Defense Health Agency

PROCEDURES MANUAL

NUMBER 6040.06
October 18, 2021

DHA MEDLOG

SUBJECT: Medical Logistics (MEDLOG) Medical Gas Services

References: See Enclosure 1.

1. PURPOSE. This Defense Health Agency-Procedures Manual (DHA-PM), based on the authority of References (a) and (b), and in accordance with the guidance of References (c) through (ae), establishes the Defense Health Agency's (DHA's) procedures to provide guidance and regulatory requirements to DHA Military Medical Treatment Facilities (MTFs) and DHA Dental Treatment Facilities (DTF) on the management of medical gas in a manner which minimizes occupational exposure, protects both the environment and the public, and ensures compliance with appropriate Federal, State, and local regulations, in accordance with References (e) and (f).

2. APPLICABILITY. This DHA-PM applies to the DHA, MTFs, and DTFs located within the continental United States, Alaska, Hawaii, and U.S. territories.

3. POLICY IMPLEMENTATION. It is DHA's instruction, pursuant to References (a) through (ae), that Medical Logistics (MEDLOG) Medical Gas Services will include the procurement, handling, transport, storage, and disposition of medical gas within MTFs and DTFs.

4. RESPONSIBILITIES. See Enclosure 2.

5. PROCEDURES. See Enclosure 3.

6. PROPONENT AND WAIVERS. The proponent of this publication is the Deputy Assistant Director (DAD), MEDLOG. When Activities are unable to comply with this publication the activity may request a waiver that must include a justification, to include an analysis of the risk

associated with not granting the waiver. The activity director or senior leader will submit the waiver request through their supervisory chain to the DAD, MEDLOG to determine if the waiver may be granted by the Director, DHA or their designee.

7. RELEASABILITY. **Cleared for public release**. This DHA-PM is available on the Internet from the Health.mil site at: https://health.mil/Reference-Center/Policies and is also available to authorized users from the DHA SharePoint site at: https://info.health.mil/cos/admin/pubs/SitePages/Home.aspx.

8. EFFECTIVE DATE. This DHA-PM:

a. Is effective upon signature.

b. Will expire 10 years from the date of signature if it has not been reissued or cancelled before this date in accordance with Reference (c).

9. FORMS

a. The following stocked forms can be ordered from the Defense Logistics Agency (DLA) at: https://forms.documentservices.dla.mil/order/.

(1) DD Form 1191, Medical Oxygen Equipment, Warning Tag for Medical Equipment

(2) DD Form 1574, Serviceable Tag–Materiel

b. DD Form 1225, Storage Quality Control Report is available on the internet at: https://www.esd.whs.mil/Directives/forms/dd1000_1499/.

/S/
RONALD J. PLACE
LTG, MC, USA
Director

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ENCLOSURE 1

REFERENCES

(a) DoD Directive 5136.01, "Assistant Secretary of Defense for Health Affairs (ASD(HA))," September 30, 2013, as amended
(b) DoD Directive 5136.13, "Defense Health Agency (DHA)," September 30, 2013
(c) DHA-Procedural Instruction 5025.01, "Publication System," August 24, 2018
(d) United States Code, Title 10, Section 1073c, "Administration of Defense Health Agency and Military Medical Treatment Facilities"
(e) DoD Directive 4715.1E, "Environment, Safety, and Occupational Health (ESOH)," March 19, 2005, as amended.
(f) DoD Instruction 6055.01, "DoD Safety and Occupational Health (SOH)", October 14, 2014, as amended.
(g) National Defense Authorization Act for Fiscal Year 2017, Section 702
(h) DHA-Procedural Instruction 6430.02, "Defense Medical Logistics (MEDLOG) Enterprise Activity (EA)," September 27, 2018
(i) National Fire Protection Agency 55, Compressed Gases and Cryogenic Fluids Code
(j) National Fire Protection Agency 99, Health Care Facilities Code
(k) National Fire Protection Agency 101, Life Safety Code
(l) Code of Federal Regulations, Title 29
(m) Military Standard MIL-STD-1411B, "Department of Defense Standard Practice: Inspection and Maintenance of Compressed Gas Cylinders," June 8, 2010[1]
(n) Military Standard MIL-STD-101C, "Department of Defense Standard Practice: Color Code for Pipelines and Compressed Gas Cylinders," August 26, 2014[2]
(o) Code of Federal Regulations, Title 49
(p) DoD Manual 4160.21, Volume 4, "Defense Materiel Disposition: Instructions for Hazardous Property and Other Special Processing Materiel," October 22, 2015, as amended
(q) Defense Logistics Agency Instruction (DLAI) 4145.3, "Preparing Hazardous Materials for Military Air Shipments," April 21, 2015
(r) Defense Logistics Agency Instruction (DLAI) 4145.25, "Storage and Handling of Liquefied and Gaseous Compressed Gasses and Their Full and Empty Cylinders," June 16, 2000
(s) American Society for Testing and Materials (ASTM) D-323-15a, "Standard Test Method for Vapor Pressure of Petroleum Products (Reid Method)"[3]
(t) Code of Federal Regulations, Title 40
(u) Military Specification MIL-O-27210, "Oxygen, Aviator's Breathing, Liquid and Gas," August 1, 1990, as amended[4]
(v) Defense Logistics Manual 4000.25-2, "Military Standard Transaction Reporting and Accounting Procedures (MILSTRAP)," June 13, 2012, as amended

[1] This reference can be found at: http://everyspec.com/MIL-STD/MIL-STD-1400-1499/MIL-STD-1411B_23144/
[2] This reference can be found at: http://everyspec.com/MIL-STD/MIL-STD-0100-0299/MIL-STD-101B_21221/
[3] This reference can be found at: https://www.astm.org/Standards/D323.htm
[4] This reference can be found at: http://everyspec.com/MIL-SPECS/MIL-SPECS-MIL-O/MIL-O-27210F_32997/

(w) Detail Specification MIL-DTL-2 Series, "Valves, Cylinder, Gas (For Compressed or Liquefied Gases), General Specifications"[5]
(x) Federal Standard (FED STD) H28, "Screw-Thread Standards for Federal Services"[6]
(y) Federal Standard (FED STD) H28/9, "Gas Cylinder Valve Outlet and Inlet Threads"[7]
(z) Military Specification MIL-V-17360, "Valves, Cylinder, Gas, Carbon Dioxide Fire Extinguisher"
(aa) Military Specification MIL-E-24572, "Extinguisher, Fire, Bromotrifluoromethane (Halon 1301) System Components (Fixed Pipe, Pneumatically Actuated, Naval Shipboard Use)"
(ab) Military Specification MIL-E-24572, "Extinguisher, Fire, Bromotrifluoromethane (Halon 1301) System Components (Fixed Pipe, Pneumatically Actuated, Naval Shipboard Use)"
(ac) DoD Instruction 6055.05, Occupational and Environmental Health (OEH) November 11, 2008, as amended
(ad) DoD Instruction 6055.07, "Mishap Notification, Investigation, Reporting and Record Keeping," August 31, 2018
(ae) Compressed Gas Association C-7, Guide to Classification and Labeling of Compressed Gases

[5] This reference can be found at: https://www.dla.mil/TroopSupport/Subsistence/OperationalRations/mildtl/
[6] This reference can be found at: http://everyspec.com/FED-STD/download.php?spec=FED-STD-H28_9.024788.pdf
[7] This reference can be found at: http://everyspec.com/FED-STD/download.php?spec=FED-STD-H28_9.024788.pdf

ENCLOSURE 2

RESPONSIBILITIES

1. DIRECTOR, DHA. The Director, DHA will assign the DAD-MEDLOG to implement this DHA-PM in accordance with Reference (b) and Reference (d).

2. DAD-MEDLOG. The DAD-MEDLOG will support oversight of the delivery of all MEDLOG services at MTFs and DTFs in accordance with Reference (f) and must:

a. Establish an Environmental Services Division to manage Medical Gas.

b. Appoint, Chief, Environmental Services Division, as appropriate, for day-to-day management of division operations.

3. DIVISION CHIEF, DHA ENVIRONMENTAL SERVICES. The Chief, DHA Environmental Services must provide the guidance, policy, and oversight for MTF environmental service operations.

4. BRANCH CHIEF, DHA MEDICAL GAS SERVICES. The Chief, DHA Medical Gas Services will provide guidance and direction for managing all medical gas regulatory requirements to include the procurement, handling, transport, storage, and disposition of medical gas.

