NOT MEASUREMENT SENSITIVE

MIL-DTL-2E
9 JUNE 95
SUPERSEDING
MIL-V-2D
9 September 1970

DETAIL SPECIFICATION

VALVES, CYLINDER, GAS

(FOR COMPRESSED OR LIQUEFIED GASES)

GENERAL SPECIFICATION FOR

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers valves for compressed gas cylinders and liquefied gas cylinders.

1.2 Classification. The valves are of the following styles, compositions, sizes and pressure relief device requirements.

All class designations represent maximum pressure at 120°F (48.9°C).

Style I	- Compression packed valve.
Style II	- O-ring seal valve.
Style III	- Pressure seal valve.
Style IV	- Diaphragm seal valve.

Class 05	- Maximum service pressure 500 psig (3450 kPa).
Class 30	- Maximum service pressure 3000 psig (20680 kPa).
Class 40	- Maximum service pressure 4000 psig (27580 kPa).
Class 55	- Maximum service pressure 5500 psig (37900 kPa).
Class 75	- Maximum service pressure 7500 psig (51700 kPa).

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Code (68) SA-ALC/SFSP, 1014 Billy Mitchell Blvd, Kelly AFB TX 78241-5603, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

Composition A	- Forged brass body.
Composition B	- Forged steel body.
Composition C	- Forged bronze.
Composition D	- Machined brass (medical post).

Inlet size 3	- .375 inch 18 NGT.
Inlet size 4	- .50 inch 14 NGT.
Inlet size 6	- .75 inch 14 NGT.
Inlet size 8	- 1.00 inch 11.50 NGT.
Inlet size 9	- 1.125 inch 12 UNF.

Pressure relief device (S-0)	None required.
Pressure relief device (S-1)	Frangible disk.
Pressure relief device (S-2)	Fusible plug, 165°F (74°C) nominal.
Pressure relief device (S-3)	Fusible plug, 212°F (100°C) nominal.
Pressure relief device (S-4)	Comb. Frangible disk-fusible plug 165°F (74°C).
Pressure relief device (S-5)	Comb. Frangible disk-fusible plug 212°F (100°C).
Pressure relief device (S-7)	Spring loaded, reseating pressure relief valve.
Pressure relief device (S-P)	Prohibited.

1.2.1 International standardization agreement code number.

QSTAG - 236 (see 6.6).

1.3 Type Designation. The type designations are formed by the heading V plus the slash number of the applicable specification sheet, followed by a dash and the outlet designation of the valve, followed by a dash and a numerical designator to differentiate valves with different pressure relief requirements.

-0 pressure relief device not required.
-1 indicates low pressure applications (500 psig 3450 kPa) or lower).
-2 indicates a combination frangible disk and fusible plug pressure relief device for cylinder service pressure range 1800 psig (12400 kPa) through 2400 psig (16550 kPa). Frangible disk for 1800 psig (12400 kPa) service pressure shall be supplied.
-3 indicates a frangible disk pressure relief device for cylinder pressure 1800 psig (12400 kPa).
-4 indicates a frangible disk pressure relief device for cylinder service pressure 2015 psig (13890 kPa).
-5 indicates a frangible disk pressure relief device for cylinder service pressure 2265 psig (15620 kPa).
-6 indicates a frangible disk pressure relief device for cylinder service pressure 2400 - 2500 psig (16550-17240 kPa).
-7 indicates a frangible disk pressure relief device for cylinder service pressure 3000 psig (20680 kPa).
-8 indicates a frangible disk pressure relief device for cylinder service pressure 3500 psig (24130 kPa).
-9 indicates combination frangible disk and fusible plug pressure relief device for cylinder pressure 6000 psig (41350 kPa).
-10 indicates a frangible disk pressure relief device for cylinder service pressure 4000 psig (27580 kPa).
-11 indicates a frangible disk pressure relief device for cylinder service pressure

4500 psig (31000 kPa).
-12 Pressure relief device prohibited for use with pressure up through 3000 psig (20680 kPa).

