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

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

SEP 5 2001

DOT-E 10869
(EIGHTH REVISION)

EXPIRATION DATE: December 31, 2002

(FOR RENEWAL, SEE 49 CFR § 107.109)

1. GRANTEE: Norris Cylinder Company
Longview, TX

2. PURPOSE AND LIMITATIONS:

a. This exemption authorizes the manufacture, marking, sale and use of a non-DOT specification cylinder which is constructed in conformance with all regulations applicable to a DOT specification 3AA 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. The safety analyses did not consider the hazards and risks associated with other uses not associated with transportation in commerce.

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

4. REGULATIONS FROM WHICH EXEMPTED: 49 CFR §§ 173.301(b), 173.302(a)(5), 173.304(a) and 175.3 in that non-DOT specification cylinders are not authorized except as specified herein.

5. BASIS: This exemption is based on the application of Norris Cylinder Company dated November 10, 2000, and supplemental information dated January 19, 2001, and July 25, 2001, submitted in accordance with § 107.105 and the public proceeding thereon.

6. HAZARDOUS MATERIALS (49 CFR § 172.101):

Proper Shipping Name/ Hazardous Material Description	Hazard Class/ Division	Identi-fication Number	Packing Group
Nonliquefied compressed gases, or mixtures which are authorized in DOT 3AA specification cylinders*	2.1, 2.2 or 2.3	As appro-priate	N/A

* The following materials may not be shipped under the terms of this exemption:

(a) Hydrogen, compressed natural gas, hydrogen sulphide, and carbon monoxide;

(b) Any gas mixture containing free sulphide, or hydrogen, or compressed natural gas;

(c) Any gas mixture containing more than 10% carbon monoxide;

(d) Any gas mixture containing carbon monoxide and having a dew point higher than minus 52°F at one atmosphere;

(e) Any gas or mixture of gases which does not remain in gaseous state when contained in the cylinder at 70°F and rated filling pressure; and

(f) Any mixture of gases, the quantity of one or more of which is capable of combining chemically with other gases in such a mixture; or can cause cylinder material degradation by corrosion, stress corrosion, embrittlement, or enhanced fatigue crack growth.

7. SAFETY CONTROL MEASURES:

a. PACKAGING - Packaging prescribed is a non-DOT specification steel cylinder made in accordance with Norris Cylinder Company's drawings Nos. 901B-B-9156 Rev.04, 901B-9170 Rev.03, 901A-A-9560 Rev.00, 901A-A-9562 Rev.00 and information as to material selection, design, and performance described in the application and additional information thereto on file with the Office of Hazardous Materials Exemption and Approvals (OHMEA). The cylinders must be in conformance with DOT-3AA specification (§§ 178.35 and 178.37) except as follows:

§ 178.35(c) *Duties of inspector.*

(1) * * *

(2) * * *

(3) * * *

(4) * * *

(5) Verify that material and design qualification tests prescribed in § 178.37(d) of this exemption have been performed with satisfactory results.

(6) Lot definition. In this exemption, a "lot" means a group of cylinders 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.

(vi) The lot size may not exceed 200 cylinders, but any cylinder processed for use in the required destructive testing need not be counted as being one of the 200.

§ 178.35(e) *Safety Devices.*

Safety devices and protection for valves and pressure relief devices must be as required or authorized by the appropriate specification, and as required in §§ 173.34(d) and 173.301(g). Pressure relief devices must be in compliance with § 173.302(c)(1), except as follows:

(1) Cylinders charged with gas mixtures containing any gas classed as Division 2.3 Hazard Zone A or Hazard Zone B shall not be equipped with any pressure relief device.

(2) Cylinders charged with gas mixtures that do not contain a hazardous material classed as Division 2.3, may be equipped with a combination rupture disk and fusible plug pressure relief device in compliance with CGA Pamphlet S-1.1.

§ 178.35(f) *Markings.*

(1) * * *

(i) "DOT-E 10869" in lieu of "DOT-3AA" followed by the service pressure. Test pressure to be marked near or following service pressure as "TP" followed by test pressure.

(ii) * * *

(iii) * * *

(iv) (Add) Rejection elastic expansion (REE) in cubic centimeters (CC) near the date of test.

§ 178.35(h) *Report retention.*

Reports of the results of tests required by this exemption must be retained by the manufacturer indefinitely as long as the cylinders manufactured under this exemption are authorized, and must be made available to an authorized DOT representative upon request.

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

(1) Seamless, 120 pounds maximum water capacity, 0.260 inch minimum wall thickness and a service pressure not to exceed 5,000 psig.