5. DIRECTORS, MTF/DTF. The Directors, MTF/DTF will:

a. Have overall responsibility for the management of medical gas within the MTF.

b. Ensure medical gas is managed in accordance with the appropriate Federal, State, and local regulations.

c. Appoint the Chief, MEDLOG Officer to manage the MTF/DTF Medical Gas Services.

d. Ensure that all personnel handling medical gases in cylinders are properly trained on transporting, handling, storing, and the hazardous of working with medical gases.

6. MTF CHIEF, MEDLOG OFFICER. The MTF Chief, MEDLOG Officer must:

a. Designate the MTF Medical Gas Control Officer.

b. Contact the Contracting Officer's Representative and MTF Chief, DHA Medical Gas Services Program Manager if there are substantial discrepancies or changes required in the Medical Gas Services contract.

c. Arrange for and supervise the procurement, handling, transport, storage, and disposition of medical gas.

7. MTF/DTF MEDICAL GAS CONTROL OFFICER. The MTF/DTF Medical Gas Control Officer must:

a. Be functionally responsible for the daily management of medical gas in accordance with References (n) through (p).

b. Supervise Medical Gas Services personnel and supplier operations while suppliers and other operations personnel are within the MTF/DTF.

c. Maintain accurate records and account for all Medical Gas Services.

d. Develop local medical gas management implementing policies and guidance.

e. Submit funding requirements for medical gas management.

f. Provide technical expertise on medical gas management.

g. Inspect MTF/DTF medical gas management, collection, disposition, and contingency plans.

h. Report any mismanagement to the Contracting Officer's Representative.

i. Assess Medical Gas Services at least annually to identify and document processes.

j. Work with department supervisors to:

(1) Establish and use management controls and conduct periodic inspections to ensure compliance with policies and procedures. All empty cylinders will be inspected every 6 months to determine their serviceability status with respect to the requalification date and physical condition. See Reference (w) for more information on inspection criteria.

(2) Plan, conduct, and document training of personnel to ensure medical gas management is conducted safely and in compliance with established policies and procedures. Initial training must be completed within 90 days of employment or change of station for military members and refresher training completed every 3 years.

j. Coordinate with the MTF/DTF ground safety manager and MTF/DTF facility manager to establish designated routes and times that medical gas will be moved within the facility to minimize patient exposure and ensure patient and employee safety, safe handling, transport, and storage of pressurized medical gas cylinders.

k. Ensure contracts specify the appropriate type of gas desired, (i.e., medical oxygen United States Pharmacopeia (USP), nitrous oxide USP, carbon dioxide USP, helium-oxygen, nitrogen USP, helium USP, nitrogen). The supplier is required to provide a Certificate of Purity documenting the concentration for each container.

l. Ensure storage sites for medical gases in bulk liquefied form are installed, repaired, and maintained in accordance with all applicable codes, standards, and regulations.

m. Maintain the supplier's Certificate of Purity for bulk liquid oxygen on file for 3 years from date of receipt. A certificate of analysis is not required prior to accepting delivery of medical gases in cylinder form. The vendor is required to maintain all documentation certifying the purity of the compressed gas being supplied to the MTF/DTF.

n. Program, requisition, and maintain sufficient stocks of medical gases to satisfy requirements of the using activity.

o. Establish contingencies for emergency resupply of medical gases and ensure gas levels in reservoirs are monitored in accordance with the local emergency preparedness plan, in the event of a natural disaster or disruption of medical gases.

p. Establish cylinder exchange program for using activities to include after hours and emergency procedures.

q. Report maintenance problems on liquid oxygen reservoir to Chief, MEDLOG Officer.

r. Ensure all gas cylinders are correctly marked and colored in accordance with Reference (s).

s. Oversee the Medical Gas program and:

(1) Maintain maintenance records based on MEDLOG Standard Support.

(2) Monitor the oxygen purity monitor daily.

t. Ensure procurement of medical gas replenishment requirements. Monitor medical gas levels and order oxygen (liquid) whenever the level reaches 50 inches.

u. Ensure all cylinders have been hydrostatically tested within the past 5 years.

v. Ensure all Oxygen Cylinders contain "Do Not Oil" tags and Green Full/In-Use Tags.

ENCLOSURE 3

PROCEDURES

1. GENERAL

a. DHA MTFs/DTFs will not maintain medical gases in operating inventories and instead will immediately issue the total quantity received to the requesting activity.

b. All workers who store, handle, or use compressed gas cylinders will be thoroughly familiar with procedures, safety requirements and potential mishap hazards associated with their use. Information pertaining to each specific gas is contained within its product labeling and Safety Data Sheet. Compliance with precautions provided on product labels and Safety Data Sheets is mandatory. Mishaps will be handled in accordance with Reference (ae).

c. All workplaces in the MTF/DTF that use compressed gas cylinders must be included in the MTF/DTF safety and occupational health program, consistent with Reference (ac). Workplaces where compressed gases are used, including compressed gases used in delivery of inhalant anesthetics, will be monitored and, when indicated, workers will be monitored, in accordance with Reference (ad).

d. Supervisors will ensure workers are trained and familiar with the properties and hazards of the products they use, and the handling, usage, and storage requirements of compressed gas cylinders. The characteristics of gases and cylinders are outlined in Appendices 1 and 2 of this enclosure in accordance with Reference (x). Supervisors will ensure valves, hoses, pipes, etc., are compatible with the compressed gases being used and non-compatible with breathing air. **Warning**: Valves, hoses, pipes, etc., used with breathing air will not be interchanged with other compressed gases under any circumstances, even though the parts may be physically compatible.

e. The worker will ensure the cylinder and attached equipment are in proper working condition and any discrepancies are fixed or reported to the supervisor.

f. All cylinders will be inspected for damage (e.g., dents, gouges, evidence of leakage, or cracks) daily before use to include:

(1) Inspection of Oxygen Cylinders to ensure "Do Not Oil" warning tag is in place and that the tag is annotated with a test date and purity indicating it is safe for use.

(2) Inspection of all cylinders to ensure "Green" In-Use/Empty tag is affixed and used in such a manner to accurately display the current condition/contents of the cylinder.

(3) Inspection of all cylinders to ensure there is adequate remaining pressure before beginning daily clinical use.

(4) Inspection of all cylinders to ensure they are properly stored. Empties must be segregated from full cylinders and well-marked to avoid mistakenly being used in an emergency.

g. Damaged cylinders will be tagged, "Out of Service," and returned to the manufacturer or distributor. Check the cylinder upon arrival for the test date, usually stamped on the neck of the cylinder. Workers may store the cylinder with the newest delivery behind older deliveries to ensure cylinders are used in the sequence received. Requalification of cylinders, including Department of Transportation (DOT)-8 cylinders will be in accordance with Subpart 180.209 of Reference (u).

(1) Cylinders will be hydrostatically tested in accordance with reference (s), which also contains additional guidance on inspection and requalification criteria for cylinders.

(2) Each time a cylinder is requalified, the date of the test or inspection indicating the month and year must be stamped into the shoulder, collar, or foot ring of the cylinder with a steel stamp. This date is used to determine the next scheduled re-qualification date. The service period for each type of cylinder is considered expired if the latest marked re-qualification date precedes the current date by more than the period indicated. Cylinders will not be accepted or used if the requalification date does not meet specifications.

h. Workers must know cylinder contents. Do not use a cylinder if you cannot quickly determine its contents either by wording on the cylinder or a tag securely attached to the cylinder. If the tag has become detached or the label defaced, do not use the cylinder. Do not rely on color coding of the cylinder. Different manufacturers use different color codes.

(1) DHA-owned cylinders will be color coded, and contents stenciled on the cylinder in accordance with Reference (t) and Reference (ae). Color codes for commonly used gases will be posted in the cylinder storage area, as indicated by Table 1.

