom of the cylinder and the second shear wave direction is from the bottom to top). The UE gain must be increased until the signal from FBH is maximized at 80 percent of the screen height.

(iii) A reference cylinder with circumferential notches made to represent line corrosion must be placed in the UE system. Each internal and external notch must be detected by a minimum of one shear wave beam. The UE gain must be increased until the signal from each notch is maximized at 80 percent of the screen height.

(iv) A reference cylinder with longitudinal notches to represent a longitudinal sidewall crack (LSC) must be placed in the UE system. Each internal and external notch must be detected by a minimum of two shear wave beams that strike the LSC from opposite directions (e.g. the first shear wave direction is clock wise and second shear wave direction is counter-clock wise). The UE gain must be increased until the signal from the notch is maximized at 80 percent of the screen height.

(2) Eddy Current Examination (EE) Equipment Standardization - The EE equipment must be standardized for each type of DOT 3AL cylinder, using the standard reference ring that includes simulated neck crack notch. The EE system is considered standardized when the probe is threaded into the mid-length of standardization ring and the sensitivity adjusted to produce a spike that crossed the gate (½ screen high) as it passes over the simulated neck crack notch. The details of the equipment standardization for each type of DOT 3AL cylinder must be obtained from the manufacturer's instruction manual included as part of this standardization procedure.

e. Test Procedures

(1) A written test procedure for performing UE, EE and enhanced visual inspection of cylinder neck under the terms of this exemption must be at each facility performing retests under this exemption. At a minimum, this procedure must include:

(i) A description of the test set-up; test parameters; transducer model number, frequency, and size; transducer assembly used; system standardization procedures and threshold gain used during the test; and other pertinent information.

(ii) Requirements for the equipment standardization to be performed at the end of the test interval (cal-out), after 200 cylinders or four hours, which ever occurs first. This cal-out can be considered the cal-in for the next interval during continuous operation. Cylinders examined during the interval between cal-in and cal-out must be quarantined until an acceptable cal-out has been performed. An acceptable cal-out occurs when the calibration cylinder is examined and all required features are revealed without changing examination settings. If an acceptable cal-out does not occur, if any equipment that affects the UE results are replaced or altered (such as a search unit or coaxial cable etc.) or when a loss of power occurs, all cylinders examined since the last successful calibration must be re-examined. Additionally, standardization of test equipment shall be performed at the beginning of each work shift, when the cylinder under test has dimensions that exceed the allowable ranges of the reference cylinder, when there is a change of operator(s), if any equipment that affects the UE results are replaced or altered (such as a search unit or coaxial cable etc.) or when a loss of power occurs, and at the end of each work shift.

(2) The test procedure must be available to a DOT official when requested. Any change to the written procedure must be submitted to OHMEA as soon as practicable.

(3) The equipment may not allow testing of a cylinder unless the system has been properly standardized (calibrated).

(4) The rotational speed of a reference cylinder must be such that all simulated defects are adequately detected, measured and recorded.

(5) The rotational speed of the cylinder under UE must not exceed the rotational speed used during the standardization.

(6) The area of ultrasonic examination (UE) coverage must be 100% of the cylindrical section. The coverage must extend three inches into the sidewall-to-base transition taper. The area of eddy current and enhanced visual examination coverage must be 100% of the threaded neck of the cylinder.

(7) The external surface of the cylinder to be examined must be free of loose material such as scale and dirt.

f. Acceptance/Rejection Criteria

(1) UE Acceptance/Rejection Criteria. A cylinder must be rejected based on any of the following:

(i) The wall thickness is less than the design minimum wall thickness for the area described in the standardization section herein, paragraph 7.d.

(ii) If any of the flaws such as the isolated pit, circumferential line corrosion or longitudinal sidewall crack (LSC) which meet the rejection criteria and produce a signal with an amplitude which crosses the reference threshold set in the standardization section (paragraph 7.d.).

(2) EE and Enhanced Visual Examination Acceptance/Rejection Criteria of the Neck Crack (Sustain Load Crack).

(i) EE Reject Criteria - One-quarter screen height indications on two consecutive revolutions of the probe at approximately the same bore location are cause for visual follow up inspection for final disposition.

