



Department of the Air Force
HQ AEDC (AFMC)
Arnold AFB, TN 37389

Safety, Health, and Environmental Standard

Title: COMPRESSED GAS CYLINDERS
Standard No.: D4
Effective Date: 05/24/2010

The provisions and requirements of this standard are mandatory for use by all AEDC personnel engaged in work tasks necessary to fulfill the AEDC mission. Please contact your safety, industrial health and/or environmental representative for clarification or questions regarding this standard.

Approved:

Contractor/ATA Director
Safety and Health Group

Air Force Functional Chief



Safety, Health, and Environmental Standard

COMPRESSED GAS CYLINDERS

1.0 INTRODUCTION/SCOPE/APPLICABILITY

1.1 Introduction. Compressed gas cylinders are identified inspected, tested, handled, and stored in accordance with this standard (Annex A gives specifics).

1.2 Scope. When there are any conflicts noted between this standard and industry or national codes, standards or regulatory requirements, the operating contractor shall notify the government.

1.3 Applicability. This standard applies to all personnel at AEDC. Self-contained breathing apparatus bottles are exempt from the requirements of this standard.

2.0 BASIC HAZARDS/HUMAN FACTORS

Failures of compressed gas cylinders may expose personnel to high pressure gas discharges, asphyxiating or toxic gases, and impacts from cylinder fragments, or even the cylinder itself, which may be propelled like a rocket.

3.0 DEFINITIONS

Compressed Gas Cylinder -- A tube, bottle, or other type of pressure container manufactured according to U.S. Department of Transportation (DOT) or Interstate Commerce Commission (ICC) specifications, is larger than 3 inches in diameter by 6 inches in length, and is used to store liquids or gases under pressure.

Hydrostatic Test (Hydro-Test) -- A pressure test conducted using water at normally no greater than 1.5 times the maximum allowable working pressure of the vessel or item being tested.

Operating Contractor -- A base contractor directly accountable to the Air Force for the AEDC mission. ATA is the current operating contractor.

Outside Contractor/Subcontractor - An organization employed by a contractor or the Air Force to do construction, maintenance, repair or other work at AEDC. There is no employment relationship, control or supervision of the subcontractor's employees by AEDC contractors. Also referred to as the construction contractor.

Self-Contained Breathing Apparatus (SCBA) -- An apparatus that provides respiratory protection against gases, vapors, particles, and/or an oxygen-deficient atmosphere. SCBAs may be closed circuit (all or a percentage of the exhaled gas is scrubbed and re-breathed), open circuit (all of the exhaled breath is released to the surrounding environment after use instead of being re-circulated), or escape (designed for 5 to 10 minute escape only).

4.0 REQUIREMENTS/RESPONSIBILITIES

4.1 Identification

4.1.1 Compressed gas cylinders must be identified according to Annex B. Vendor-owned cylinders must be clearly identified to indicate the gases they contain, otherwise they will be rejected.

4.1.2 Additional identifying colors are assigned by the Operating Contractor Safety Office as required.

4.2 Inspection and Test

4.2.1 Compressed gas cylinders must be hydrostatically tested and given a visual internal and external inspection per the table in Annex C.

4.2.2 Cylinders may not be recharged after the due date for testing has expired.

- 4.2.3 If removal of a cylinder for testing on the due date presents an undue hardship on the cylinder user, the **Operating Contractor Safety Office** must be contacted to determine the feasibility of leaving the cylinder in service until a more convenient time may be arranged.
- 4.2.4 If the hydrostatic test date on an empty cylinder is within 45 days of being due, the vendor must be requested to perform the hydrostatic testing before filling.
- 4.2.5 Contractors using compressed gas cylinders at AEDC are responsible for:
 - 4.2.5.1 Periodically inspecting cylinders that are permanently installed in a pressure system under their jurisdiction or are infrequently used, to ensure that they are hydrostatically tested per Annexes C and D.
 - 4.2.5.2 Removing permanently installed or infrequently used cylinders from service that are due for testing and sending them to Hazardous Materials for testing. (For exceptions to due dates, see Annexes C and D.)
 - 4.2.5.3 Inspecting cylinders assigned to AEDC to ensure that they are in a safe, usable condition.
 - 4.2.5.4 Inspecting vendor-owned cylinders on receipt to ensure that the vendor decals and color-name designations correspond and are legible.
 - 4.2.5.5 Having cylinders tested per the requirements of Annexes C and D.