Type Cylinder	Top A	Band B	Band C	Body
Oxygen	White	Green	Green	Green
Nitrogen	Black	Black	Black	Black
Nitrous Oxide	Blue	Blue	Blue	Blue
Carbon Dioxide	Gray	Gray	Gray	Gray
Compressed Air	Yellow	Yellow	Yellow	Yellow
Helium	Brown	Brown	Brown	Brown

Table 1. Color Coding for Cylinders

(2) Two DD Form 1574, Serviceable Tag-Materiel, will be placed on all cylinders. The first tag is used to identify the contents of the cylinder and the second tag will identify the cylinder. Additionally, the cylinder will carry a DOT identification label and a hazard class

label. For commercially filled cylinders, the user is responsible for affixing a three-part cylinder status tag (Full, In-use, Empty), which is useful for identifying content status and cylinder inventory.

i. For commercially filled cylinders, the user is responsible for affixing a three-part cylinder status tag (Full, In-use, Empty), which is useful for identifying content status and cylinder inventory.

j. Workers will be aware of the flammability, corrosiveness, or oxidation potential as well as the physiological properties (e.g., toxic, anesthetic, or irritating, of compressed gases they use or handle).

k. Handle all cylinders carefully. Careless handling may damage cylinders and valves. Install valve and dust covers when cylinders are not in use. Use cylinders for no purpose other than containing compressed gases; handle them with the same care whether full or empty.

l. Secure all cylinders by using a chain or other fastening device to a solid fixture (wall, stanchion, etc.), to prevent cylinders from falling over, whether in use or in storage, full or empty. Non-metallic or synthetic straps may be used to secure non-flammable gases, except oxygen.

m. Move cylinders safely. Appropriate dollies or hand trucks must be used to move cylinders weighing more than 50 pounds. The cylinder must be secured to the hand-truck prior to and during movement. Movement by spinning, sliding, rolling, etc., is prohibited. Cylinders less than 50 pounds may be moved without using a dolly or hand-truck. Proper lifting techniques must be used when lifting cylinders.

(1) Electromagnets or slings must not be used to move cylinders.

(2) Cylinders cannot be moved unless the regulator is removed, and the protective cap is in place and securely fastened to the cylinder. Note: cylinders secured to a hand truck are exempt from this requirement if regulators and hoses are connected to the cylinders.

n. Some gases/cylinders pose problems if placed in a horizontal position. Keep all cylinders in a vertical position at all times, unless the cylinders are designed to work in a horizontal position.

o. Do not tamper, or allow others to tamper, with cylinder valves or any part of a valve, such as a safety nut or stem packing nut.

p. Use cylinders only with the appropriate equipment. Do not force connections or use unauthorized adapters. Never use a cylinder without a regulator.

q. Always close the cylinder valve when the cylinder is not in use or when it is empty. Replace safety covers and dust caps.

r. Oxygen will support the rapid combustion of most materials. Flammable materials, such as oil, paint, or grease, may ignite if exposed to pressurized oxygen gas.

(1) Most compressed oxygen is not intended for breathing and must not be substituted for air used in ventilation systems. Oxygen will not be used as a substitute for compressed air.

(2) Never oil or grease an oxygen regulator. If oil or grease is found on an oxygen cylinder or regulator, it must be taken out of service immediately and the cylinder returned to the supplier.

s. Before attempting to place regulators or other fittings on a cylinder, ensure the threads on the cylinder match those on the fittings. The type of thread, number of threads per inch and the hand of the thread must match to ensure a satisfactory seal. If the fittings are hard to turn, do not force them; instead, check the threads.

t. Open cylinder valves slowly (cracking) so the gas is not released suddenly into the regulators. Operate valve hand-wheels only by hand. Do not use cheaters or pipes. Cylinders without fixed hand-wheels will be equipped with keys, handles or nonadjustable wrenches on the valve stems during the time they are in service.

u. Before removing a regulator from a cylinder, close the control valves and allow the gas to escape from the regulator.

v. On oxygen cylinders, do not use a regulator previously used for oil-pumped gases or any combustible gases. Gauges on oxygen regulators will be marked, "USE NO OIL."

w. Only cylinders that are in use should be in the laboratory or work area. Cylinders will be secured by a chain or other effective fastening device to a solid fixture (wall, stanchion, etc.) to prevent cylinders from falling over. Spare or empty cylinders will only be stored in a designated storage area.

x. Compressed gas cylinders represent a hazard because the gases may be:

(1) Flammable. These gases can burn or explode if ignited.

(2) Asphyxiants (Inert). Gases that are chemically inactive but may displace oxygen and cause death.

(3) Oxidizers. Oxidizing gases such as compressed oxygen and nitrous oxide do not burn, but support combustion of flammable materials by releasing oxygen or other oxidizing substances. Increasing the concentration of an oxidizer can stimulate and accelerate combustion. Materials that are nonflammable under normal conditions may burn in oxygen-enriched atmospheres.

(4) Corrosive. A gas that causes destruction of living tissue by chemical action.

(5) Toxic. A gas that may cause illness or death if inhaled, ingested or from skin contact. Refer to Subpart 1910.1200 of Reference (l) for additional information.

(6) Extremely Cold (Cryogenic). A cryogenic liquid has a boiling point below minus 130º F (minus 90º) at 14.7 pounds per square inch absolute.

y. Do not attempt to repair a cylinder or cylinder valve. All malfunctioning cylinders should be marked and returned to the vendor for repairs.

z. Cleaning, internal and external, is performed by the commercial supplier and/or vendor at the time of retesting and reconditioning or at the time the cylinder is filled. Should external cleaning become necessary during storage, materials used to clean the cylinders must be compatible with the gas or liquid to be put into the cylinders, or the gas previously in the empty cylinders. For instance, 1, trichloroethylene can explode.

aa. Verification of the quality of the purchased or manufactured product is conducted at the site of manufacturer or at the product distributor's warehouse. Necessary testing is performed by the supplier's personnel under the surveillance of a Government representative, or records of the examination and tests are maintained by the supplier and made available to the Government upon request. The quality of the gas product contained under pressure in a compressed gas cylinder will not change under normal storage and handling conditions; however, the condition of the cylinder may deteriorate and render the cylinder unsafe for further use.

2. STORAGE

a. While in storage, cylinder valve protection caps must be firmly in place. All cylinders will be secured by a metal chain, straps, braces, or other restraining devices to a solid fixture (wall, stanchion, etc.), to prevent cylinders from falling over. Synthetic straps will not be used to secure cylinders of flammable gases or oxygen. While in storage, cylinder valve protection caps must be firmly in place.

(1) Doors or gates for gas cylinder supply areas must be locked.

(2) Enclosures for gas supply systems must not be used for storage purposes other than for cylinders.

(3) Cylinders attached to a manifold must also be secured to solid fixtures to prevent the cylinder from falling over.

(4) The enclosure must be posted as a "No Smoking Area."

(5) The storage area is to be dry, cool, and well ventilated. The storage area is to be kept clean, neat, and free of debris at all times.

b. While in storage, do not store cylinders in locations where temperatures may exceed 125 deg F (51.7 deg C) or near other sources of heat to prevent excessive pressures in the cylinders. Many cylinders have fusible safety plugs that will release the contents when high temperatures or pressures exist in the cylinder.

(1) Do not store cylinders where there is danger of accidental damage or in areas where they will be subject to corrosive chemicals. Do not store flammable gases near electrical wires, batteries or other conductors or sources of electricity.

(2) Empty cylinders must be plainly marked "EMPTY" and stored in a separate area, segregated, if possible, from full cylinders. When stored together, full, and empty cylinders must be stored so that the older cylinders (old stock) can be removed first with minimum handling of other cylinders (newer stock).

(3) The preferred method of securing compressed gas cylinders is by enclosure within a length of chain firmly anchored at both ends to a solid fixture (wall, stanchion, etc.). An alternative method of securing is with a canvas tank strap securely clamped to an immovable table or bench top. In either case, the anchor points of the chain or strap must be about 2/3 the way up the tank. Metallic or synthetic nylon straps must not be used to secure cylinders of flammable gases or oxygen.

(4) Cylinders stored in the open must be adequately protected from extreme heat and cold. Cold weather usually increases the brittleness of the cylinder metal, and if brittle cylinders are handled roughly, they can rupture. Remove accumulated ice or snow to prevent cylinders from rusting.

(5) When gas cylinders are stored indoors, ventilate the area to prevent accumulation of flammable or asphyxiating gases in the atmosphere. Cylinders must not be kept in unventilated enclosures.

c. Cryogenic cylinders must be fitted with stainless steel or other suitable plumbing only.

d. Stored cylinders (either inside or outside) must not obstruct exit routes or other traffic areas.

e. All stored cylinders must have their valves closed. Valve protection caps must always be in place and hand tight except when cylinders are in use or connected for use. All cylinders must be stored valve end up.

f. Oxygen cylinders must not be stored within twenty feet of combustible material (especially oil and grease), other fuel gas cylinders or near any other substance likely to cause or accelerate fire.

g. Storage facilities must be prominently labeled/posted with the types of gases being stored. Where gases of different types are stored at the same location, cylinders must be grouped by type of gas and the groups arranged to consider the gases contained. Cylinders must be prominently labeled in accordance with Part 172, Subparts D through F of Reference (o).