EXAMPLES:

Acetylene, Outlet 510, Inlet .75 inch
V1-510-0

Oxygen, Outlet 540, Inlet .75 inch for use with 2015 psig (13890 kPa) service pressure cylinder.
V39-540-4

Oxygen, Outlet 540, Inlet .75 inch for use with 1800 psig (12400 kPa), 2015 psig (13890 kPa), 2265 psig (15620 kPa) or 2400 psig (16550 kPa) service pressure cylinder where a combination frangible disk, fusible plug pressure relief device is required.
V39-540-2

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications and standards. Unless otherwise specified, the following specifications and standards of the issue listed in that issue of the Department of Defense Index of Specifications and Standards (DODISS) specified in the solicitation form a part of this specification to the extent specified herein.

SPECIFICATIONS

FEDERAL

L-P-390	- Plastic, Molding and Extrusion - Material Polyethylene and Copolymers (Low, - Medium and High Density).
L-P-410	- Plastic, Polyamide (Nylon), Rigid: Rods, - Tubes, Flats, Molded and Cast Parts.
QQ-A-225/1	- Aluminum Alloy Bar, Rod, and Wire; Rolled, - Drawn or Cold Finished, 1100.
QQ-C-320	- Chromium Plating (Electrodeposited).
QQ-C-390	- Copper Alloy Castings (Including Cast Bar).
QQ-C-00465	- Copper-Aluminum Alloys (Aluminum Bronze) (Copper - Alloy Numbers 60600, 61400, 63000, and 64200); Rod, - Flat Products with Finished Edges (Flat Wire, Strip, and - Bar) Shapes, and Forgings.
QQ-N-281	- Nickel-Copper Alloy Bar, Rod, Plate, Sheets, Strip, Wire, - Forgings, and Structural and Special shaped Sections.
QQ-N-290	- Nickel Plating (Electrodeposited).
QQ-P-416	- Plating, Cadmium (Electrodeposited) - Resisting.
QQ-W-321/10	- Wire, Copper Alloy
RR-C-271	- Chains and Attachments, Welded and Weldless.

PPP-B-601 - Boxes, Wood, Cleated-Plywood.

MILITARY

MIL-P-116 - Preservation, Methods of.
MIL-I-24768/9 - Insulation Plastics, Laminated, Thermosetting, Nylon - Fabric-Base, Phenolic Resin.
MIL-P-46036 - Plastic Sheets, Rods, Tubes and Discs, - Polychlorotrifluoroethylene.
MIL-S-81733 - Sealing and Coating Compound, Corrosion Inhibitive.

STANDARDS

FEDERAL

FED-STD-H28 - Screw-Thread Standards for Federal Services.
FED-STD-66 - Steel: Chemical Composition and Hardenability.
FED-STD-151 - Metals; Test Methods.

MILITARY

MIL-STD-129 - Marking for Shipment and Storage.
MIL-STD-831 - Test Reports, Preparation of.
MIL-STD-889 - Dissimilar Metals.

2.1.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this document to extent specified herein.

DEPARTMENT OF TRANSPORTATION

Code of Federal Regulations, Title 49, Parts 100-177 and Parts 178-199. (Applications for copies should be addressed to the Superintendent of documents, Government Printing Office, Washington, D. C. 20402

NASA-MARSHALL SPACE FLIGHT CENTER

NHB-8060.1B - Flammability, Odor, and Offgassing Requirements and Test Procedures For Materials, In Environments That Support Combustion.

(Application for copies should be addressed to George C. Marshall Space Flight Center, Huntsville, AL 35810, ATTN: Marshall Documentation Repository, A and TS-MS-D.)

(Copies of specifications, standards, and publications required by manufacturers in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting officer.)

2.2 Non-Government publications. The following document(s) form a part of this specification to the extent specified herein. The issues of the documents which are indicated as DOD adopted shall be the issue listed in the current DODISS.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI-Z1.4 - Procedures, Sampling and Tables for Inspection by Attributes

(Application for copies should be addressed to the American National Standards Institute, 11 West 42nd Street, New York NY 10036.)