4.3 Handling

- 4.3.1 Cylinders must be transported:
 - 4.3.1.1 In an upright position if they contain acetylene; other cylinders should also be transported in an upright position if practicable.
 - 4.3.1.2 With valves closed and protection caps on.
 - 4.3.1.3 Secured to the vehicle to prevent overturning.
 - 4.3.1.4 If distance is short and a hand truck or co-worker is not available, by tilting or rolling on the bottom edge.
NOTE: Never hoist a cylinder with a sling, electric magnet, or by the cap.
- 4.3.2 Do not drop a cylinder, strike it, or permit cylinders to strike each other.
- 4.3.3 Never use a pry-bar under valves or valve protection caps to pry a cylinder loose when frozen to the ground or "stuck" in any other way. Use warm water (not boiling) to free the cylinder when frozen.

4.4 Care in Use

- 4.4.1 Secure the cylinder around the upper part of the body with durable and substantial non-combustible chain or strap to protect it against damage by overturning or by being struck by other objects.
- 4.4.2 Locate the cylinder so that the valve and regulator are easily accessible.
- 4.4.3 Perform a leak test immediately after the cylinder is connected and the system is pressurized. Use the AEDC-stocked, leak-detector solution or other approved mixture for the test.
- 4.4.4 Use cylinders in an upright position where possible. If they contain acetylene, they must be used in an upright position.
- 4.4.5 Keep protective caps installed whenever the cylinder is not connected to a regulator or manifold.
- 4.4.6 Presume that a cylinder is full if its pressure condition is unknown and it is not in an "Empty" rack.
- 4.4.7 The following practices are prohibited:
 - 4.4.7.1 Pressurizing a cylinder above its rated capacity.
 - 4.4.7.2 Using acetylene at a working pressure exceeding 15 psig. At the elevated pressure, it may decompose and cause an explosion.
 - 4.4.7.3 Permitting a cylinder to come in contact with oil, grease, or other readily combustible substances.
 - 4.4.7.4 Striking an arc on a cylinder.

- 4.4.7.5 Putting a cylinder where it may become part of an electric circuit, such as in contact with a radiator, piping system, or layout table that may be used as a ground return circuit for an arc-welding machine.
- 4.4.7.6 Putting a cylinder in an unventilated confined space. (Even though the gas may be nontoxic, it could create a lethal oxygen-deficient atmosphere by displacement of air.)
- 4.4.7.7 Using a cylinder as a roller or for any purpose except what it is designed for.
- 4.4.7.8 Tampering with or altering any safety device on valves or cylinders.
- 4.4.7.9 Using compressed gas to dust clothing.
- 4.4.7.10 Putting hands or any part of the body in a gas stream.
- 4.4.7.11 Refilling a vendor-owned cylinder.
- 4.4.7.12 Interchanging pressure gages, hoses, or other appliances with similar equipment specified for other gases.
- 4.4.7.13 Using a cylinder without a suitable regulator and gage.
- 4.4.7.14 Securing cylinders around the neck or valve.
- 4.4.7.15 Securing cylinders to electrical conduit or pressurized piping.

4.5 Valves, Regulators and Operation

- 4.5.1 Use only regulators with gage scales that make it easy to read the pressure and that permit release of pressure in safe increments.
- 4.5.2 Stand aside when opening a cylinder valve, and open it slowly to prevent a shock-loading effect on gages, regulators, and other equipment.
- 4.5.3 Open the valve one-quarter turn and then close it immediately before connecting the cylinder to a pressure regulator or manifold to clear any foreign matter from the gas passage.
EXCEPTION: This practice is forbidden on hydrogen cylinders, as the hydrogen may self-ignite.
- 4.5.4 Keep the valve fully open when in use, **except for acetylene cylinder valves** that must not be opened more than one and one-half turns and preferably no more than three-fourths of a turn.
- 4.5.5 Do not force cylinder valves that are difficult to operate. Inspect the valve to find the obstruction, such as a wire around the stem from a tag. If the obstruction cannot be removed, take the cylinder out of service and have it repaired.
- 4.5.6 Close the valve when the cylinder is empty or moved or when the work is finished. If it is an oxyacetylene outfit, close the valve and drain the hose.
- 4.5.7 If a wrench or key is used, it should be kept ready for instant use while the cylinder valve is open.
- 4.5.8 Do not repair or alter valves or regulators in the field. Only authorized personnel are permitted to repair regulators. If regulators need repair or replacement, contact the Model Shop.
- 4.5.9 Do not use any type of valve adapter to connect regulators or hoses to cylinders.

