



U.S. Department
of Transportation

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

APR 16 2004

Research and
Special Programs
Administration

DOT-E 12022
(FIFTH REVISION)

EXPIRATION DATE: March 31, 2006

(FOR RENEWAL, SEE 49 CFR § 107.109)

1. GRANTEE: Taylor-Wharton
Harsco Gas and Fluid Control Group
(Former Grantee: Taylor-Wharton Gas Equipment
Division)
Harrisburg, PA

2. PURPOSE AND LIMITATION:
 - a. This exemption authorizes the use of certain DOT Specification 3AA and 3BN cylinders and cylinders manufactured under DOT-E 9421, DOT-E 9706, DOT-E 9909, and DOT-E 10047 for transportation in commerce of the compressed gases described in paragraph 6. The cylinders are retested by 100 percent ultrasonic examination as described in paragraph 7 in lieu of the internal visual and the hydrostatic retest required in § 180.205. This exemption provides no relief from the Hazardous Material 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.

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

4. REGULATIONS FROM WHICH EXEMPTED: 49 CFR §§ 180.205 and 173.302a(b) in that ultrasonic examination is performed in lieu of the specified hydrostatic pressure test and internal visual inspection. 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 Taylor-Wharton dated February 17, 2004, submitted in accordance with § 107.109.
6. HAZARDOUS MATERIALS (49 CFR § 172.101):

Proper Shipping Name/ Hazardous Materials Description	Hazard Class/ Division	Identifi- cation number	Packing Group
The appropriate proper shipping name listed in § 172.101/Liquefied or nonliquefied compressed gases, or mixtures of such compressed gases which are authorized in the Hazardous Materials Regulations for transportation in DOT 3AA, 3BN cylinders and those commodities authorized under DOT-E 9421, DOT-E 9706, DOT-E 9909 and DOT-E 10047.	2.1, 2.2 or 2.3 as applicable	As listed in § 172.101 for specific compressed gas or gas mixture.	N/A

7. SAFETY CONTROL MEASURES:

a. Packaging. Packagings prescribed are DOT Specification 3AA, and 3BN cylinders or a cylinders made under DOT-E 9421, DOT-E 9706, DOT-E 9909 or DOT-E 10047 that are subjected to periodic retesting, reinspection and marking prescribed in § 173.34(e), except that each cylinder is examined by ultrasonic examination (UE) in lieu of the hydrostatic pressure test and internal visual inspection prescribed in § 173.34(e)(1), (e)(3) and (e)(4). Each cylinder must be retested and marked in accordance with the procedure described herein and Appendices A, B and C of Taylor-Wharton's application on file with the Office of Hazardous Materials Exemptions and Approvals (OHMEA).

b. Ultrasonic equipment and Performance. The ultrasonic equipment performance must conform to Appendices A and B of the Taylor-Wharton application on file with OHMEA and as prescribed in this exemption. The UE equipment incorporates multiple channels contact or 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 inside-wall-to base transition area (SBT)) must be detected. For the multiple channel UE system, the transducers must be arranged so that the ultrasonic beams are focused on a single location in the cylinder wall and all beams exit at the same location. For a single channel immersion UE system, the transducer or cylinder must be arranged so that the ultrasonic beams enter into the cylinder wall in x-y-z directions 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 which is calibrated in accordance with a nationally recognized standard. Search units of 2.25 to 5 MHZ nominal frequency and 1/4" to a 1" diameter must be used during ultrasonic examination. For the multiple channel UE system, the equipment will incorporate continuous automatic monitoring of the transducer to cylinder wall acoustic coupling to assure 100% cylinder wall coverage during the ultrasonic examination. It must be equipped to discern when the ultrasonic data indicates a loss of acoustic coupling between the transducer assembly and the cylinder wall. This safety control measure must be an integral part of the ultrasonic testing procedure. A test must be considered invalid if a Lack-of-Expected-Response (L.E.R.) incident is indicated. An L.E.R. indication of the wall thickness channel in the sidewall-to-base transition (SBT) area will not invalidate the test, as long as one of the longitudinal shear wave channels is transmitting the ultrasonic signals into the SBT area. A manual contact shear or longitudinal search units may be used for evaluating and sizing indicated defects. Manual UE 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.

c. Standard References (Calibration Standards).

