A6.5. Nonliquefied Compressed Gases. Package nonliquefied compressed gases as follows:

A6.5.1. Ship nonliquefied, compressed gases in accordance with the filling, pressure, and DOT cylinder specification requirements of Table A6.1. If the compressed gas is not specifically identified in Table A6.1., ship in DOT 3, 3A, 3AA, 3AL, 3B, 3E, 4B, 4BA, or 4BW. Use of existing cylinders, DOT 3, 3C, 3D, 4, 4A, 4C, 25, 26, 33, and 38 is authorized, but new construction of these cylinders is not authorized.

A6.5.2. DOT-3HT Cylinders. DOT-3HT cylinders for use in aircraft only, having a maximum service life of 24 years, are only authorized for nonflammable gases. They must be equipped with a frangible disc safety relief device, without fusible metal backing, with a rated bursting pressure not over 90 percent of the minimum required test pressure of the cylinder with which the device is used. **(T-0)**. Pack cylinders in strong outer packagings.

A6.5.3. DOT 39 Cylinder. Use DOT 39 cylinder for compressed gasses. When used for flammable gases, the internal volume must not exceed 1.23 L (75 cubic inches). **(T-0).** Use aluminum cylinders for oxygen only under the following conditions:

A6.5.3.1. Cylinder threads must be straight threads (except for UN Cylinders). **(T-0).**

A6.5.3.2. Valves must be made of brass or stainless steel. **(T-0).**

A6.5.3.3. Each cylinder must be cleaned to comply with the requirements of DLAI 4145.25 or MIL-STD-1411, *Inspection and Maintenance of Compressed Gas Cylinders*. **(T-0).**

A6.5.3.4. The pressure in each cylinder must not exceed 20,684 kPa (3000 psig) at 21 degrees C (70 degrees F). **(T-0).**

A6.5.4. DOT 3AL Cylinder. Ship flammable gases in 3AL cylinders on cargo aircraft only. When used in oxygen service, the cylinders must comply with 49 CFR Subparagraph 173.302a(a)(5). **(T-0).**

A6.5.5. DOT 3AX, 3AAX, 3T Cylinders. Use cylinders, DOT 3AX, 3AAX, or 3T for Division 2.1 and 2.2 materials and for carbon monoxide. DOT 3T cylinders are not authorized for hydrogen. When used in methane service, the methane must be a nonliquefied gas with a minimum purity of 98.0 percent methane and which is commercially free of corroding components. **(T-0).**

A6.5.6. UN Specification cylinders as authorized in 49 CFR Section 173.302b.

A6.5.7. Foreign Cylinders. Foreign cylinders meeting the requirements of A3.3.2.10.

A6.5.8. Compressed Oxygen and Oxidizing Gases. Ship compressed oxygen and oxidizing gases in DOT specification 3A, 3AA, 3AL, 3E, 3HT, 39 cylinders, 4E (filled to less than 200 psig at 21 °C (70 °F), and UN pressure receptacles ISO 9809-1, ISO 9809-2, ISO 9809-3 and ISO 7866 cylinders. Cylinders must be equipped with a pressure relief device in accordance with 49 CFR Paragraph 173.301(f) and, DOT specification cylinders or for the UN pressure receptacles prior to initial use. **(T-0).** The rated burst pressure of a rupture disc for DOT 3A, 3AA, 3AL, 3E, and 39 cylinders, and UN pressure receptacles ISO 9809-1, ISO 9809-2, ISO 9809-3 and ISO 7866 cylinders must be 100% of the cylinder minimum test pressure with a tolerance of plus zero to minus 10%. **(T-0).** The rated burst pressure of a rupture disc for a DOT 3HT cylinder must be 90% of the cylinder minimum test pressure with a tolerance of plus zero to minus 10%. **(T-0).** A cylinder containing compressed oxygen, compressed

oxidizing gases, or nitrogen trifluoride must be packaged in a rigid outer packaging that conforms to the requirements of either 49 CFR Part 178, Subparts L and M, at the Packing Group I or II performance level; or the performance criteria in Air Transport Association (ATA) Specification No. 300 for a Category I Shipping Container. **(T-0).** In addition, is capable of meeting the following additional requirements:

A6.5.8.1. Pass the Flame Penetration Resistance Test specified in 49 CFR Part 178, Appendix E.