4.6 Leaks in Cylinder Valve

- 4.6.1 Try to stop the leak by manually tightening the valve. Do not use wrenches or other leverage producing tools to force the valve closed.
- 4.6.2 If the leak is not stopped by manually closing the valve, the user must remove the cylinder to a safe area and contact the Operating Contractor Safety Office. If the cylinder contains a combustible or toxic gas, the user must call the Operations Center.
- 4.6.3 If the gas is an irritant or is toxic, the operator must wear appropriate respiratory protection when removing the cylinder. Contact Industrial Hygiene for proper respiratory protection.

4.7 Removal from Use or Empty

- 4.7.1 Close the valve, drain the line, disconnect the regulator or manifold, and replace the cylinder cap.

4.7.2 Leave a minimum 25 psig in the cylinder unless it contains acetylene which must be left at 15 psig.

4.8 Mixing Inert or Compatible Gases

4.8.1 The procedure for obtaining mixed gases is as follows:

4.8.1.1 Requestor prepares Synergen Work Order indicating gas composition requested; forwards to Chemical Lab.

4.8.1.2 Requestor selects the cylinder to be used and enters the cylinder serial number on the work order. Arranges for delivery of the cylinder with one copy of the work order to the Chemical Lab.

4.8.1.3 Chemical Lab mixes the gases and identifies the cylinder as specified in the table in Annex B. Chemical Lab logs the cylinder and arranges for delivery.

NOTE: Quantities of chemicals involving partial flammable gases mixed with inert gases must be in cylinders designated for the flammable gas in the cylinder. For example, a mixture of 1% hydrogen, 99% nitrogen must be in a hydrogen cylinder, since it is the flammable component of the mixture, even though only at 1%.

4.8.1.4 When use of the cylinder is completed, the requestor attaches a green DD Form 1577-2, Unserviceable (Repairable) Tag, to it with the proper information, and arranges for delivery of the cylinder to Supply.

4.8.1.5 Supply arranges to have the cylinder purged and cleaned, and to have the identification changed before returning the cylinder to service.

4.9 Storage

4.9.1 Compressed gas cylinders must be stored as follows:

4.9.1.1 In separate storage racks identified as "Full" or "Empty." Compressed gas storage must be further identified as "Oxygen and Inert Gases" or "Acetylene and Other Flammable Gases."

4.9.1.2 If oxygen, isolate from fuel-gas cylinders by a minimum of 20 feet or by a noncombustible barrier at least five-feet high that has a fire-resistance rating of at least one-half hour.

4.9.1.3 If incompatible products, store away from each other

4.9.1.4 If partially used, store in the "Full" rack when not in use and tag it "Partially used _____ psig."

4.9.2 In an upright position.

4.9.3 Secured with durable and substantial non-combustible chain or strap to prevent falling, and with protective caps in place.

4.9.4 Away from excessive heat and areas where they might be damaged or knocked over by passing or falling objects and at least 50 feet from corrosive or highly combustible materials (especially oil or grease).

4.9.5 At a safe distance or well shielded from welding or cutting operations and in a place where they cannot come in contact with electric circuits.

4.9.6 Protected from the weather if stored outdoors.

4.9.7 Smoking is prohibited within 50 feet of compressed gas storage areas; "No Smoking" signs must be posted.

4.9.8 Compressed gas cylinders in quantities beyond reasonable need must not be stored in work areas.

4.9.9 Small oxyacetylene rigs for laboratory use (cylinder sizes DOT-3AA, DOT 8AL) may be stored upright together on their individual racks inside the laboratory as long as cylinder supply valves are closed after use, and lines are drained. Normal precautions listed in 4.9.2 through 4.9.5, and 4.9.7, above must be followed. Cylinder shell and porous filler requalification requirements must be met per Note H of Annex C.