- (1) A cylinder or a cylinder section must be used as a standard reference and must be of the same nominal diameter, surface finish and metallurgical condition as the cylinders under the test. Prior to machining for calibration defects and the minimum wall thickness, the

average minimum wall thickness for the calibration cylinder must be determined by means of an independent method. The calibration cylinder must be machined with defects simulating those that occur during service conditions, such as a reduction in wall thickness (area corrosion), isolated pits, line corrosion, sidewall defects (e.g. cracks, folds) and line corrosion in the inside-wall-to base transition area (SBT).

(2) The standard reference (calibration cylinder) must be machined to include the following simulated defects:

- (i) A simulated defect for reduction in wall thickness (area corrosion). Area corrosion must be 0.25 square inch (in^2) and less than or equal $1/20$ of the design minimum wall thickness (t_m) deep. The remaining wall thickness must conform to the design minimum wall for a cylinder under the test. To achieve the reduction in wall thickness, a minimum of two different thickness steps must be machined in the cylinder wall.
- (ii) A minimum of one simulated defect, a flat bottom hole (FBH), for isolated pits. The FBH for isolated pits must be $1/4$ -inch diameters by $1/4$ of t_m in depth.
- (iii) A minimum of two FBH for line corrosion. Each FBH must be $1/4$ -inch diameter by $1/10$ of t_m in depth. The FBHs for line corrosion must be adjacent to each other.
- (iv) A minimum of one circumferential notch on the inside surface that simulates line corrosion in the SBT area. The circumferential notch for SBT must have a depth of less than or equal to 10 percent of t_m , a width of less than or equal to 0.020-inch, and a length of 1-inch.
- (v) A minimum of one longitudinal (axial) notch on the inside surface for a sidewall flaw such as fatigue or stress corrosion crack. The longitudinal notch for a side wall flaw must have a depth of less than or equal to 6 percent of t_m , a width of less than or equal to 0.020-inch, and a length of 1-inch.

(3) A certification statement signed by a person certified as a Level III operator (in UE) must be available for inspection for each calibrated cylinder at each site where testing is performed. The certification statement must include drawings, dimensions and the location of each simulated defect.

d. UE System Standardization (Calibration). System standardization must be performed using the standard references described in section 7.c. of this exemption. The UE system must be standardized such that any cylinder found with the following defects must be rejected:

(1) In any area larger than 0.25 in², the maximum wall stress exceeds:

73,000 psi for DOT-3AA cylinders;

15,000 psi for DOT-3BN;

103% of the original design wall stress of the cylinder for DOT-E 10047;

94,900 psi for DOT-E 9706 cylinders; or

107,100 psi for DOT-E 9909 and E-9421 cylinders

When calculated from the following formula:

$$S = P(1.3D^2 + 0.4d^2) / (D^2 - d^2)$$

where:

S = wall stress in pounds per square inch;

P = minimum test pressure in pounds per square inch;

D = outside diameter in inches;

d = D-2t, where t=minimum wall thickness determined by ultrasonic testing, in inches.

(2) An isolated pit that is deeper than 1/4 of the design minimum wall thickness (t_m) and larger than 1/4-inch in diameter. A FBH stimulating an isolated pit must be detected by the shear wave channels and a minimum of two flaw gates must be set during standardization (calibration).

(3) Line corrosion is deeper than 10 percent of the design t_m and longer than 1/4-inch in length (the

length is measured from center to center of two adjacent corrosion pits).

(4) A circumferential defect in the SBT deeper than 10 percent of the t_m and longer than 1-inch. A notch simulating the SBT must be detected by an axial shear wave channel and a flaw gate must be set during standardization.

(5) A longitudinal (axial) sidewall flaw deeper than 6 percent of the t_m and longer than 1-inch. A notch simulating an axial side wall flaw must be detected by the circumferential shear wave channels and a minimum of two flaw gates must be set during standardization.

e. Test Procedures.

(1) A written test procedure for performing ultrasonic examination of cylinders under the terms of this exemption must be at each facility performing ultrasonic examination. At a minimum, this procedure must:

(i) Include a description of the test set-up; test parameters; transducer model number, frequency, and size; transducer assembly; couplant used; system standardization method and threshold gain used during the test; and other pertinent information such as additional gain used during the ultrasonic examination to confirm the defects.

(ii) Require restandardization of the test equipment when ultrasonic examination of 200 cylinders has been completed, or a time period of more than 4 hours has elapsed since equipment standardization, whichever occurs first. The equipment must be recalibrated in accordance with the requirements of paragraph 7.d. of this exemption.

(iii) Be made available to a DOT official when requested. Any change to the written procedure must be submitted to OHMEA as soon as practicable.