A6.5.8.2. Pass the Thermal Resistance Test specified in 49 CFR Part 178, Appendix D.

A6.5.8.3. Prior to each shipment, passes a visual inspection that verifies that all features of the packaging are in good condition, including all latches, hinges, seams, and other features, and that the packaging is free from perforations, cracks, dents, or other abrasions that may negatively affect the flame penetration resistance and thermal resistance characteristics of the packaging.

A6.5.9. Carbon Monoxide. Ship carbon monoxide in a DOT-3A, 3AX, 3AA, 3AAX, 3AL, 3, 3E, or 3T cylinder having a minimum service pressure of 12,411 kPa (1800 psig). The pressure in the cylinder must not exceed 6895 kPa at 21 degrees C (1000 psig at 70 degrees F), except that if the gas is dry and sulfur free, charge the cylinder to no more than five-sixths of the cylinder service pressure or 13,790 kPa (2000 psig), whichever is the least. **(T-0).** Fill DOT 3AL cylinders to no more than its marked service pressure.

A6.5.10. Fluorine. For fluorine gas use only DOT 3A1000, 3AA1000, or 3BN400 cylinders without a safety relief device and equipped with valve protection caps. Do not charge cylinders over 2758 kPa at 21 degrees C (400 psig at 70 degrees F) and ensure contents do not exceed 2.7 kg (6 pounds) of gas.

A6.5.11. Liquid Argon, Oxygen, and Nitrogen Samples. Ship liquid argon, oxygen, or nitrogen samples under pressure, in Cosmodyne Gas Samplers, Models CS 4.4 and CS 2.0 or in TTU-131/E Sampler (MIL-S-27626). Package as required for the specific model used. Take samples in the liquid state but vaporize before shipment.

A6.5.12. Diborane and Diborane Mixtures. For Diborane and Diborane mixtures, use only a DOT 3AL or 3AA cylinders having a minimum service pressure of 12,411 kPa (1800 psig). Ensure the maximum filling density of the diborane does not exceed 7 percent. Ensure diborane mixed with compatible compressed gas does not have a pressure exceeding the service pressure of the cylinder if complete decomposition of the diborane occurs.

A6.5.13. Recoil Mechanisms/Artillery Gun Mounts. Pack recoil mechanisms or artillery gun mounts containing nitrogen charged to a maximum pressure of 15,858 kPa at 21 degrees C (2300 psig at 70 degrees F) in strong outer wooden containers. Ship recoil mechanisms or artillery gun mounts containing nitrogen unpackaged when securely attached to the weapon system.

A6.5.14. Satellites, Spacecraft, and Other Articles Charged with Nitrogen or Dry Air. These items may be transported inside a protective shipping container with a nitrogen or air purge during flight. The compressed gas must be in authorized cylinders and protected from damage during transport. **(T-0).** The system must be equipped with a safety valve, enabling

the nitrogen flow to be immediately shut off in the event of a problem while on the aircraft. **(T-0).** Transport authorized on C-5, and C-17 aircraft only. The following limitations apply:

A6.5.14.1. Nitrogen may be purged into the shipping container at a rate not to exceed five (5) cubic feet per hour.

A6.5.14.2. Nitrogen may be purged into the shipping container at a rate not to exceed twenty (20) cubic feet per hour during transport. A technical escort must, using a portable oxygen monitor, continuously check the atmosphere inside the aircraft during flight. **(T-0).** If the percentage of oxygen drops to 19.5% per volume, the escort must notify the aircraft commander immediately and the nitrogen purge immediately discontinued. **(T-0).** All personnel will use supplemental oxygen until the percentage of oxygen exceeds 19.5% per volume. **(T-0).** Provide maximum airflow rate in the cargo compartment during flight. Cargo doors must remain open during ground operations to provide adequate ventilation. **(T-0).**

A6.5.14.3. Dry air may be purged into the shipping container at a rate not to exceed 70 cubic feet per hour.

A6.5.14.4. Meet all other requirements of this manual.

A6.5.14.5. See Attachment 17 for additional certification requirements.

Table A6.1. Cylinder Requirements for Compressed Gases.