4.9.10 Small propane cylinders (DOT-39 or similar) are considered compressed gas cylinders and must not be stored in flammable cabinets. Propane cylinders are to be stored in outside storage shelters, fire rated storage rooms, or well-ventilated racks protected from the weather and a safe distance from building openings such as exits and windows.

4.9.11 Compressed gas cylinders shall not be stored in flammable storage cabinets regardless of size or content (no exceptions).

4.9.12 Users of compressed gas cylinders must provide a way to secure all cylinders regardless of size, whether in use or in storage.

4.10 Responsibilities

4.10.1 The asset owner/manager is responsible for ensuring that the requirements of this standard are complied with.

4.10.2 The Contractor will implement the requirements contained in this standard.

5.0 TRAINING

N/A

6.0 INSPECTIONS/AUDITS

Refer to Annex C

7.0 REFERENCES

Air Force Occupational Safety and Health Standard

AFOSHSTD 91-10, Civil Engineering

Code of Federal Regulations (CFR), Occupational Safety and Health Administration (OSHA) Standards

OSHA Standard 29 CFR 1910.101 – Compressed Gases

OSHA Standard 29 CFR 1910.253 – Oxygen-Fuel Gas Welding and Cutting

OSHA Standard 29 CFR 1926.350 Welding and Cutting

Code of Federal Regulations (CFR), Department of Transportation (DOT) Standards

DOT Standard 49 CFR Part 172 Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, Training Requirements, and Security Plans

DOT Standard 49 CFR Part 173 Shippers - General Requirements for Shipments and Packagings

Compressed Gas Association (CGA)

CGA C-6 Standards for Visual Inspection of Steel Compressed Gas Cylinders

CGA C-6.3 Guidelines for Visual Inspection and Requalification of Low Pressure Aluminum Compressed Gas Cylinders

CGA C-8 Standard for Requalification of DOT-3HT, CTC-3HT, and TC-3HTM Seamless Steel Cylinders

CGA C-13 Guidelines for Periodic Visual Inspection and Requalification Of Acetylene Cylinders

CGA P-1 Safe Handling of Compressed Gases in Containers

Department of Defense Regulations (DOD R)

DOD 4145.19-R- 1 – Storage and Warehousing Facilities and Service

Department of Transportation/Interstate Commerce Commission Specifications (DOT/ICC Spec)

DOT/ICC Spec. - (From NFPA 58H, Annex C Design, Construction, and Requalification of DOT/ICC Cylinders. See references in Annexes C and D)

Military Standard (MIL-STD)

MIL-STD-101B –Color Code for Pipelines and for Compressed Gas Cylinders

National Fire Protection Association (NFPA) Standard

NFPA 55, Standard for the Storage, Use, and Handling of Compressed and Liquefied Gases in Portable Cylinders, latest edition

8.0 ANNEXES

Annex A, Guidelines for Safe Handling, Use, and Storage of Oxygen and Acetylene Cylinders

Annex B, Required Identification of AEDC Gas Cylinders

Annex C, Retest and Inspection of Cylinders

Annex D, Specification Cylinders

SHE Standard D4 Compressed Gas Cylinders

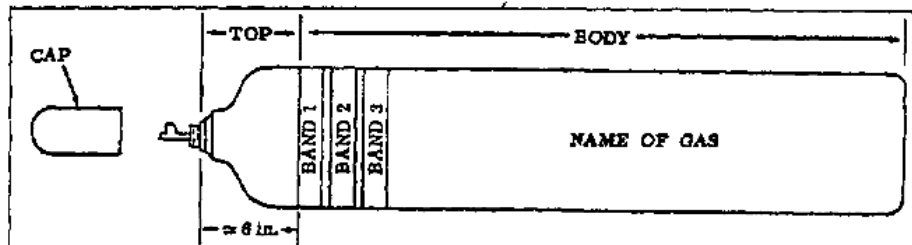
Annex A Guidelines for Safe Handling, Use, and Storage of Oxygen and Acetylene Cylinders

The following guidelines are based on OSHA, NFPA, and Air Force regulations. For a more comprehensive discussion of requirements consult the references.