3. TRANSPORTING COMPRESSED GAS CYLINDERS

a. As a minimum, cylinders must be transported on an appropriate cart secured by a chain or strap. Cylinders must not be dropped, dragged, slid, or allowed to strike each other violently. Protective valve caps should be utilized whenever cylinders are in transport.

b. Consult the safety officer prior to establishing or relocating storage areas for compressed gas cylinders.

4. TESTING OXYGEN DURING DELIVERIES. The purity of oxygen will be tested when received from the vendor and for monitoring oxygen provided to using activities. Table 2 contains the medical gas types and purities.

Medical Gas	USP Grade Purity
Liquid Oxygen	99%
Gaseous Oxygen	99%
Liquid Nitrogen	99%
Compressed Nitrogen	99%
Carbon Dioxide	99%
Nitrous Oxide	97%
Compressed Air	N/A

Table 2. Medical Gas Types and Purities

a. Oxygen is replenished via contract. Oxygen (liquid and compressed) delivered by commercial vendors must be at least 99% pure.

b. During delivery, the following actions are to be performed:

(1) The vendor is to verify purity of the oxygen and provide a statement certifying the purity of the oxygen on the delivery ticket.

(2) Utilizing calibrated oxygen analyzers, the Medical Gas Control Officer must test all delivered oxygen.

(3) Testing the Bulk Oxygen System each time a delivery is made. This will consist of testing the oxygen in the delivery truck prior to discharge into our storage tank using an oxygen analyzer for oxygen percentage. Individual conducting test will notify Chief, Anesthesia or Senior Clinical Director when oxygen concentration is less than 99%. When concentration is less than 99%, supplier will not be allowed to connect to the bulk tank until approved by the Chief, Anesthesia or Senior Clinical Director.

(a) Compressed oxygen cylinders less than 99% pure will be returned to the vendor and a discrepancy report submitted to Chief, MEDLOG Officer. Inspect each cylinder for a Green In-Use/Empty Tag, Test results for compressed oxygen cylinders are to be recorded on DD Form 1191, Medical Oxygen Equipment, Warning Tag for Medical Equipment and the form attached to the cylinders. Annotations to the DD 1191 will include Julian Date of quality check; quality of oxygen (in percentage); and initials of individual accomplishing check.

(b) For bulk liquid oxygen, readings are to be taken from the vendor's truck reservoir, not the MTF/DTF bulk liquid oxygen system reservoir. This action prevents any possibility of impure oxygen entering the main oxygen system.

c. The MTF/DTF Medical Gas Control Officer will complete a Report of Discrepancies whenever the vendor delivers empty tanks or impure oxygen. These reports are to be provided to the Chief, MEDLOG Officer, on the same day, for appropriate action.

d. The MTF/DTF Medical Gas Control Officer will immediately notify the Chief, Anesthesia or Senior Clinical Director if readings taken on the bulk liquid oxygen reservoir become less than 96% pure.

e. Records of receipt must be maintained for 3 years.

5. DISPOSAL AND SHIPPING

a. Disposal of Compressed Gas Cylinders. Disposal of compressed gas cylinders will be accomplished in accordance with References (k) and (m).

(1) Non-government owned cylinders will be returned to the owner. Language requiring takeback of non-government owned cylinders must be included in all contracts. If the owner cannot be determined, cylinders must be processed in accordance with Reference (k).

(2) Cylinders rejected for failure to pass hydrostatic testing or any other reason must be disposed of as condemned property after the identification numbers, symbols and cylinder contents have been destroyed according to procedures outlined within the governing medical gas contracts.

b. Prior to shipment, empty cylinders must be inspected for dents, bulges, oxidation pits or other damage. Faulty cylinders must be disposed of in accordance with local policy and/or

procedures outlined within the governing medical gas contract. Additional information regarding the procedures for faulty cylinder disposal can be found at: https://www.dla.mil/DispositionServices. Cylinders must be shipped in accordance with instructions outlined in Reference (l). Ensure cylinders (especially oxygen) will not be contaminated with oil, grease, paint, etc., by the shipper while en route to or from the filling agency.

APPENDIX 1

CHARACTERISTICS OF GASES

1. GENERAL. Personnel having the responsibility of storing, handling, and/or using compressed gases and gas cylinders must have a working knowledge of the characteristics and hazards associated with each individual gas. Specific and detailed information on the properties and/or hazards of any gas is best obtained from the manufacturer or supplier of the product through Safety Data Sheets (SDS) or brochures. Additional information related to this Appendix is available from commercial sources and is referred to below; however, references to commercial manufacturers or service providers does not constitute an overt or implied federal endorsement and is provided only to promote the education of and technical expertise of DHA personnel. The following commercial publications are sources for additional information pertaining to technical data and to first aid and medical treatment for exposure to gases:

a. Effects of Exposure to Toxic Gases/First Aid and Medical Treatment, available from Matheson Gas Products.

b. Gas Data Book, available from Matheson Gas Products. This document contains technical information about the various compressed gases and provides such information as the chemical characteristics, how a gas is manufactured, how it is used, how it is transported, safety and health information and how to dispose of it.

c. Methods for Hydrostatic Testing of Compressed Gas Cylinders, Compressed Gas Association (CGA) Pamphlet C-1, available from the CGA. This pamphlet provides the detailed information on the retesting (requalification) of compressed gas cylinders.

d. Handbook of Compressed Gases, available from the CGA. This document is a compilation of technical information like that of the Matheson Gas Data Book but also contains much of the specific information found in the individual CGA pamphlets.

e. Chlorine Manual, available from The Chlorine Institute. This document provides detailed information on the manufacture, transporting, safety, and health and other critical information on the chlorine industry.

f. Cylinder Service Life Seamless, High-Pressure Cylinder Specification Interstate Commerce Commission (ICC)/DOT-3, ICC/DOT-3A, ICC/DOT-3AA, CGA Pamphlet C-5, available from the CGA. This document provides detailed information on the manufacture of cylinders and, when used with the results of the hydrostatic test outlined in Pamphlet C-1, a person can determine the expected life of a high pressure steel cylinder.

g. Standards for Visual Inspection of Compressed Gas Cylinders, CGA Pamphlets C-6, C-6.1, C-6.2 and C-6.3 available from the CGA. These documents provide direction and guidance in performing a visual inspection of a compressed gas cylinder to visually determine the integrity of the structure of the cylinder.

2. GASES AND THEIR CHARACTERISTICS. The gases most likely to be found in DoD storage and support facilities inventories are listed below. The label requirements for each gas are indicated. For special handling and transportation, refer to the specific label requirements found in Part 82 of Reference (j) and of Reference (o).

a. Air, Compressed (Hazard Class 2.2, I.D. NO. UN1002, Nonflammable Gas Label); Air, Refrigerated liquid (Cryogenic Liquid) (Hazard Class 2.2, I.D. No. UN1003, Nonflammable Gas (primary) and Oxidizer (subsidiary) Labels). Air is the natural atmosphere of the earth – a nonflammable, colorless, odorless gas that consists of a mixture of gaseous elements (with water vapor, a small amount of carbon dioxide, and traces of many other constituents). Synthesized air is produced by combining pure oxygen and nitrogen and contains between 19.5 and 23.5 percent oxygen, with the balance nitrogen and with a major portion of the other components eliminated. Dry air is noncorrosive. Liquefied air is transparent with a bluish cast and has a milky color when it contains carbon dioxide. Because air is a mixture, not a compound, it can be separated into its components. The most common method is the liquefaction of air by reducing its temperature to approximately -320 deg F (-195.6 Deg C), then fractionally distilling to remove each of the constituents as fractions. Compressed air is nontoxic. It may act as an oxidizing material. Direct contact with the releasing high pressure gas or the cryogenic liquid may cause frostbite.