Table A6.1 **Name of Gas**	**Maximum Permitted Filling Density in Percent (See A3.3.2.6)**	**Cylinders Marked as Shown Below, Or of The Same Type With Higher Service Pressure**
Anhydrous ammonia	54	DOT-3A480, DOT-3AA480, DOT3A480X, DOT-4AA480, DOT-3, DOT-3E1800, DOT-3AL480
Bromotrifluoromethane (R-13B1 or H-1301)	124	DOT-3A400, DOT-3AA400, DOT-3B400, DOT-4AA480, DOT-4B400, DOT-4BA400, DOT-4BW400, DOT-3E1800, DOT-39, DOT-3AL400
Carbon dioxide (see notes 3 and 4)	68	DOT-3A1800, DOT-3AX1800, DOT-3AA1800, DOT-3AAX1800, DOT-3, DOT-3E1800, DOT-3T1800, DOT-3HT2000, DOT-39, DOT-3AL1800,
Carbon dioxide refrigerated liquid		DOT-4L
Chlorine (see note 1)	125	DOT-3A480, DOT-3AA480, DOT-3, DOT-3BN480, DOT-3E1800

Table A6.1 Name of Gas	Maximum Permitted Filling Density in Percent (See A3.3.2.6)	Cylinders Marked as Shown Below, Or of The Same Type With Higher Service Pressure
Chlorodifluroethane (R142b) or 1-Chloro-1, 1-Difluoroethane (see note 4)	100	DOT-3A150, DOT-3AA150, DOT-3B150, DOT-4B150, DOT-4BA225, DOT-4BW225, DOT-3E1800, DOT-39, DOT-3AL150,
Chlorodifluoromethane (R22) (see note 4)	105	DOT-3A240, DOT-3AA240, DOT-3B240, DOT-4B240, DOT-4BA240, DOT-4BW240, DOT-4B240ET, DOT-4E240, DOT-39, DOT-3E1800, DOT-3ALA240,
Chloropentafluorethane (R-115)	110	DOT-3A225, DOT-3AA225, DOT-3B225, DOT4A225, DOT-4BA225, DOT-4B225, DOT-4BW225, DOT-3E1800, DOT-39, DOT-3AL225,
Chlorotrifluoromethane (R-13) (see note 4)	100	DOT-3A1800, DOT-3AA1800, DOT-3, DOT-3E1800, DOT-39, DOT-3AL1800
Cyclopropane (see note 4)	55	DOT-3A225, DOT-3A480X, DOT-3AA225, DOT-3B225, DOT-4AA480, DOT-4B225, DOT-4BA225, DOT-4BW225, DOT-4B240ET, DOT-3, DOT-3E1800, DOT-39, DOT-3AL225
Dichlorodifluoromethane (R-12) (see note 4)	119	DOT-3A225, DOT-3AA225, DOT-3B225, DOT-4B225, DOT-4BA225, DOT-4BW225, DOT-4B240ET, DOT-4E225, DOT-39, DOT-3E1800, DOT-3AL225

Table A6.1 Name of Gas	Maximum Permitted Filling Density in Percent (See A3.3.2.6)	Cylinders Marked as Shown Below, Or of The Same Type With Higher Service Pressure
Dichlorodifluoromethane and difluoroethane mixture (constant boiling mixture) (R-500) (see note 4)	Not liquid full at 55 degrees C (131 degrees F)	DOT-3A240, DOT-3AA240, DOT-3B240, DOT-3E1800, DOT-4B240, DOT-4BA240, DOT-4BW240, DOT-4E240, DOT-39
Difluoroethane (R-152a) (see note 4)	79	DOT-3A150, DOT-3AA150, DOT-3B150, DOT-4B150, DOT-4BA225, DOT-4BW225, DOT-3E1800, DOT-3AL150
1,1-Difluoroethylene (R-1132A)	73	DOT-3A2200, DOT-3AA2200, DOT-3AX2200, DOT-3AAX2200, DOT-3T2200, DOT-39
Dimethylamine, anhydrous	59	DOT-3A150, DOT-3AA150, DOT-3B150, DOT-4B150, DOT-4BA225, DOT-4BW225, ICC-3E1800
Ethane (see note 4)	35.8	DOT-3A1800, DOT-3AX1800, DOT-3AA1800, DOT-3AAX1800, DOT-3, DOT 3E1800, DOT-3T1800, DOT-39, DOT-3AL1800
Ethane (see note 4)	36.8	DOT-3A2000, DOT-3AX2000, DOT-3AA2000, DOT-3AAX2000, DOT-3T2000, DOT-39, DOT-3AL2000
Ethylene (see note 4)	31.0	DOT-3A1800, DOT-3AX1800, DOT-3AA1800, DOT-3AAX1800, DOT -3, DOT-3E1800, DOT-3T1800, DOT-39, DOT-3AL1800