General Guidelines

1. Store cylinders in definitely assigned places. Make sure the Fire Department is aware of the storage location and approves it.
2. Store cylinders in a well protected, well ventilated, dry location at least 50 feet from highly combustible materials. Do not store cylinders in unventilated spaces such as lockers.
3. In storage, separate fuel cylinders from oxygen cylinders by at least 20 feet or by a firewall at least 5 feet high with a minimum fire resistance of one-half hour. This separation distance also applies to incompatible and toxic materials.
4. No smoking or open flame within 50 feet of cylinders in storage.
5. Separate empty cylinders from full cylinders in storage. Consider partially full cylinders as being full.
6. Never completely empty a cylinder. Keep at least 25 psig on all cylinders except acetylene, which should have at least 15 psig.
7. Keep cylinders in an upright position at all times except, if necessary, for short periods when cylinders are being hoisted or carried. Acetylene cylinders must be kept in an upright position whether empty or full.
8. Secure cylinders to prevent them from falling or being knocked over.
9. **Valve protection caps** must be in place and hand tight at all times except when cylinders are in use or ready for use. They must be in place during transport. *Ready for use means that the regulators are attached to the cylinders, the cylinders are attached to a truck or cart designed for cylinders, and there is a reasonable expectation that the cylinders will be used within 72 hours.*
10. Keep cylinder valves closed except when in use. Cylinder valves will be closed before moving the cylinders and when work is finished. Do not use valve caps for lifting.
11. Do not take cylinders into a confined space.
12. Do not use damaged or defective cylinders.
13. Keep a Material Safety Data Sheet on hand for each compressed gas.
14. No one other than the gas supplier shall attempt to mix gases in a cylinder. No one, other than the owner, or those authorized in writing by the owner, shall refill a cylinder.
15. See AEDC Safety, Health, and Environmental Standard D-4, Compressed Gas Cylinders, for information about cylinder labeling and hydrostatic testing. The following references have even more information.
29 CFR 1910.101 Compressed Gases
29 CFR 1910.253 Oxygen Fuel Gas Welding and Cutting
29 CFR 1926.350 Welding and Cutting
NFPA 55, Standard for the Storage, Use, and Handling of Compressed and Liquefied Gases in Portable Cylinders, latest edition
16. If you need assistance call your Safety Office or the Fire Department.

**Annex B
Required Identification of AEDC Gas Cylinders**



1. Band Width--About 3 inches
2. Distance Between Bands--About 1 inch
3. Cap Color--Same as top
4. Name of Gas--On cylinder twice, on opposite sides, in all capital letters and Arabic numerals about 2 inches high on cylinders 4 or more inches in diameter.
5. Color of Letters and Numerals--White against all colors except yellow, orange or buff, which require black.

MIL-STD-101B IDENTIFICATION		MIXED GASES
<u>Color</u>	<u>Class of Materials</u>	
Yellow, No. 1310	Flammable materials	Three bands of black and yellow striped warning tape (Stock No. 7510-NL042939) in addition to other identification as required on this page
Brown, No. 1710	Toxic materials	
Blue, No. 1520	Anesthetics and harmful materials	
Green, No. 1460	Oxidizing materials	
Gray, No. 1625	Physically dangerous materials which are asphyxiating in confined areas or are generally handled in a dangerous physical state of pressure or temperature.	
Red, No. 1105	Materials exclusively for use in fire protection.	

COLOR CODING FOR GASES COMMONLY USED AT AEDC

<u>Name</u>	<u>Color</u>				
	<u>Top</u>	<u>Band 1</u>	<u>Band 2</u>	<u>Band 3</u>	<u>Body</u>
Acetylene			All Yellow		
Air (oil pumped)	Black	Green	Green		Black
Air (water pumped)	Black	Green			Black
Argon	Gray	White			Gray
Argon 75% + carbon dioxide 25%	Gray	White	Buff		Gray
Argon 7.5% + carbon dioxide 2.5% + helium 90%	Gray	White	Buff	Orange	Gray
Argon 65% + hydrogen 35%	Gray	White			Yellow
Argon 95% + oxygen 5%	Gray	White	Green		Gray
Carbon dioxide (non-fire use)			All Gray		
Carbon dioxide (fire only)			All Red		
Carbon dioxide, liquid (fire only)	White				Red
Chlorine			All Brown		
Helium, oil free	Buff				Gray
Hydrogen	Yellow	Black			Yellow
Nitrogen (prepurified)	Gray	Black	Black	Orange	Gray
Nitrogen (bone dry)	Gray	Black	Black	Black	Gray
Oxygen, medical	White				Green
Oxygen			All Green		