AMERICAN SOCIETY FOR TESTING MATERIALS (ASTM)

ASTM A 27 - Castings, Steel, Carbon, For General Application.
ASTM A 53 - Pipe, Steel, Black And Hot-Dipped, Zinc-Coated Welded And Seamless.
ASTM A 108 - Steel Bars, Carbon, Cold-Finished, Standard Quality.
ASTM A 148 - Castings, Steel, High-Strength, For Structural Purpose.
ASTM A 167 - Steel Plate, Sheet, And Strip, Chromium-Nickel, Stainless And Heat-Resisting.
ASTM A 176 - Steel Plate, Sheet, And Strip, Chromium, Stainless And Heat-Resisting.
ASTM A 181 - Forgings, Carbon Steel, For General-Purpose Piping.
ASTM A 181M - Forgings, Carbon Steel, For General-Purpose Piping (Metric).
ASTM A 240 - Chromium And Chromium-Nickel Stainless Steel, Heat-Resisting Plate.
ASTM A 313 - Chromium-Nickel Stainless And Heat-Resisting Steel Wire.
ASTM A 331 - Steel Bars, Alloy, Cold-Finished.
ASTM A 580 - Wire Steel, Stainless And Heat Resisting.
ASTM A 666 - Austentic Stainless Steel, Sheet, Strip, Plate, And Flat Bar For Structural Applications.
ASTM A 681 - Steels, Alloy Tool.
ASTM A 693 - Steel Plate, Sheet, And Strip, Stainless And Heat-resisting, Precipitation-Hardening.
ASTM B 16 - Rod, Bar, And Shapes For Use In Screw Machines, Free Cutting Brass.
ASTM B 16M - Rod, Bar, And Shapes For Use In Screw Machines, Free Cutting Brass (Metric).
ASTM B 21 - Naval Brass, Rod, Bar, And Shapes
ASTM B 21M - Naval Brass, Rod, Bar, And Shapes (Metric).
ASTM B 36 - Brass Plate, Sheet, Strip, And Rolled Bar.
ASTM B 86 - Zinc-Alloy, Die Castings
ASTM B 98 - Rod, Bar, And Shapes, Copper Silicon Alloy.
ASTM B 98M - Rod, Bar, And Shapes, Copper Silicon Alloy (Metric).
ASTM B 99 - Wire, Copper-Silicon Alloy For General Purpose.
ASTM B 99M - Wire, Copper-Silicon Alloy For General Purpose. (Metric).
ASTM B 105 - Hard Drawn Copper Alloy Wires For Electrical Conductors.
ASTM B 121 - Leaded Brass, Plate, Sheet, Strip, And Rolled Bar.
ASTM B 121M - Leaded Brass, Plate, Sheet, Strip, And Rolled Bar (Metric).
ASTM B 124 - Copper And Copper Alloy, Forging Rod, Bar And Shapes.
ASTM B 124M - Copper And Copper Alloy, Forging Rod, Bar And Shapes (Metric).
ASTM B 138 - Manganese Bronze Rod, Bar And Shapes.
ASTM B 138M - Manganese Bronze Rod, Bar And Shapes (Metric).
ASTM B 139 - Phosphor Bronze, Rod, Bar, And Shapes.
ASTM B 139M - Phosphor Bronze, Rod, Bar, And Shapes (Metric).
ASTM B 152 - Copper Sheets, Strip, Plate, And Rolled Bar.
ASTM B 152M - Copper Sheets, Strip, Plate, And Rolled Bar (Metric).
ASTM B 169 - Aluminum Bronze, Plate, Sheet, Strip And Rolled Bar.
ASTM B 169M - Aluminum Bronze, Plate, Sheet, Strip And Rolled Bar (Metric).
ASTM B 194 - Copper-Beryllium Alloy, Plate, Sheet, Strip, And Rolled Bar.

ASTM B 283 - Copper And Copper-Alloy Die Forgings (Hot-Pressed).
ASTM D 1229 - Rubber, Property-Compression Set At Low Temperatures.
ASTM D 1710 - TFE-Fluorocarbon Rod.
ASTM D 2000 - Rubber Products In Automotive Applications.
ASTM D 3951 - Packaging, Commercial.
ASTM D 4066 - Nylon Injection And Extrusion Materials.
ASTM E 18 - Rockwell Hardness And Rockwell Superficial Hardness Metallic Materials.
ASTM G 37 - Stress-corrosion cracking

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103-1187.)

COMPRESSED GAS ASSOCIATION, INC.