Table A6.1 Name of Gas	Maximum Permitted Filling Density in Percent (See A3.3.2.6)	Cylinders Marked as Shown Below, Or of The Same Type With Higher Service Pressure
Ethylene (see note 4)	32.5	DOT-3A2000, DOT-3AX2000, DOT-3AA2000, DOT-3AAX2000, DOT-3T2000, DOT-39, DOT-3AL2000
Ethylene (see notes 4)	35.5	DOT-3A2400, DOT-3AX2400, DOT-3AA2400, DOT-3AAX2400, DOT-3T2400, DOT-39, DOT-3AL2400
Hydrogen chloride, anhydrous	65	DOT-3A1800, DOT-3AA1800, DOT-3AX1800, DOT-3AAX1800, DOT-3, DOT-3T1800, DOT-3E1800
Hydrogen sulfide (see notes 5 and 6)	62.5	DOT-3A, DOT-3AA, DOT-3B, DOT-4A, DOT-4B, DOT-4BA, DOT-4BW, DOT-3E1800, DOT-3AL
Insecticide, gases liquefied (see note 4 and 8)	Not liquid full at 55 degrees C (131 degrees F)	DOT-3A300, DOT-3AA300, DOT-3B300, DOT-4B300, DOT-4BA300, DOT-4BW300, DOT-3E1800
Liquefied nonflammable gases, other than classified flammable, corrosive, toxic & mixtures or solution thereof filled with nitrogen, carbon dioxide or air (see notes 3 and 4)	Not liquid full at 55 degrees C (131 degrees F)	DOT specification cylinders identified in A6.4.1. and DOT-3HT, DOT-4D, DOT-4DA, DOT-4DS

Table A6.1 Name of Gas	Maximum Permitted Filling Density in Percent (See A3.3.2.6)	Cylinders Marked as Shown Below, Or of The Same Type With Higher Service Pressure
Methylacetylene-propadiene, mixtures, stabilized (see note 2)	Not liquid full at 55 degrees C (131 degrees F)	DOT-4B240, without brazed seams, DOT-4BA240, without brazed seams, DOT-3A240, DOT-3AA240, DOT-3B240, DOT-3E1800, DOT-4BW240, DOT-4E240, DOT-4B240ET, DOT-3AL240
Methyl chloride	84	DOT-3, DOT-3A225, DOT-3AA225, DOT-3B225, DOT-3E1800, DOT-4B225, DOT-4BA225, DOT-4BW225, DOT-4B240ET, Cylinders complying with DOT-3A150, 3B150, and 4B150 manufactured before 7 December 1936 are also authorized.
Methyl mercaptan	80	DOT-3A240, DOT-3AA240, DOT-3B240, DOT-4B240, DOT-4B240ET, DOT-3E1800, DOT-4BA240, DOT-4BW240
Nitrosyl Chloride	110	DOT-3BN400 only
Nitrous Oxide (see notes 3, 4, and 7)	68	DOT-3A1800, DOT-3AA1800, DOT-3AX1800, DOT-3AAX1800, DOT-3, DOT-3E1800, DOT-3T1800, DOT-3HT2000, DOT-39, DOT-3AL1800
Refrigerant gas, N.O.S. or Dispersant gas, N.O.S. (see notes 4 and 9)	Not liquid full at 55 degrees C (131 degrees F)	DOT-3A240, DOT-3AA240, DOT-3AL240, DOT-3B240, DOT-3E1800, DOT-4B240, DOT-4BA240, DOT-4BW240, DOT-4E240, DOT-39