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

(3) The Rotational speed of a standard reference cylinder must be such that all artificial defects are adequately detected, measured and recorded.

(4) 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.

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

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

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

(1) Wall thickness less than the design minimum wall thickness for the area described herein, paragraph 7.d.(1).

(2) An isolated pit equal to or greater than that described in paragraphs 7.d.(2).

(3) Line corrosion equal to or greater than that described in paragraph 7.d.(3).

(4) A circumferential defect in the SBT equal to or greater than that described in paragraph 7.d.(4).

(5) A longitudinal sidewall defect equal to or greater than that described in paragraph 7.d.(5).

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: "UT REJECTED DOT-E 12022. 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(d). In addition, each cylinder must be marked UE, in characters not less than 1/4 high at a location close to the retester's marking.

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

- (1) UE equipment, model and serial number
- (2) Transducer specification, size, frequency and manufacturer
- (3) Specification of each standard reference used to complete UE
- (4) Cylinder serial no. and type
- (5) UE technicians' name and certification level
- (6) Date of the UE
- (7) All recorded defects (pitting, corrosion, etc.)
- (8) Brief description of the UE acceptance/rejection result
- (9) The UE report must be on file at the test site, and made available to a DOT official when requested.

j. A cylinder that has been exposed to fire or to excessive heat (temperatures of 1000 °F or greater) must not be retested under the terms of this exemption.

k. 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 Taylor-Wharton 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.

8. SPECIAL PROVISIONS:

- a. During the initial use of the exemption, the test data, results, and additional technical information deemed pertinent in successful application of the retest procedure must be reported to OHMEA. The purpose of this information is to determine whether certain testing procedures and criteria require modification. In particular, special attention should be paid to evaluating and compiling information on any cylinders rejected by the ultrasonic testing procedure. For any rejected cylinder, the defect causing the rejection must be fully characterized and profiled. That is, the specific type of defect should be identified (i.e. crack, pit, general corrosion, etc.) and the specific size of the defect should be determined (i.e. length, depth, width, area, etc.). The cylinder type, size, minimum design wall thickness, age, etc. of the rejected cylinder must be reported. The ultrasonic signal profile should be reported for any defect causing the cylinder to be rejected. These results must be summarized and reported to DOT on an annual basis. Taylor-Wharton must submit to DOT an evaluation of the effectiveness of the ultrasonic testing program authorized by this exemption as part of any request to renew the exemption submitted in accordance with § 107.109.
- b. In addition, the total number of cylinders tested under this exemption must be reported by type (i.e. DOT-3AA, 3BN, DOT-E 9421, DOT-E 9706, DOT-E 9909, DOT-E 10047) and age. The number of cylinders rejected and the total number of cylinders tested in each lot inspected under the provision of this exemption must be reported by cylinder type and age. These results must be summarized and reported to DOT on an annual basis.
- c. A cylinder that meets the requirements of this exemption and the introductory text and paragraph (1) of § 173.302a(b) may be marked with a plus sign (+) following the test date marking on the cylinder.
- d. A person who is not a holder of this exemption who 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 reoffered for transportation in conformance with this exemption and the HMR.
- e. No person may perform UE of cylinders subject to this exemption unless that person (1) is an employee or agent of

Taylor-Wharton and has a current copy of this exemption at the location of such inspection and testing, and (2) complies with all the terms and conditions of this exemption and (3) complies with all the terms and conditions of an approval required for retesting cylinders. The marking on the cylinders of the retester's registration identification number (RIN) issued in the approval authorization certifies compliance with all the terms and conditions of this exemption.

f. This exemption authorizes the DOT Specification 3BN to be retested only by full immersion UE system described in paragraph 7.b. of this exemption.

g. Each facility approved by the Department to test cylinders under the terms of this exemption must have a resident operator with at least a Level II certification.

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

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

j. Transportation of oxygen by aircraft is only authorized 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, passenger-carrying aircraft, and cargo-aircraft only (see restrictions in paragraphs 8.i and 8.j).
10. MODAL REQUIREMENTS: No additional requirements other than those required in the HMR.
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:
 - o All terms and conditions prescribed in this exemption and the Hazardous Materials Regulations, 49 CFR Parts 171-180.

- o Persons operating under the terms of this exemption 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 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 also inform the AAHMS, in writing, as soon as practicable of any incidents involving the package and shipments made under this exemption.

Issued in Washington, D.C.:



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Robert A. McGuire
Associate Administrator for
Hazardous Materials Safety

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(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.

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

PO: MMT/dl