Pamphlet S-1.1 - Pressure Relief Device Standards, Part 1 - Cylinders For Compressed Gases.
Pamphlet S-7 - Method For Selecting Pressure Relief Devices For Compressed Gas Mixtures In Cylinders.
Standard V-1 - ANSI/CSA/CGA, Compressed Gas Cylinder Valve Outlet And Inlet Connections.
Standard V-7 - Standard Method Of Determining Cylinder Valve Outlet Connections For Industrial Gas Mixtures.

THE CHLORINE INSTITUTE, INC.

Drawing No. 110- Valve For Chlorine Cylinders And Ton Containers Assembly.
Drawing No. 112- Valve And Fusible Plug For Chlorine Cylinders And Ton Containers-Specifications And General Notes.
Drawing No. 113- Valve For Chlorine Cylinders And Ton Containers-Parts.

(Non-government standards and other publications are normally available from the organizations that prepare or distribute the documents. These documents also may be available in or through libraries or other informational services.)

2.3 Order of precedence. In the event of a conflict between the text of this document and the references cited herein (except for related associated detail specifications, specification sheets, or MS standards), the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Specification sheets. The individual item requirements shall be as specified herein and in accordance with the applicable specification sheet. In the event of any conflict between the requirements of this specification and the specification sheet, the latter shall govern.

3.2 Qualification. The valves furnished under this specification shall be products which are qualified for listing on the applicable qualified products list at the time set for opening of bids (see 4.3 and 6.5).

3.3 Reliability. The diaphragm valve shall have a reliability of not less than 2,000 cycles and all other valves shall have a reliability of not less than 5,000 cycles. After having been opened and closed 2,000 times or 5,000 times as applicable, at the maximum service pressure specified herein: The valve shall not

leak; shall not require an opening or closing torque greater than that specified herein; shall show no evidence of cracks, detaching, or failure of the seat disk insert or the stem tang when so equipped; and shall show no evidence of thread failure. The compression packed valve shall not require tightening of the packing nut or bonnet at intervals of less than 100 cycles. The diaphragm valve shall not require tightening of any component at intervals of less than 2,000 cycles. The O-ring valve and the pressure sealed valve shall not require tightening of any component at less than 5,000 cycles.

3.4 Material. Material shall be as specified herein. Materials not specified shall be selected by the Contractor and shall be subject to all provisions of this specification.

3.4.1 Material deterioration and control. The valves shall be fabricated from materials compatible with the gas or product being used. Materials used shall be treated or processed to provide protection against the various forms of corrosion and deterioration that may be encountered in any of the applicable storage and operating environment to which the item may be exposed.

3.4.1.1 Dissimilar metals. Dissimilar metals, as defined in MIL-STD-889, shall be electrically insulated from one another to minimize or prevent galvanic corrosion. Insulation may be provided by an insulating barrier such as a corrosion inhibiting sealant conforming to MIL-S-81733 or chromate tape conforming to ZZ-R-765. Protection against corrosion could also be obtained by exclusion of the electrolyte if feasible.

3.4.1.2 Identification of materials and finishes. The contractor shall identify the specific material, material finish or treatment for use with components and sub-components, and shall make information available, upon request, to the contracting officer or designated representative. (see 6.2).

3.4.2 Recovered materials. For the purpose of this requirement, recovered materials are those materials which have been collected from solid waste and reprocessed to become a source of raw materials, as distinguished from virgin raw materials. The components, pieces and parts incorporated in the valves may be newly fabricated from recovered materials to the maximum extent practicable, provided the valves produced meet all other requirements of this specification. Used, rebuilt or remanufactured components, pieces and parts shall not be incorporated in the valves.