(ii) Enhanced Visual Examination/Verification - Enhanced visual inspection shall be performed before and after eddy current examination or when required by eddy current examination. The inspection is performed with the use of supplemental tools, which typically include an inspection light and mirror. The light is a high intensity type and the mirror a ½ inch diameter 2X dental mirror.

(A) Visual Examination Reject Criteria

(1) Neck Cracks. Cylinders with neck cracks must be condemned. Repair of neck cracks is not allowed.

(2) Folds. Condemn all cylinders with folds that enter into more than one continuous full neck thread.

(3) Valleys. Cylinders with one or more valleys are acceptable for use, provided the valley(s) does not enter into the minimum number of required threads. Seven full threads for tapered threads and six full threads for straight threads.

(4) Threads. Cylinders must be condemned if seven continuous full threads for tapered threads or six continuous full threads for straight threads are not present. A thread shall be considered full if its root and crest display no significant visual difference to that of the uppermost cylinder

thread. Threads that do not meet this criteria are considered to be incomplete or a partial thread.

(5) Tool Stop Mark. A neck with a tool stop mark is to be distinguished from a crack. Cylinders with tool stop marks are acceptable for use.

g. Rejected cylinders. When a cylinder is rejected, the retester must stamp a series of X's over the DOT specification number and marked service pressure, or stamp "CONDEMNED" on the shoulder, top head, or neck using a steel stamp, and must notify the cylinder owner, in writing, that the cylinder is rejected and may not be filled with hazardous material for transportation in commerce.

(1) Alternatively, at the direction of the owner, the retester may render the cylinder incapable of holding pressure.

(2) If a condemned cylinder contains hazardous materials and the testing facility does not have the capability of safely removing the hazardous material, the retester must stamp the cylinder "CONDEMNED" and affix conspicuous labels on the cylinder(s) stating: "UE REJECTED DOT-E 12966. RETURNING TO ORIGIN FOR PROPER DISPOSITION". The retester may only offer the condemned cylinders for transportation by a motor vehicle operated by a private carrier to a facility, identified to, and acknowledged in writing with OHMEA, that is capable of safely removing the hazardous material. A current copy of this exemption must accompany each shipment of condemned cylinders transported for the disposal of hazardous material.

h. Marking. Each cylinder passing retests under the provisions of this exemption must be marked as prescribed in § 180.213. In addition, each cylinder must be marked UE/EE, in characters not less than 1/4 high for a cylinder with a diameter equal to or greater than 4 inches and 1/8" for a cylinder with a diameter less than 4 inches. The marking must be at a location close to the retester's marking.

i. Report. A report must be generated for each cylinder that is examined. The UE, EE and visual examination report must include the following:

(1) UE and EE equipments, model and serial number
(2) UE Transducer specification, size, frequency and manufacturer
(3) Specification of each standard reference used to performed UE and EE. UE Standard reference must be identified by serial number or other stamped identification marking.
(4) Cylinder serial no. and type
(5) UE technicians' name and certification level
(6) Examination Date.
(7) Location and type of each defect on the cylinder sidewall and in the threaded neck (e.g. longitudinal line corrosion 5 inches from base).
(8) Dimensions (area, depth and remaining wall thickness, crack length & Depth) and brief description of each defect.
(9) Acceptance/rejection results.
(10) The report must be on file at the test site and made available to a DOT official when requested.

j. Personnel Qualification: Each person who performs retesting, and evaluates and certifies retest results must meet the following qualification requirements:

(1) Project Manager/Director of Product Technology- is the senior manager of SCC responsible for compliance with DOT regulations including this exemption.

(2) The personnel responsible for performing cylinder retesting under this exemption must be qualified to an appropriate Ultrasonic Testing Certification Level(Level I, II or III) in accordance with the American Society for Nondestructive Testing (ASNT) Recommended Practice SNT-TC-1A depending upon the assigned responsibility as described below:

(i) System startup and calibration must be performed by a Level II operator. A Level II operator may review and certify test results when a written acceptance and rejection criteria for cylinders has been provided by a Senior Review Technologist. Based upon written criteria, the Level II Operator may authorize cylinders that pass the retest to be marked in accordance with paragraph 7.h. of this exemption. However, a person with Level I certification may perform a system startup, check calibration, and perform ultrasonic testing under the direct guidance and supervision of a Senior Review Technologist or a Level II Operator, either of whom must be

physically present at the test site so as to be able to observe testing conducted under this exemption.