Table A6.1 Name of Gas	Maximum Permitted Filling Density in Percent (See A3.3.2.6)	Cylinders Marked as Shown Below, Or of The Same Type With Higher Service Pressure
Sulfur dioxide (see note 4)	125	DOT-3, DOT-3A225, DOT-3AA225, DOT-3AL225, DOT-3B225, DOT-3E1800, DOT-4B225, DOT-4BA225, DOT-4BW225, DOT-4B240ET, DOT-39
Sulfur hexafluoride	120	DOT-3A1000, DOT- 3AA1000, DOT-3AAX2400, DOT-3, DOT-3AL1000, DOT-3E1800, DOT-3T1800
Sulfuryl fluoride	106	DOT-3A480, DOT-3AA480, DOT-3E1800, DOT-4B480, DOT-4BA480, DOT-4BW480
Tetrafluoroethylene, stabilized	90	DOT-3A1200, DOT-3AA1200, DOT-3E1800
Trifluorochloroethylene, stabilized	115	DOT-3A300, DOT-3AA300, DOT-3B300, DOT-3E1800, DOT-4B300, DOT-4BA300, DOT-4BW300
Trimethylamine, anhydrous	57	DOT-3A150, DOT-3AA150, DOT-3B150, DOT-4B150, DOT-4BA225, DOT-4BW225, DOT-3E1800
Vinyl chloride (see note 2)	84	DOT-4B150 without brazed seams, DOT-4BA225 without brazed seams, DOT-4BW225, DOT-3A150, DOT-3AA150, DOT-3AL150, DOT-3E1800
Vinyl fluoride, stabilized	62	DOT-3A1800, DOT-3AA1800, DOT-3E1800, DOT-3AL1800

Table A6.1 Name of Gas	Maximum Permitted Filling Density in Percent (See A3.3.2.6)	Cylinders Marked as Shown Below, Or of The Same Type With Higher Service Pressure
Vinyl methyl ether (see note 2)	68	DOT-4B150 without brazed seams, DOT-4BA225 without brazed seams, DOT-4BW225, DOT-3A150, DOT-3AA150, DOT-3B1800, DOT 3E1800

Notes:
1. Cylinders purchased after 1 October 1944 for the transportation of chlorine must contain no aperture other than that provided in the neck of the cylinder for attachment of a valve equipped with an approved safety device. Cylinders purchased after November 1, 1935 and charged with chlorine must not contain over 150 pounds of gas. **(T-0).**
2. All parts of valve and safety devices in contact with contents of cylinders must be of a metal or other material, suitably treated if necessary, which will not cause formation of any acetylides. **(T-0).**
3. DOT-3HT cylinders are authorized for use in aircraft only for a maximum service life of 24 years. They must be equipped with a frangible disc safety relief device, without fusible metal backing, and with a rated bursting pressure not over 9 percent of the minimum required test pressure of the cylinder with which the device is used. Ship only nonflammable gases in these cylinders and pack in strong outer packagings.
4. Refer to A3.3.2.7. for additional packaging requirements, if applicable.
5. Use of a DOT specification cylinder with a service pressure of 480 psi is not authorized.
6. Ensure each valve outlet is sealed by a threaded cap or a threaded solid plug.
7. Ensure DOT-3AL cylinders are equipped with brass or stainless steel valves and cleaned in compliance with Federal Specification RR-C-901c.
8. See A6.4.1. and A6.4.6. (Only DOT 2P is authorized).
9. See A6.4.6.

A6.6. Liquefied Petroleum Gas (see A3.3.2. for additional cylinder and filling requirements). Package liquefied petroleum gas as follows:

A6.6.1. Use DOT 3, 3A, 3AA, 3AL, 3B, 3E, 4B, 4BA, 4B240ET, 4BW, 4E, or 39, cylinders. Ensure the internal volume of DOT 39 cylinders is not over 1.23 L (75 cubic inches). Comply with the requirements of Table A6.1. for the gases named.

A6.6.2. DOT 2P or 2Q Containers. Use DOT 2P or 2Q containers, packed in strong wooden or fiberboard boxes designed to protect valves from damage or accidental functioning under normal transportation conditions. Each completed container filled for shipment must have been heated until contents reached a minimum temperature of 54 degrees C (130 degrees F) without evidence of leakage, distortion, or other defects. **(T-0).** DOT 2P or 2Q containers with a maximum capacity of 31.83 cubic inches are authorized under the following conditions:

A6.6.2.1. Maximum filling pressure of 310.3 kPa (45 psig) at 21 degrees C (70 degrees F), and 724 kPa (105 psig) at 54 degrees C (130 degrees F) when equipped with safety devices which prevents rupture of the container and dangerous projection of a closing device when it is exposed to fire.