(2) Not applicable.

§ 178.37(b) *Authorized steel.*

Basic oxygen or electric furnace steel of uniform quality is authorized. The steel analysis must be in conformance with the following:

CHEMICAL COMPOSITION IN WEIGHT PERCENT

Element	Ladle analyses	Check analyses Tolerance	
		Under	Over
Carbon	.32/.36	0.01	0.02
Manganese	.40/.60	0.03	0.03
Phosphorus	.015 Max.	-	0.01
Sulfur	.008 Max.	-	0.00
Silicon	.15/.35	0.02	0.02
Chromium	.80/1.10	.03	0.03
Molybdenum	.55/.70	0.03	0.03
Aluminum	.01/.05	0.00	0.00
Calcium	Trace	----	----

Note 1: Steel shall be treated with calcium to provide inclusion shape control. The steel manufacturer must certify that the steel was calcium treated.

§ 178.37(d) *Manufacture.*

(Add) (1) Metal removal for any purpose other than removal of isolated defects and threading must be done prior to the hydrostatic test. The thickness of treated areas must be measured and may not be less than the minimum prescribed thickness.

(2) Each cylinder must be of seamless construction manufactured by the backward extrusion method with integrally formed heads and bottoms.

(3) The thickness at the bottom of the cylinder may not be less than two times the minimum wall thickness of the cylindrical shell; such bottom thickness to be measured within an area bounded by a line representing the points of contact between the cylinder and floor when the cylinder is in a vertical position.

(4) Shape and thickness of the cylinder bottom and sidewall adjacent to the bottom must be such that failure during the cyclic pressure test occurs in the sidewall of the cylinder.

(5) The design authorized herein must be qualified for production by subjecting at least three prototype samples to pressure cycling tests and burst test as follows:

(i) Cycle test: The cycle test must be performed on completed cylinders after hydrostatic test by subjecting the cylinder to successive hydrostatic pressurization from a lower cyclic pressure to an upper cyclic pressure at a rate not to exceed 10 cycles per minute. Adequate recording instrumentation shall be provided if equipment is to be left unattended for any period of time. The lower cyclic pressure may not exceed 10 percent of the upper cyclic pressure. The upper cyclic pressure must be at least equal to the minimum prescribed test pressure.

(ii) Burst pressure test: The burst pressure test must be performed on the completed cylinder by hydrostatically pressurizing the cylinder to destruction. Rate of pressurization may not exceed 200 psi per second.

(6) Ultrasonic Examination:

Each cylinder produced under the terms of this exemption shall be examined after heat treatment by a shear wave ultrasonic equipment which has been calibrated to give an indication greater than the equivalent of a 5% of wall thickness by 1" long notch. Procedures must be in accordance with ASTM E213-86 (re-approved in 1990) including supplementary requirements. When immersion method is used, the method must conform to the ASTM Standard E-214-68 (reapproved in 1991). Ultrasonic test results must be recorded by individual cylinder serial number and maintained as long as the cylinder is in service.

§ 178.37(e) *Welding or brazing.*

Welding or brazing is prohibited.

§ 178.37(f) *Wall thickness.*

(1) The minimum wall thickness must be such that the wall stress at the minimum prescribed test pressure does not exceed 67 percent of the minimum tensile strength of the steel as determined by the mechanical tests required in §§ 178.37(k) and 178.37(l). A wall stress of more than 104,000 psi is not permitted. The wall thickness may not be less than 0.260 inch.

(2) Does not apply.

(3) Applies except P, the minimum prescribed test pressure, must be at least 3/2 times the service pressure.

§ 178.37(g) *Heat Treatment.*

The completed cylinders must be uniformly and properly heat treated prior to tests. Heat treatment of cylinders shall be as follows:

(1) The furnace must be equipped with instrumentation capable of continuously recording thermocouple readings determining cylinder temperature in both the austenitizing and tempering sections at the beginning and end of each soak zone. The furnace shall have fault controls providing uniform temperature in each control zone and proper function of the feed mechanism.

(2) Each cylinder must be heated and held above the upper critical temperature (Ac_3) for at least one hour per inch of thickness based on the maximum thickness of the cylinder and then quenched in a suitable liquid medium having a cooling rate not in excess of 80 percent of water. The steel temperature on quenching must be above the Ac_3 temperature, but not higher than 1700°F.

(3) After quenching, each cylinder must be reheated to a tempering temperature below the transformation range but not less than 1,100°F, and must be held at this temperature for at least one hour per inch of thickness based on the maximum thickness of the cylinder. Each cylinder must then be air cooled.