(ii) Senior Review Technologist (SRT) - is a person who reviews overall test results, provides supervisory training and technical guidance to Operators, and reviews and verifies the retest results. A SRT must have a Level III Certification in UE, and a thorough understanding of the DOT Regulations (49 CFR) pertaining to the re-qualification and reuse of the DOT cylinders authorized under this exemption. The SRT must prepare and submit the reports required in paragraphs 7.i. and annually verify that the UE program is being operated in accordance with the requirements of this exemption.

k. OPERATIONAL CONTROLS.

(1) No person may perform inspection and testing of cylinders subject to this exemption unless:

(i) that person is an employee or agent of SCC and has a current copy of this exemption at the location of such inspection and testing, and

(ii) complies with all the terms and conditions of this exemption.

(2) The marking of the retester's symbol on the cylinders certifies compliance with all of the terms and conditions of this exemption.

(3) Each facility approved by OHMEA to test cylinders under the terms of this exemption must have a resident operator with at least a Level II Certification in UT.

8. SPECIAL PROVISIONS:

a. During the initial use of the exemption, the total number of cylinders retested under this exemption must be reported to OHMEA on an annual basis. The reports must be summarized to two tables which include a list of all the passed and failed cylinders under this exemption. One copy of the summarized reports must be submitted on CD or diskette in a word processing format compatible with Word Perfect, Microsoft Word or Microsoft Excel.

(1) The table for the passed cylinders must include:

(i) UE Date

(ii) Cylinder type (e.g. DOT 3AL 2016)

(iii) Cylinder serial Number

(iv) The Standard reference number used to standardize the UE.

(2) The table for the failed cylinders must include:

(i) UE Date

(ii) Cylinder type

(iii) Cylinder serial number

(iv) The Standard reference number used to standardize the UE.

(v) Types of defects (Area Corrosion, Isolated Pit, Longitudinal Line Corrosion, circumferential Line Corrosion or other type such as dent, etc.)

(vi) Location of the defect (e.g. longitudinal line corrosion 5 inches from base)

(vii) Dimensions (e.g. for area corrosion, larger than 0.70 in^2 or for isolated pit deeper than $1/3t_m$.

(3) SCC must submit to DOT an evaluation of the effectiveness of the ultrasonic and eddy current examination program authorized by this exemption as part of any request to renew the exemption submitted in accordance with § 107.109.

b. Offerors may use the cylinders specified and tested in accordance with the provisions of this exemption for the transportation in commerce of those hazardous materials specified herein, provided no modifications or changes are made to the cylinders, and all terms of this exemption are complied with.

c. Shippers using the cylinders covered by this exemption must comply with the provisions of this exemption, and all other applicable requirements contained in 49 CFR Parts 100-180.

d. Transportation of Division 2.1 (flammable gases) and Division 2.3 (gases which are poisonous by inhalation) are not authorized aboard cargo vessel or aircraft unless specifically authorized in the Hazardous Materials Table (§ 172.101).

e. Transportation of oxygen is only authorized by aircraft when in accordance with § 172.102(c)(2) Special Provision A52 and §§ 175.85(h) and (i).

9. MODES OF TRANSPORTATION AUTHORIZED: Motor vehicle, rail freight, cargo vessel, cargo aircraft only and passenger-carrying aircraft, as currently authorized by the regulations for the hazardous materials being transported.

10. MODAL REQUIREMENTS: See paragraphs 8.d. and 8.e. for restrictions.

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, 49 CFR 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 this exemption has expired or is otherwise no longer in effect.

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 inform the AAHMS, in writing, of any incident involving the package and shipments made under the terms of this exemption.

Issued in Washington, D.C.:

OCT 30 2002
(DATE)

Robert A. McGuire
Associate Administrator for
Hazardous Materials Safety

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.

Copies of this exemption may be obtained by accessing the Hazardous Materials Safety Homepage at http://hazmat.dot.gov/exemptions Photo reproductions and legible reductions of this exemption are permitted. Any alteration of this exemption is prohibited.

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