SHE Standard D4 Compressed Gas Cylinders

**Annex C
Retest and Inspection of Cylinders**

Specification under which cylinder was manufactured	Minimum retest pressure	Retest period (years) Reference notes are listed after this table.
DOT-3	3000 psi	5
DOT-3A, 3AA	5/3 times service pressure, except non-corrosive service. See 49CFR173.34 (e13).	5, 10, or 12 (See B, D, F, H)
DOT-3AL	5/3 times service pressure	5 or 12 (See I)
DOT-3AX, 3AAX	5/3 times service pressure	5
3B, 3BN	2 times service pressure. See 49CFR173.34 (e13).	5 or 10 (See B)
3C	Retest not required.	N/A
3D	5/3 times service pressure	5
3E	Retest not required	N/A
3HT	5/3 times service pressure	3 (See E)
3T	5/3 times service pressure	5
4	700 psi	10
4A	5/3 times service pressure	5 or 10 (See B)
4AA480	2 times service pressure	5 or 10 (See D)
4B, 4BA, 4BW, 4B-240-ET	2 times service pressure, except non-corrosive service	5, 10, or 12 (See A, B, and I)
4C	Retest not required.	N/A
4D, 4DA, 4DS	2 times service pressure	5
DOT-4E	2 times service pressure, except non-corrosive service	5
4L	Retest no required.	N/A
8, 8AL		10 or 20 (See H)
DOT-9	400 psi (maximum 600 psi)	5
25	500 psi	5
26 for filling at over 450 psi	5/3 times service pressure	5
26 for filling at 450 psi and below	2 times service pressure, except non-corrosive service.	5 or 10 (See A)
33	800 psi	5
38	500 psi	5
Exemption cylinder	See current exemption	See current exemption
Foreign cylinder (See 49 CRF 173.301(j) for restrictions on use).	As marked on the cylinder, but no less than 5/3 of any service or working pressure marking.	5

NOTES:

(A) Modified hydrostatic retest. A cylinder made in compliance with specification DOT 4B, DOT 4BA, DOT 4BW, DOT 4E or ICC-26-300 (See note 1) that is used exclusively for anhydrous dimethylamine; anhydrous methylamine; anhydrous trimethylamine; methyl chloride; liquefied petroleum gas; methylacetylene-propadiene stabilized; or dichlorodifluoromethane, difluoroethane, difluorochloroethane, chlorodifluoromethane, chlorotetrafluoroethane, trifluorochloroethylene, or mixture thereof, or mixtures of one or more with trichlorofluoromethane; and that is commercially free from corroding components and protected externally by a suitable corrosion-resistant coating (such as galvanizing or painting) may be given a hydrostatic retest every 12 years instead of every five years. Alternatively, the cylinder may be subjected to internal hydrostatic pressure of at least two times the marked service pressure without determination of expansions, but this latter type of test must be repeated every seven years after

expiration of the first 12-year period. When subjected to the latter test, the cylinder must be carefully examined under test pressure and removed from service if a leak or other harmful defect exists. A cylinder re-qualified by the modified hydrostatic test method must be marked after a retest or an inspection by stamping the date of retest or re-inspection on the cylinder followed by an "S".

Note 1: For filling at 450 psi. and below. Use of existing cylinders authorized; new construction not authorized.

(B) A cylinder made in conformance with specification DOT-3A, DOT-3AA, DOT-3B, DOT-4BA or DOT-4BW having a service pressure of 300 psi or less that is used exclusively for methyl bromide, liquid; mixtures of methyl bromide and ethylene dibromide, liquid; mixtures of methyl bromide and chlorpicrin, liquid; mixtures of methyl bromide and petroleum solvents, liquid; or methyl bromide and nonflammable, non-liquefied compressed gas mixtures, liquid; that is commercially free of corroding components, and that is protected externally by a suitable corrosion resistant coating (such as galvanizing or painting) and internally by a suitable corrosion resistant lining (such as galvanizing) may be tested every 10 years instead of every five years, provided that a visual internal and external examination of the cylinder is conducted every five years in accordance with CGA Pamphlet C-6. The cylinder must be examined at each filling, and rejected if a dent, corroded area, leak or other condition indicates possible weakness.