b. Argon, Compressed (Hazard Class 2.2, I.D. NO. UN1006, Nonflammable Gas Label); Argon, Refrigerated Liquid (Cryogenic Liquid) (Hazard Class 2.2, I.D. NO. UN1951, Nonflammable Gas Label). Argon is nonflammable and nontoxic and will not support combustion. It is manufactured as a cryogenic liquid with a normal boiling point of -302.6 deg F. As a cryogenic fluid, it is stored and transported in special insulated and vacuum-jacketed cylinders (DOT 4L) with a water capacity of not over 1000 pounds (454.6 liters or 120 gallons) or in insulated tanks and cargo tank trucks. It is also vaporized into its gaseous state and charged into high-pressure cylinders (DOT 3A or 3AA) of 1800 pounds per square inch gauge (psig) or greater. Argon, in its cryogenic liquid state, is normally stored in large, insulated storage tanks at the manufacturing facility and is delivered in small quantities directly to the point of use or to a special storage facility designed for cryogenic liquids. Argon, as a cryogenic liquid, cannot be stored in a closed container because the liquid is continuously boiling (vaporizing) and building up pressure; therefore, it is stored in a container with an open vent or a vent that incorporates a controlled pressure relief device. The storage and handling of argon, as addressed in this regulation, will be in its vapor or gaseous state in high-pressure DOT 3A, 3AA, or 3AL cylinders. Due to its ability to displace air, argon is a simple asphyxiant. Contact with the cryogenic liquid or its cold vapors and the escaping high pressure from a cylinder may cause frostbite and serious eye damage.

c. Carbon Dioxide (Hazard Class 2.2, I.D. NO. UN1013, Nonflammable Gas Label). Carbon dioxide in cylinders is in the form of a gas over liquid and at 70 deg F exerts a pressure of 838 psig. Humans cannot breathe air containing more than 10 percent carbon dioxide (by volume) without losing consciousness. The gas is about 1.5 times heavier than air and is nontoxic, nonreactive, slightly acidic, and will not burn or support combustion or human life. Carbon dioxide gas interferes with proper mentation at 1.9 percent and is not tolerable at 3.5 percent-5.0 percent. Carbon dioxide cylinders become extremely dangerous when heated to a temperature approximating 125 deg F and should never be placed near furnaces, radiators, or any other source of heat. Contact with the liquid or high-pressure gas may cause frostbite and serious eye damage.

d. Ethylene Oxide, Pure or with nitrogen (Hazard Class 2.3, I.D. NO. UN1040, Poison Gas and Flammable Gas Labels). Ethylene oxide is a highly reactive colorless gas that condenses to a colorless liquid boiling at 50.7 deg F (10.4 deg Celsius) and 14.7 psia. It is miscible in all proportions with water, alcohol, ether, and most organic solvents. The vapors of ethylene oxide are flammable and explosive. It is generally noncorrosive to metals and leaves no residual odor or taste. The major use of ethylene oxide is as a chemical intermediate for the manufacture of ethylene glycol and higher glycols. These glycols are used as drying agents, antifreezes, and raw materials for the manufacture of other chemical derivatives. Ethylene oxide, both pure and mixed with carbon dioxide or halocarbons, is also used as a sterilant and fumigant for heat-sensitive materials. Ethylene oxide is a toxic liquid and gas. The vapors from Ethylene oxide form flammable mixtures with air over a wide range (lower flammable limit (LFL) 3 percent and upper flammable limit (UFL) 100 percent). The vapor is heavier than air (vapor density 1.5 times heavier) and may travel a considerable distance to a source of ignition and flash back. Ethylene oxide is dangerously reactive; it may rearrange chemically and/or polymerize violently with evolution of heat when in contact with highly active Catalytic surfaces such as anhydrous chlorides of iron, tin, aluminum, and pure oxides of iron and aluminum, and alkali metal hydroxides. Although soluble in water, solutions will continue to burn until diluted to approximately 22 volumes of water to one volume of ethylene oxide. Ethylene oxide is moderately toxic by inhalation and breathing and high concentrations may cause pulmonary edema. It is a severe, eye, skin, and respiratory irritant, and effects may be delayed. For specific health hazards refer to the SDS, the DoD Hazardous Materials Information System, or the manufacturer, supplier, or vendor for information.

e. Ethylene Oxide and Nonflammable Gas Mixtures (Labeled According to Mixture). Due to the high flammability and explosive hazards of pure ethylene oxide and the need for its use as a sterilizer for medical equipment and material, a mixture of nonflammable gases is added to the material to reduce its hazard. The mixtures are usually 20 to 90 percent carbon dioxide or dichlorodifluoromethane by volume. The mixtures are less toxic than pure ethylene oxide but do pose a health threat when inhaled or when in direct contact with skin or eyes. For specific health hazards refer to the SDS, the DoD Hazardous Materials Information System, or the manufacturer, supplier, or vendor for information.

f. Helium, Compressed (Hazard Class 2.2, I.D. NO. UN1046, Nonflammable Gas); Helium, Refrigerated Liquid (Cryogenic Liquid) (Hazard Class 2.2, I.D. NO. UN1963, Nonflammable Gas Label). Helium is a colorless, odorless, and tasteless gas at room temperature and

atmospheric pressure. Its principal source in the United States is from certain natural gas wells in which the natural gas may contain up to 9 percent helium. It is normally supplied as a nonliquefied compressed gas in high-pressure DOT 3A or 3AA cylinders at or above a pressure of 1800 psig at 70 deg F. Helium can be condensed into a cryogenic liquid when refrigerated to below its normal boiling point of -452.1 deg F, the lowest boiling point of any substance known. As a cryogenic liquid, it is stored and transported in special insulated and vacuum-jacketed cylinders (DOT 4L) with a water capacity of not over 1,000 pounds (454.6 liters or 120 gallons) or in larger insulated and vacuum-jacketed tanks and cargo tank trucks. Helium, as a cryogenic liquid, is like argon and cannot be stored in a closed container because the liquid is continuously boiling (vaporizing) and building up pressure; therefore, it is stored in a container with an open vent or a vent that incorporates a controlled pressure relief device. The storage and handling of helium, as addressed in this regulation, will be in its vapor or gas state in high-pressure cylinders. In high concentrations, helium acts as a simple asphyxiant, causing suffocation due to oxygen deficiency. Contact with the liquid or cold vapors may cause frostbite and serious eye damage.

g. Hydrogen (Hazard Class 2.1, I.D. NO. UN1049, Flammable Gas Label). Hydrogen is a colorless, odorless, flammable gas at room temperature and atmospheric pressure. It is the lightest gas known. It is usually shipped as a nonliquefied compressed gas in high-pressure DOT 3A or 3AA cylinders at a pressure greater than 1800 psig at 70 deg F. Hydrogen can be condensed into a cryogenic liquid when refrigerated below its normal boiling point of -423.0 deg F. As a cryogenic liquid, it is stored and transported in special insulated and vacuum-jacketed cylinders (DOT 4L) with a water capacity of not over 1000 pounds (454.6 liters or 120 gallons) or in larger insulated and vacuum-jacketed tanks and cargo tank trucks. Hydrogen, as a cryogenic liquid, is like argon and helium and cannot be stored in a closed container because the liquid is continuously boiling (vaporizing) and building up pressure; therefore, it is stored in a container with an open vent or a vent that incorporates a controlled pressure relief device. The storage and handling of hydrogen, as addressed in this regulation, will be in its vapor or gaseous state in high-pressure cylinders. Hydrogen burns in air with a pale blue, almost invisible, flame. Hydrogen will form flammable and explosive mixtures over a wide range with air (LFL 4 percent, UFL 74 percent, lower explosive limit 4.1 percent, and upper explosive limit 74.2 percent) and oxygen (LFL 4 percent, UFL 95 percent, lower explosive limit 4.7 percent, and upper explosive limit 93.9 percent). Unlike hydrogen at normal ambient temperatures when it is lighter than air, the cold gas as it is vented or released from the container is slightly heavier than air and may remain near ground level until it warms up. Fog formed when the cold gas comes in contact with the moisture in the air will indicate where the gas is spreading; however, explosive mixtures can exist outside the visible fog. Hydrogen is nontoxic but can cause asphyxiation. Contact with the cryogenic liquid or cold vapor can cause frostbite and serious eye damage.