§ 178.37(h) *Openings.*

(1) Openings are permitted in the cylinder head only.

(2) All openings must be threaded. Threads must be in compliance with the following:

(i) Each thread must be clean cut, even, without checks, and to gauge.

(ii) Taper threads, when used, must be in compliance with one of the following:

(a) American Standard Pipe Thread (NPT) type must be in compliance with the requirements of Federal Standard H-28 (1978), Section 7.

(b) National Gas Taper Thread (NGT) type must be in compliance with the requirements of Federal Standard H-28 (1978), Sections 7 and 9.

(c) Other taper threads conforming with other standards may be used provided the length is not less than that specified for NPT threads.

(iii) Straight threads when used must be in compliance with one of the following:

(a) National Gas Straight Thread (NGS) type must be in compliance with the requirements of Federal Standard H-28 (1978), Sections 7 and 9.

(b) Unified Thread (UN) type must be in compliance with the requirements of Federal Standard H-28 (1978), Section 2.

(c) Controlled Radius Root Thread (UNJ) type must be in compliance with the requirements of Federal Standard H-28 (1978), Section 4.

(d) Other straight threads in compliance with other recognized standards may be used provided that the requirements of paragraph (iv) below are met.

(iv) All straight threads must have at least 6 engaged threads, a leak tight fit, and a factor of safety in shear of at least 10 at the test pressure of the cylinder. Shear stress must be calculated by using the appropriate thread shear area in accordance with Federal Standard H-28(1978), Appendix A5, Section 3.

§ 178.37(i) *Hydrostatic test.*

Applies except that water jacket method only is authorized and each cylinder must be tested to at least 3/2 times service pressure. In, addition, a rejection elastic expansion (REE) limit must be developed as specified in CGA pamphlet C-5. If the elastic expansion of any cylinder at test pressure exceeds the limit so developed, that cylinder must be rejected.

§ 178.37(j) *Flattening and ductility tests.*

(1) Flattening test: Between knife edges, wedge shaped, 60 degree angle, rounded to 1/2 inch radius; test 1 cylinder taken at random out of each lot of 200 or less cylinders. Longitudinal axis of the cylinder must be at approximately a 90-degree angle to knife edges.

(2) Impact tests:

(i) Three Charpy impact specimens must be prepared from one cylinder taken from each lot after heat treatment, and tested at minus 60°F (minus 50°C) or colder. When the cylinders in a lot are made from different heats of steel, the test cylinder from one of the heats in that lot may represent all the heats, provided all other heats in that lot were previously qualified. New impact tests are required for each 200 cylinders consecutively produced form any one heat.

(ii) Each impact specimen must be Charpy V-notch type of size 10mm X 4mm or 10mm X 5mm taken in accordance with ASTM Standard A370-92.

(iii) Each specimen must be taken from the sidewall of the cylinder. The longitudinal axis of the specimen must be at 90 degrees to the longitudinal axis of the cylinder.

(3) Hardness measurement: A hardness measurement must be performed on the cylindrical section of each cylinder after heat treatment in accordance with ASTM Standard A-370. At a minimum, one reading must be taken in the cylindrical reaction and one reading at about 1.5 inches from the bottom of the cylinders. The results must be recorded.

(4) Flawed cylinder pressure test: One cylinder must be selected from each heat of steel and subjected to a preflawed cylinder burst test. A sharp part through longitudinal flaw must be introduced into the test cylinder by a means that will not affect the metallurgical properties of the cylinder. The flaw must be at least 2.2 inches long and have a depth that will cause the cylinder to fail when pressurized to not less than 110 percent and not more than 125 percent of the stress at service pressure. The cylinder must be hydrostatically pressurized to failure at a rate not in excess of 200 psi per second.

§ 178.37(l) *Acceptable results of tests and inspections.*

(1) Physical Test:

(i) Tensile strength at least 155,000 psi and not more than 175,000 psi.

(ii) Elongation at least 12 percent for gauge length 2 inches with width not over 1-1/2 inches.

(2) Flattening test: Flattening required without cracking to 10 times wall thickness. Maximum degree of flattening attained without cracking must be entered on the inspector's report.

(3) Impact test: The Charpy V-notch impact properties for the three impact specimens which must be tested at minus 60°F (minus 50°C) or colder may not be less than the values shown below:

Size (mm)	Avg. value for acceptance 3 specimens	Min. value 1 specimen only of the three
10 x 5 or 10 x 4	13.0 ft. lbs	10.0 ft. lbs

(4) Hardness measurement: The tensile strength equivalent of the hardness number obtained may not be more than Rc 40 (Brinell 371). When the result of a hardness test exceeds the maximum permitted, two or more retests may be made; however, the hardness number obtained in each retest may not exceed the maximum permitted.