(C) A cylinder made in conformance with a specification listed in the table in this paragraph and used exclusively in the service indicated may, instead of a periodic hydrostatic retest, be given a complete external visual inspection at the time periodic retest becomes due. External visual inspection must be in accordance with CGA Pamphlet C-6 or C-6.3. When this inspection is used instead of hydrostatic retesting, subsequent inspections are required at five-year intervals after the first inspection. Inspections must only be made by competent persons and the results recorded and maintained. Records shall include: date of inspection (month and year); DOT specification number; cylinder identification (registered symbol and serial number, date of manufacture, and owner); type of cylinder protective coating (including statement as to need of refinishing or recoating); conditions checked (e.g., leakage, corrosion, gouges, dents or digs in shell or heads, broken or damaged footing or protective ring or fire damage); disposition of cylinder (returned to service, returned to cylinder manufacturer for repairs or scrapped). A cylinder that passes inspection shall be marked with the date in accordance with 49 CFR173.34(e)(7). An "E" after the date indicates requalification by the external inspection method. Specification cylinders must be in exclusive service per Annex D.

(D) A cylinder made in compliance with specification DOT-3A, DOT-3A 480X, or DOT-4AA480 used exclusively for anhydrous ammonia, commercially free from corroding components, and protected externally by a suitable corrosion-resistant coating (such as painting) may be retested every 10 years instead of every five years.

(E) 3HT cylinders. (i) In addition to the other requirements of this section, a cylinder marked DOT-3HT must be re-qualified in accordance with CGA Pamphlet C-8.

(ii) The cylinder must be condemned:

(A) If elastic expansion exceeds the marked rejection elastic expansion. A cylinder made before January 17, 1978, and not marked with a rejection elastic expansion in cubic centimeters near the marked original elastic expansion must be so marked before the next retest date. The rejection elastic expansion for a cylinder is 1.05 times its original elastic expansion.

(B) If there is evidence of denting or bulging.

(C) Twenty-four years after the date of the original test or after 4,380 pressurizations, whichever occurs first. If a cylinder is recharged, on average, more than once every other day, an accurate record of the number of rechargings must be maintained by the cylinder owner or his/her agent.

(iii) The retest date and re-tester identification number must be applied by low-stress steel stamp to a depth no greater than that of the marking at the time of manufacture. Stamping on the sidewall is not authorized.

(F) DOT-3A or 3AA cylinders. (i) A cylinder made in conformance with specification DOT-3A or 3AA with a water capacity of 125 pounds or less that is removed from any cluster, bank, group, rack or vehicle each time it is filled, may be retested every ten years instead of every five years, provided the cylinder complies with all of the following:

(A) The cylinder was manufactured after December 31, 1945;

(B) The cylinder is used exclusively for air, argon, cyclopropane, ethylene, helium, hydrogen, krypton, neon, nitrogen, nitrous oxide, oxygen, sulfur hexafluoride, xenon, permitted mixtures of these gases and permitted mixtures of these gases with up to 30% by volume of carbon dioxide, provided that the gas has a dew point at or below minus 52°F at 1 atmosphere;

(C) Before each refill, the cylinder passes the hammer test specified in CGA Pamphlet C-6;

(D) The cylinder is dried immediately after hydrostatic testing to remove all traces of free water;

(E) The cylinder is not used for underwater breathing; and

(F) Each cylinder is stamped with a five-point star at least one-fourth of an inch high immediately following the test date.

(ii) If, since the last required hydrostatic retest, a cylinder has not been used exclusively as specified in paragraph (B) of this section, but currently conforms with all other provisions of paragraph (i) of this section, it may be retested every 10 years instead of every five years, provided it is first retested and examined as prescribed by 49CFR173.302 (c) (2), (3) and (4).

(iii) Except as specified in paragraph (ii) of this section, if a cylinder marked with a star is charged with a compressed gas other than as specified in this paragraph, the star following the most recent test date must be obliterated. The cylinder must be retested five years from the marked retest date, or prior to the first charging with a compressed gas, if the required five-year retest period has passed.