h. Nitrogen, Compressed (Hazard Class 2.2, I.D. NO. UN1066, Nonflammable Gas Label) Nitrogen, Refrigerated Liquid (Cryogenic Liquid) (Hazard Class 2.2, I.D. No. UN1977, Nonflammable Gas Label). Nitrogen is an odorless, colorless, tasteless, nontoxic, and almost totally inert gas that makes up 78 percent of the earth's atmosphere. It is colorless as a cryogenic liquid. It is not flammable and will not support combustion or human life. It is manufactured as a cryogenic liquid with a normal boiling point of -320 deg F. As a cryogenic liquid, it is stored and transported in either special insulated and vacuum-jacketed cylinders (DOT 4L) with a water

capacity of not over 1,000 pounds (454.6 liters or 120 gallons) or in insulated and vacuum-jacketed tanks or cargo tank trucks. It is also vaporized into the gaseous state and charged into high- pressure cylinders (DOT 3A, 3AA, or 3AL) 1800 psig or greater. Nitrogen in its cryogenic liquid state is normally stored in large storage tanks at the manufacturing facility and is delivered in small quantities directly to the point of use or to a special storage facility designed for cryogenic liquids. Nitrogen, as a cryogenic liquid like other cryogenic liquids, cannot be stored in a closed container because the liquid is continuously boiling (vaporizing) and building up pressure; therefore, it is stored in containers with an open vent or with a vent that incorporates a controlled pressure relief device. Alternate methods of producing nitrogen gas may be produced utilizing the pressure swing adsorption cycle or the use of membrane technology. The storage and handling of nitrogen as addressed in this regulation will be in its vapor or gas state in high-pressure DOT 3A, 3AA, or 3AL cylinders. Unlike nitrogen at normal ambient temperatures when it is lighter than air, the cold gas as it is vented or released from the cryogenic container is slightly heavier than air and may remain near ground level until it warms up. In this case, nitrogen can act as an asphyxiant, displacing air and causing suffocation due to oxygen deficiency. Fog formed when the cold gas comes in contact with the moisture in the air will indicate where the gas is spreading. Contact with the liquid or cold gas can cause frostbite and serious eye damage.

i. Nitrous Oxide, Compressed (Hazard Class 2.2, I.D. NO. 1070) and Nitrous Oxide, Refrigerated Liquid (Hazard Class 2.2, I.D. NO. 2201), Nonflammable Gas Label). Nitrous oxide at normal temperatures and pressures is a colorless, practically odorless, and tasteless, nontoxic gas. It is shipped as nitrous oxide, compressed, or nitrous oxide, refrigerated liquid. Nitrous oxide is nonflammable, but, being a mild oxidizing agent, will support combustion of flammable materials. It is used as an inhalant type of anesthetic or analgesic gas. When inhaled in high concentrations for a few seconds, it affects the central nervous system and may induce symptoms closely resembling alcoholic intoxication. Its colloquial name, "laughing gas," stems from the fact that some persons exhibit hilarity after inhaling nitrous oxide. Continued inhalation without an ample supply of oxygen results in simple asphyxia.

j. Oxygen, Compressed (Hazard Class 2.2, I.D. NO. UN1072, Nonflammable Gas (primary) and Oxidizer (subsidiary) Labels) Oxygen, Refrigerated Liquid (Cryogenic Liquid) (Hazard Class 2.2, I.D. No. UN1073, Nonflammable Gas (primary) and Oxidizer (subsidiary) Labels). Oxygen in the gaseous state is colorless, odorless, tasteless, nontoxic, and nonflammable but supports combustion vigorously. It is necessary to sustain life, and it constitutes about 20 percent, by volume, of the earth's atmosphere. As a cryogenic liquid, it is pale blue in color and, at its normal boiling point of -297 deg F, is slightly heavier than water. It is manufactured as a cryogenic fluid by fractional distillation of liquefied air or is manufactured as a gas using an electrolytic generator. Oxygen produced by the pressure swing adsorption cycle is a maximum of 94% oxygen with the remainder consisting of Argon. In accordance with Reference (u), this process does not meet procurement for gaseous aviators breathing oxygen; therefore, it should not be stored in a high pressure cylinder designated as aviators breathing oxygen. As a cryogenic liquid, it can be stored or transported in special insulated and vacuum-jacketed cylinders (DOT 4L) with a water capacity of not over 1,000 pounds (454.6 liter or 120 gallons) or in insulated and vacuum-jacketed tanks or cargo tank trucks. It is also vaporized into the gas state and charged into high-pressure cylinders (DOT 3A, 3AA, or 3AL) of 1800 psig or greater.

Oxygen, in its cryogenic liquid state, is normally stored in large storage tanks at the manufacturing facility and is delivered in small quantities directly to the point of use or to a special storage facility designed for cryogenic liquids. As with other cryogenic fluids, it cannot be stored in a closed container because the liquid is continuously boiling (vaporizing) and building up pressure; therefore, it is stored in containers with an open vent or with a vent that incorporates a controlled pressure relief device. The storage and handling of oxygen as addressed in this regulation will be in its vapor or gas state in high-pressure DOT 3A, 3AA, or 3AL cylinders. Contact with the cryogenic liquid or the cold vapor may cause frostbite and serious eye damage. The cold gas, as it is vented or released from the cryogenic container, is slightly heavier than air and will remain near ground level until it warms up. Fog formed when the cold gas comes in contact with the moisture in the air will indicate where the gas is spreading. All materials that are flammable in air burn much more vigorously in oxygen. Some combustibles, such as oil and grease, burn with nearly explosive violence in an oxygen atmosphere, if ignited. Oxygen itself is nonflammable. Containers must be kept free of oil, grease, and any other organic or hydrocarbon contamination and must not be handled with oily hands, gloves, or greasy equipment. Use of perchloroethylene, trichloroethylene, or 1, 1, 1, -trichloroethane to clean cylinders is prohibited and may create an explosive atmosphere with a resulting fire or explosion.

APPENDIX 2

CHARACTERISTICS OF CYLINDERS

1. GENERAL. In the absence of a standardization program, the type and size of compressed gas cylinders has varied in past procurements. The type, design, size, and capacity normally depend on the commodity of gas and the amount to be shipped in one cylinder. It may be necessary to occasionally identify a cylinder to exact specifications for a specific application in or with an end item or weapon system. The current method of procurement stipulates that all cylinders be purchased using military or Federal specifications and standards to provide a standardization in the cylinder program. These documents are continuously updated to reflect the of state-of-the-art applications; however, since the cylinder is a nonexpendable item and is continually cycled into and out of various applications, methods must be established for its accountability and reconditioning.

2. BASIC CYLINDER TYPES

a. Basic Cylinders. Compressed gas cylinders in use by DoD activities and other Government activities are of three basic types: high pressure, low pressure, and low pressure for gas in solution. High-pressure cylinders are those marked with a service pressure of 900 psig (6200 kilopascal or greater and low pressure cylinders are marked with a service pressure of less than 900 psig [6200 kilopascal]). The differentiating pressure types of cylinders are identified as DOT designations 3, 4, or 8 with an applicable suffix to identify the particular specification that was used in manufacturing the cylinder. All cylinders purchased and/or requalified for use by DoD and other Government activities must be manufactured, inspected, and tested in accordance with Parts 173 and 178 of Reference (o) or to its designated Military or Federal Specification. Each person who represents that he manufactures or performs retesting as outlined in Reference (o) must be approved by, and have a registration number issued by, DOT.

b. Cylinder Types. The cylinders used throughout DoD that are managed by the DLA are cylinders identified by DOT specifications 3, 3A, 3AA, 3AL, 4, 4A, 4AA, 4B, 4BA, 4BW, 8, and 8AL.