(5) Flawed cylinder pressure test: The failure must be by leakage without crack extension, or by plastic fracture with visible evidence of bulging.

(6) Ultrasonic examination: Any cylinder having a discontinuity greater than the equivalent of 5 percent of wall thickness by 1 inch long notch must be rejected. Any cylinder with rejectable ID indication shall be scrapped and destroyed.

(7) Cycle test: Cylinders subjected to design qualification cycle tests prescribed in § 178.37(d)(v) in this exemption must withstand at least 10,000 cyclic pressurization without distortion or failure. At lest one cylinder must be cycled using water as the pressurizing medium.

(8) Burst tests: Cylinders subjected to design qualification tests must withstand a pressure of at least 2.25 times the service pressure without failure. Failure must initiate in the sidewall in a longitudinal direction, and the cylinder must remain in one piece.

§ 178.37(m) *Leakage test.*

Not Applicable.

§ 178.37(n) *Rejected cylinders.*

If any lot in an already accepted heat fails any of the qualification tests as prescribed in §§ 178.37(d), 178.37(i) and 178.37(j) of this exemption, that lot may be subjected to reheat treatment. Acceptable results are prescribed in § 178.37(l) of this exemption. Any lot subjected to reheat treatment is considered as equivalent to a new lot and therefore must pass all prescribed tests.

(1) Lot requalification:

(i) The reheat treatment procedure shall be in accordance with that prescribed in § 178.37(g) of this exemption.

(ii) The lot is identified in the heat treatment records appropriately indicating repeated heat treatment.

(iii) Metal removal for any purpose is not permitted, except as provided in § 178.37(d)(1) of this exemption.

b. TESTING -

(1) Fracture toughness (K_{IC} or J_{IC}) test for each heat of material: At least two fracture toughness specimens taken from one completed cylinder in each heat of steel must be tested for K_{IC} values. The valid K_{IC} data may be obtained via the J-integral test method prescribed in ASTM Standard E813-89. The specimens shall be so tested at room temperature in the T-L orientation as defined in ASTM Standard E399-90. The specimens must be prepared only from material removed from the cylindrical portion of the cylinder. Flattening of the material without heating is allowed for preparing the test specimens. The K_{IC} value, directly measured or derived from the measured J_{IC} values must be at least 85 KSI $(in)^{1/2}$. The test need not be witnessed by the Inspector. The test records must be maintained by the manufacturer for a period not less than 5 years.

(2) Each cylinder must be reinspected and hydrostatically retested every five years in accordance with § 173.34(e), as prescribed for DOT 3AA Specification cylinders except that the test pressure is 3/2 times the service pressure. Each cylinder passing retest must be marked in accordance with § 173.34(e)(6) as prescribed for DOT 3AA Specification cylinders.

c. OPERATIONAL CONTROL -

(1) Cylinders manufactured under the authority of this exemption may not be used for transportation of gases or gas mixtures that would cause hydrogen embrittlement.

(2) Filling limits specified in § 173.302(c) are not authorized. Under no circumstances are these cylinders to be filled to a pressure exceeding the marked service pressure at 70°F.

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. Reheat treatment or repair of rejected cylinders is not authorized. When a hydrostatic retest is repeated as provided for in § 173.34(e)(3), only two such retests are permitted. Cylinders, requalified after having been subjected to the actions of fire, must be reported to the OHMEA prior to shipment.

g. 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).

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

i. The number of tests prescribed in this exemption is well in excess of those prescribed for DOT specification cylinders. These tests are intended to accumulate a comprehensive array of test results to serve as a basis for developing the most appropriate test regimen for the cylinders manufactured under this exemption. Acceptability of the above cylinders is determined primarily on obtaining satisfactory results from the many standard tests included therein. Evaluation at a future date of the test results from production lots may indicate a need for revision to the currently imposed tests.

9. MODES OF TRANSPORTATION AUTHORIZED: Motor vehicle, rail freight, cargo vessel, cargo aircraft only, and passenger-carrying aircraft (see paragraphs (g) and (h) for restriction).

10. MODAL REQUIREMENTS: A current copy of this exemption must be carried aboard each cargo vessel and aircraft used to transport packages covered by this exemption. The shipper shall 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.

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.

SEP 5 2001
(DATE)

for 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.

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.

PO: M Toughiry/KFW