(G) Cylinders containing corrosive materials. (i) A cylinder that previously contained a Class 8 (corrosive) material may not be used to transport a compressed gas in commerce unless the following requirements are met--

(A) The cylinder is visually inspected, internally and externally, in accordance with CGA Pamphlet C-6;

(B) Regardless of the date of previous retest, the cylinder is subjected to and passes inspection and hydrostatic retest in accordance with this section; and

(C) The record prescribed in paragraph 49CFR173.34 (e)(8) includes: the month and year of inspection and test; the cylinder identification (including ICC or DOT specification number, registered symbol, serial number, date of manufacture and owner); the conditions checked (e.g., leakage, corrosion, gouges, dents, or digs in shell or heads, broken or damaged footings, fire damage) and the disposition of the cylinder (returned to service, returned to the manufacturer for repairs, or scrapped).

(ii) A cylinder re-qualified for compressed gas service in accordance with this paragraph may have its next retest and inspection scheduled from the date of the inspection and retest prescribed in this paragraph. If decontamination cannot remove all significant residue or impregnation by the Class 8 material, the cylinder may not be used to transport compressed gas in commerce.

(H) DOT 8 and 8AL cylinders. (i) Each owner of a DOT 8 or 8AL cylinder used to transport acetylene must have the cylinder shell and the porous filler re-qualified in accordance with CGA Pamphlet C-13.

Requalification must be performed in accordance with the following schedule:

Date of cylinder manufacture	Shell initial (visual inspection) requalification	Shell subsequent (visual inspection) requalification	Initial porous filler requalification	Subsequent porous filler requalification
Before January 1, 1991	Before January 1, 2001	10 years	Before January 1, 2011	Not required
On or after January 1, 1991	10 years from date of cylinder manufacture	10 years	3 to 20 years*	Not required

* For a cylinder manufactured on or after January 1, 1991, requalification of the porous filler must be performed no sooner than 3 years, and no later than 20 years, from the date of manufacture.

(I) Cylinders used as fire extinguishers. Only DOT specification cylinders used as fire extinguishers and meeting Special Provision 18 in 49CFR 172.102 section (c) (1) may be retested in accordance with this paragraph.

SHE Standard D4 Compressed Gas Cylinders

**Annex D
Specification Cylinders***

Cylinders made in compliance with	Used exclusively for
DOT-4, DOT-3A, DOT-3AA, DOT-3A480X, DOT-4A, DOT-4AA480	Anhydrous ammonia of at least 99.95% purity.
DOT-3A, DOT-3AA, DOT-3A480X, DOT-3B, DOT-4B, DOT-4BA, DOT-4BW, ICC-26-240, ICC-26-300	Butadiene, inhibited, that is commercially free from corroding components.
DOT-3A, DOT-3A480X, DOT-3AA, DOT-3B, DOT-4A, DOT-4AA480, DOT-4B, DOT-4BA, DOT-4BW	Cyclopropane that is commercially free from corroding components.
DOT-3A, DOT-3AA, DOT-3A480X, DOT-4B, DOT-4BA, DOT-4BW, DOT-4E	Fluorinated hydrocarbons and mixtures thereof that are commercially free from corroding components.
DOT-3A, DOT-3AA, DOT-3A480X, DOT-3B, DOT-4B, DOT-4BA, DOT-4BW, DOT-4E, ICC-26-240, ICC-26-3001	Liquefied hydrocarbon gas that is commercially free from corroding components.
DOT-A, DOT-3AA, DOT-3A480X, DOT-3B, DOT-4B, DOT-4BA, DOT-4BW, DOT-4E, ICC-26-2401, ICC-26-3001	Liquefied petroleum gas that is commercially free from corroding components.
DOT-3A, DOT-3AA, DOT-3B, DOT-4B, DOT-4BA, DOT-4BW, DOT-4E	Methylacetylene-propadiene, stabilized, which is commercially free from corroding components.
DOT-3A, DOT-3AA, DOT-3B, DOT-4B, DOT-4BA, DOT-4BW	Anhydrous mono, ditrimethylamines which are commercially free from corroding components.
DOT-4B240, DOT-4W240	Ethyleneimine, inhibited.

*A cylinder made in conformance with the specification listed in the table above and used exclusively in the service indicated may, instead of a periodic hydrostatic retest, be given a complete external visual inspection at the time periodic retest becomes due. (See Para. C of Annex C).