(1) The markings of a typical cylinder might be arranged on one side of the shoulder or head of the cylinder as follows:

(2) The markings of a typical cylinder might be arranged on one side of the shoulder or head of the cylinder as follows:

DOT 3AA2265
CX428813TW
US GOVT

(3) In this case, the DOT specification is 3AA, the service pressure is 2265 psig at 70 deg F, the purchasing agency is CX (DLA), the serial number is 428813, the manufacturer is TW (Taylor-Wharton), and the owner is the United States Government. These same markings could be arranged in a horizontal line around the shoulder and might appear as follows: DOT 3AA2265 CX428813TW US GOVT. Complete requirements for markings on cylinders are contained in the applicable cylinder specification in Part 178 of Reference (o), and in the Government procurement specification.

c. Cylinder Interchangeability. In most instances, depending on product and application, cylinders of a given basic type are interchangeable. For instance, DOT 3A and 3AA cylinders are interchangeable when the shatterproof characteristic is not a prime factor in their use. DOT 4B, 4BA, and 4BW are also interchangeable when the materials of construction are compatible with the product used. In the military supply system, the DOT 4A and 4AA cylinders are used exclusively for anhydrous ammonia and should not be substituted for or by any other specification 4 cylinder unless such use is approved by DOT. The specification 8 and 8AL cylinders are packed with a porous material that, even when the cylinders are empty, makes them much heavier than would normally be expected. These cylinders are used exclusively for acetylene; no other product may be used with these cylinders. When newly manufactured, the porous material in these cylinders is filled with acetone.

d. Cylinder Sizes. The physical dimensions (e.g., diameter and height) of the cylinders in the DoD inventory are continuously changing to meet new design and application requirements. The Government, over the past several years, has thus accumulated various size and capacity cylinders for each of the compressed gas applications. This is more predominant in the DOT 4 and 8 specification cylinders. A variation of the cylinder dimensions to + 2 inches in diameter and + 6 inches in height is found with some refrigerant and acetylene cylinders having a common volumetric capacity. In such instances, the cylinders have been grouped together based on the common capacity under one or more designated National Stock Numbers (NSNs). This grouping is available for cylinders that are not within the dimensional criteria but are within the capacity criteria of the established NSNs. When an NSN has been established for a cylinder with critical dimensions, or for a critical end item application such as where the cylinder must fit in a retaining fixture aboard a ship or aircraft, the cylinders must be within the specified tolerances. The variation of cylinder size is not as prevalent with the DOT 3 series cylinders. Tolerances of these cylinders must not exceed +1/4 inch diameter and + 1 inch in height from the established NSN description. As with the low-pressure DOT 4 and 8 cylinders, there are specific requirements for DOT 3 series cylinders that must be mounted in retaining fixtures; the designated tolerances must be considered for proper cylinder identification or cylinder procurement. Most of the DOT 4 and 8 cylinders that are not designated for a specific end use in which the size is critical may be identified only as cylinders with the same capacity for a given gas under one NSN.

e. Cylinder Pressures. Compressed gas cylinders are designed and constructed to meet the specific needs of storing, using, and transporting compressed gases safely. All cylinder designs and/or types are regulated and manufactured in accordance with DOT specifications. Each cylinder has been marked with a DOT specification and working (service) pressure, which is stamped (not stenciled) into the shoulder of the cylinder. The cylinder selected for use with a

product is based on the stabilized pressure of the product at an ambient temperature of 130 deg F, which must not exceed 5/4 times the service pressure (at ambient temperatures) of the cylinder; the materials used in the construction of the cylinder also must be compatible with the product. Exceptions apply for certain charged cylinders depending on the product, such as acetylene, liquefied nitrous oxide, or liquefied carbon dioxide.

(1) Cylinder Pressure Substitutions. Cylinders of the same type manufactured to the same specification (3A, 3AA, 3AL, 4B, 4BA, or 4BW) with a greater service pressure than is necessary for the designated product may be substituted for the specified cylinder of lower pressure provided the prescribed valve and cylinder characteristic requirements for the product and application are met. The minimum service pressure of a cylinder for a compressed gas that is filled by weight (gas in the liquid state) is determined by the vapor pressure of the gas product at a temperature of 130 deg F. The approved cylinders and the regulated service pressures are found in Reference (o) and in the product and cylinder description listings for Federal Supply Classes 6505, 6830, and 8120.

(2) Cylinders. High-pressure cylinders DOT 3A and 3AA with service pressures of 1800 psig or greater will vary in capacity based on the service pressure and the product. DOT cylinders 3A2000, 3AA2000, 3A2260, and 3AA2260 were purchased in the past for helium service, and NSNs were assigned as necessary. It has been necessary to convert some of these cylinders to other services where a specific NSN does not apply. The following cylinders have been consolidated: DOT 3A2000 with 3A2015, 3AA2000 with 3AA2015, 3A2260 with 3A2265, and 3AA2260 with 3AA2265. New NSNs were not established for this consolidation.

f. Nonshatterable/Shatterproof Cylinders. The term "nonshatterable" as used herein refers only to specification 3A and 3AA high pressure cylinders. This designation is not considered applicable to specification 4 or 8 cylinders. This type of cylinder is required in all aircraft and shipboard applications where fragmentation must be controlled to minimize loss of life and damage to vital systems. The designation is applied to high-pressure DOT 3A or 3AA cylinders made of a high grade of steel that will not separate into more than two pieces when ruptured by a Caliber projectile when the cylinder is filled to its service pressure. Cylinders meeting this requirement have been specifically identified by item description in Federal Supply Classes 8120. Many nonshatterable cylinders are identified by the words "NONSHATTERABLE," "NON-SHAT," or "SHATTERPROOF" stamped, not stenciled, into the shoulder of the cylinder. In other instances, nonshatterable cylinders can be identified as follows:

(1) All cylinders stamped DOT 3AA that are made of 4130x steel.

(2) All cylinders stamped DOT 3A with one of the following specification numbers on the shoulder:

SPS 843 (INT)
SPS 1022 (INT)
51-C-26 and 51-C-26 (INT)
51-C-41 and 51-C-41 (INT)

(3) Cylinders that are marked with specification 51-C-31 or 51-C-31 (INT) are also nonshatterable if the initial (earliest) hydrostatic test date is 6-44 or later. Cylinders manufactured prior to 6-44 are nonshatterable only if they are so indicated by the manufacturer. Cylinders that are not identified by any of the above markings will not be classed and identified by NSN as nonshatterable. Changes in NSNs or Condition Codes that result from reidentifying cylinders from shatterable to nonshatterable as stated above will be reported to DLA in accordance with Reference (v), except that DD Form 1225, Storage Quality Control Report, is not required.

3. CYLINDER REQUALIFICATION

a. Compressed gas cylinders will not be refilled if the prescribed service period between cylinder requalifications has expired. Each time a cylinder is requalified, the date of test or inspection, indicating the month and year, is stamped into the shoulder, collar, or foot ring of the cylinder with a steel stamp. This date is used to determine the next scheduled requalification date. The DOT registration identification number of the requalification facility must be stamped between the month and year. This marking will provide traceability to the last facility that performed a requalification on the cylinder. **Note**: when there is a conflict between DoD cylinder specifications and the specifications required by the host nation at an OCONUS installation, the more stringent requirements must apply.

b. The service period for each type of cylinder is considered to have expired if the latest marked requalification date stamped on the shoulder, valve guard, or foot ring of the cylinder precedes the current date by more than the period indicated in Table 3. The referenced paragraph entries all refer to Reference (o). Only the types that qualify as compressed gas cylinders have been incorporated.

DOT Cylinder Specification	Paragraph Reference*	Description	Retest Period
DOT 3			5 years
DOT 3A, DOT 3AA			
Specific Applications	173.34e(12)	With 5 year internal and external visual	10 years
Specific Applications	173.34e(13)	Non-corrosive—external visual only	5 years
Specific Applications	173.34e(14)	Anhydrous Ammonia	10 years
Specific Applications	173.34e(16)	Dry Gas Applications	10 years
Specific Applications	173.34e(19)	Extinguishers	12 years
General Applications			5 years
DOT 3AL			
Specific Applications	173.34e(19)	Extinguishers	12 years
General Applications			5 years
DOT 4A			
Specific Applications	173.34e(12)	With 5 year internal and external visual	10 years
Specific Applications	173.34e(13)	Non-corrosive—external visual only	5 years
General Applications			5 years
DOT 4AA			
Specific Applications	173.34e(13)	Non-corrosive—external visual only	5 years
Specific Applications	173.34e(14)	Anhydrous Ammonia	10 years
General Applications			5 years
DOT 4B, 4BA, 4BW			
Specific Applications	173.34e(11)	With water jacket hydrostatic test	12 years
Specific Applications	173.34e(11)	With modified hydrostatic test	5 years
Specific Applications	173.34e(12)	With 5 year internal and external visual	10 years
Specific Applications	173.34e(13)	Non-corrosive—external visual only	5 years
Specific Applications	173.34e(19)	Extinguishers	12 years
General Applications			5 years

Table 3. Department of Transportation Cylinder Retest Periods

(1) Applications of Paragraph 173.34e(11). Anhydrous dimethylamine; anhydrous methylamine; anhydrous trimethylamine; methyl chloride; liquefied petroleum gas; methylacetylene-propadiene stabilized; dichlorodifluoromethane; diflurorethane; difluorochloroethane; chlorodifluoromethane; chlorotetrafluoroethane; trifluorochloroethylene;

or mixtures thereof or mixtures of one or more with trichlorofluoromethane. All gases must be free of corroding components.

(2) Applications of Paragraph 173.34e(13). Anhydrous ammonia: Butadiene, inhibited; cyclopropane; fluorinated hydrocarbons and mixtures thereof; liquefied hydrocarbon gas; liquefied petroleum gas; methylacetylene-propadiene, stabilized; anhydrous mono, di, trimethylamines; ethyleneimine, inhibited. All gases must be free of corroding components.

(3) Applications of Paragraph 173.34e(16). Air, argon, cyclopropane, ethylene, helium, hydrogen, krypton, neon, nitrogen, nitrous oxide, oxygen, sulfur hexafluoride (domestic)/sulphur hexafluoride (international), xenon, permitted mixtures of these gases and permitted mixtures of these gases with up to 30 percent by volume of carbon dioxide. All additional requirements of paragraph 173.34e(16) must be met.

c. Requalification Identification. Each cylinder passing the requalification test and inspection must be marked with the facilities assigned identification number set in a square pattern, between the month and year of the requalification date. This number must be stamped in characters not less than 1/8-inch high with the first character occupying the upper left corner of the square pattern. The second character must be in the upper right, the third in the lower right, and the fourth in the lower left.

(1) For example, a cylinder requalified in May 1984 and approved by a facility that has been issued identification number A123 would be stamped:

A 1
5 84
3 2

(2) Variations from the marking requirements may be permitted upon written request to, and approval issued by, the DOT Office of Hazardous Materials Transportation. Stamping must be in accordance with the location requirements of the cylinder specification. Date of previous requalification's must not be obliterated. Cylinders subject to a modified requalification and cylinders that are exempt from requalification are not required to be marked with a registration identification number.

d. Requalification Exemptions. All cylinders not exceeding an outside diameter of 2 inches and a length of 2 feet, and all cylinders designated 3E and 4C are exempted from hydrostatic requalification.

e. Requalification Requirements. The requirement for a cylinder to be retested after the expiration of a specific service period is further clarified to indicate that after the expiration of the service period, the cylinder must not be recharged until the requalification is performed. This is to imply that a visually serviceable full cylinder is considered fully serviceable until the product is exhausted, and then it cannot be refilled until a requalification test and inspection is performed. An exception to this extension of the retest period for cylinders still full of product is the specific requirements for cylinders used as fire extinguishers. Such cylinders (extinguishers)

must be removed from service, emptied, and requalified at intervals not to exceed those intervals specified in Paragraph 1910.l 57(f) of Reference (l). All periods cited herein meet or exceed the requalification requirements outlined in Reference (j). DOD activities will requalify cylinders as cited herein. IMPORTANT: All cylinders must be requalified by a facility that has been inspected and registered with DOT.

4. CYLINDER VALVES

a. Cylinder Valves. The physical and functional design of the compressed gas cylinder valve is critical to its designated application with a specific gas product. Each valve is designed with an outlet connection that will prevent the cylinder from being coupled to a system that is not compatible with the gas product. Examples would be to prevent an oxidizing gas cylinder, such as one containing oxygen, to be connected to a flammable gas system such as a system containing acetylene, or to prevent a life-threatening gas from being connected to a medical, dental, or veterinary gas system for respiratory use. Cylinder valve outlet connection adapters must only be used within the same commodity group with compatible applications. All valves procured for use on Government-owned cylinders must meet all requirements of Reference (r). Information on the various cylinder valve outlet designs and their specific assigned gas applications is provided in References (x) and (y).

b. Valve Procurement. Reference (w) and all its supplementary specification sheets have been developed to provide all necessary data to competitively procure cylinder valves for each gas product used by the Government. A type of designator has been assigned to each valve that identifies the specification sheet, the assigned valve outlet connection number, and, if applicable, the standard pressure relief device. Valves installed on Government-owned cylinders may not always conform to the latest issue of Reference (w); however, they must have an outlet connection compatible with the product contained in the cylinder. Replacement of nonconforming valves is only required if the valve is defective, is not properly marked, does not have the proper outlet connection, or has an improper pressure relief device that cannot be changed. Several of the compressed gas cylinders used by DOD have valve outlet connections that are common for several different gases based on the properties of the gases. To determine a suitable outlet connection when one cannot be identified by visual inspection, it is recommended that a valve outlet connection nipple and a nut from a regulator of a known compatible application be tried in or on the outlet. This method is preferred overusing an outlet plug or cap because some connections employ the same size thread but the bore depth to accept the connection nipple is different to prevent cross connection. Valve design and outlet connection number assignments have not been accomplished on all gases or gas mixtures. If a valve and its specific design has not been identified in Reference (w), the proper valve and cylinder assembly identification will be obtained from DLA.

c. Medical Valves. Materials sanctioned by the National Aeronautics and Space Administration are specified for medical cylinder valves. Materials routinely used in the commercial marketplace, such as neoprene, have been found to be detrimental in high-pressure oxygen systems. Valves that are chromium plated should possess approved materials, as

recommended by National Aeronautics and Space Administration, and as specified for valves managed by DLA. Cylinder valves on refillable medical gas cylinders that are not chromium plated must be replaced.

d. Fire Extinguishing System Cylinder Valves. Fire extinguishing system cylinder valves for carbon dioxide and bromotrifluoromethane (Halon 1301) will be different. Fire extinguishing system cylinder valves, as prescribed by Reference (u) for carbon dioxide, and Reference (v) for Halon 1301, will be used.

5. COLOR CODING. All personnel who handle or use compressed gas cylinders must be familiar with the purpose of color coding cylinders to the requirements of Reference (n). Color coding is provided as a hazard warning and should be used with other characteristics such as physical size, valve outlet connection, nomenclature stamped on the valve, nomenclature stenciled on the cylinder, the type, and the service pressure of the cylinder to identify the contents of the cylinder. The appearance of any of the colors on the body or top or as a band(s) on compressed gas cylinders in Table 4 serve as a hazard warning: If there is any doubt as to the contents of the cylinder, DLA should be contacted immediately, and the cylinder should be stored as a poison gas until the contents are verified.

Band Color	Hazard Type
Yellow	Flammable
Brown	Toxic and Poisonous
Blue	Anesthetic and Harmful
Green	Oxidizers
Gray	Dangerously High Pressure and Asphyxiant
Red	Fire Protection

Table 4. Hazard Warning Colors for Compressed Gas Cylinders

GLOSSARY

PART I. ABBREVIATIONS AND ACRONYMS

C	Celsius
CGA	Compressed Gas Association
DAD	Deputy Assistant Director
Deg	Degrees
DHA	Defense Health Agency
DHA-PM	Defense Health Agency-Procedures Manual
DLA	Defense Logistics Agency
DOT	Department of Transportation
DTF	dental treatment facilities
F	Fahrenheit
ICC	Interstate Commerce Commission
LFL	lower flammable limit
MEDLOG	Medical Logistics
MTF	military medical treatment facility
N/A	Not Applicable
NSN	National Stock Number
psia	pounds per square inch absolute
psig	pounds per square inch gauge
SDS	Safety Data Sheets
UFL	upper flammable limit
USP	United States Pharmacopeia

PART II. DEFINITIONS

bulk (liquid) gas. A fixed, central system consisting of a main storage tank that pipes oxygen, ethylene oxide, or other gasses to patient care areas.

compressed gas. The term "compressed gas" is described as follows:

a. Any material or mixture having, in the container, an absolute pressure exceeding 40 psia (25 psig) at 70 deg F.

b. Regardless of the pressure at 70 deg F, having an absolute pressure exceeding 104 psia (89 psig) at 130 deg F.

c. Any liquid flammable material having a vapor pressure exceeding 40 psia (25 psig at 100 deg F as determined by Reference (s).

cylinder. A compressed gas cylinder is a pressure vessel designed for the storage and transportation of a compressed gas at pressures higher than 40 psia (25 psig), with a tubular shape and circular cross section. This does not include a portable tank, a multi-unit tank car tank, a cargo tank, or a tank car.

Julian Date. Interval of time in days and fractions of a day since January 1, 4713 BC Greenwich noon. See http://www.csgnetwork.com/juliangregcalconv.html.