3.4.3 Aluminum.

3.4.3.1 Die castings. Aluminum die castings shall conform to Alloy Numbers, 413.0, A413.0, or 360.0.

3.4.3.2 Flat stock. Flat aluminum stock shall conform to QQ-A-225/1, temper optional.

3.4.5 Brass.

3.4.5.1 Castings. Brass castings shall conform to QQ-C-390, CDA Alloy Numbers C83600, C83800, C84200 or C84400.

3.4.5.2 Forging. Forging brass shall conform to CDA Alloy Number C37700.

3.4.5.3 Free-cutting. Free-cutting brass shall conform to CDA Alloy Number C36000.

3.4.5.4 Naval. Naval brass shall conform to CDA Alloy Number 48500.

3.4.5.5 Strainer wire. Brass strainer wire shall conform to QQ-W-321/10, CDA Alloy Number 27400.

3.4.6 Bronze.

3.4.6.1 Aluminum. Aluminum bronze shall conform to QQ-C-00465, CDA Alloy Number C63000.

3.4.6.2 Aluminum-silicon, alloy B. Aluminum-silicon bronze, alloy B, CDA Alloy Number 64210 shall conform to Chlorine Institute Drawing Number 112.

3.4.6.3 Aluminum-silicon. Aluminum-silicon bronze shall conform to QQ-C-00465, CDA Alloy Number C64200.

3.4.6.4 Manganese. Manganese bronze shall conform to ASTM B138, B138M.

3.4.6.5 Phosphor, flat stock. Phosphor bronze flat stock shall conform to ASTM B139, B139M composition A or D, spring or extra spring temper.

3.4.6.6 Phosphor, round wire. Phosphor bronze round wire shall conform to QQ-W-321/10, CDA Alloy Number C51000.

3.4.7 Copper. Copper shall conform to ASTM B152, B152M, soft-annealed temper.

3.4.8 Copper alloys.

3.4.8.1 Beryllium. Copper-beryllium alloy shall conform to ASTM B194, CDA Alloy Number C17200.

3.4.8.2 Silicon. Copper-Silicon alloy shall conform to CDA Alloy Numbers C65100, C65500, C69200.

3.4.9 Nickel-copper alloy. Nickel-copper alloy shall conform to QQ-N-281.

3.4.10 Plastics.

3.4.10.1 Polyamide. Polyamide plastic shall conform to L-P-410 or ASTM D4066, compositions as specified herein.

3.4.10.2 Polyethylene. Polyethylene plastic shall conform to L-P-390, Type 1, Class H, Grade 5.

3.4.10.3 Polytetrafluoroethylene. Polytetrafluoroethylene plastic shall conform to ASTM D1710.

3.4.10.4 Phenolic resins. Phenolic resin laminates shall conform to MIL-I-24768/9.

3.4.10.5 Polychlorotrifluoroethylene. Polychlorotrifluoroethylene plastic shall conform to MIL-P-46036.

3.4.11 Rubber. Rubber shall conform to ASTM D 2000,designation 4BA820A14C12F19Z1Z2 with Z, or special requirements as follows: Z1-equivalent to suffix D of ASTM D 2000 table IV, with load of 20 percent deflection to be 475 +/-100 psig (690 kPa); Z2-compression set after 22 hours at -50° F (-45° C) shall be 70 percent (maximum) after 30 minutes recovery at -50° F (45°C) as per ASTM D 1229, with specimens initially compressed 30 percent.

3.4.12 Steel.

3.4.12.1 Carbon. Carbon steel bar stock shall conform to ASTM A108, UNS G10450.

3.4.12.2 Castings. Steel castings shall conform to ASTM A27, A148, class 70-36.

3.4.12.3 Corrosion-resisting bar stock. Corrosion-resisting steel bar stock shall conform to QQ-S-763, classes as specified herein.

3.4.12.4 Corrosion-resisting wire. Corrosion-resisting steel wire shall conform to ASTM A313, A580, compositions as specified herein.

3.4.12.4.1 Corrosion-resisting sheet and strip stock. Corrosion-resisting sheet and strip stock shall conform to ASTM A167, A176, A240, A666, A693, classes as specified herein.

3.4.12.5 Forgings. Steel forgings shall conform to ASTM A181, Class 70.

3.4.12.6 SteelAlloy. Steel alloy barstock shall conform to ASTM A 331, UNS G48200.

3.4.12.7 Pipe.Steel pipe shall conform to ASTM A 53, type S, grade A, schedule number 40.

3.4.12.8 Medical valves. The material used in all medical valves shall be in accordance with the latest revision of NHB-8060.1.

3.4.13 Zinc.

3.4.13.1 Die casting. Zinc die casting shall conform to ASTM B 86, Alloy optional.

3.5 Design. The valve shall be of a compression packed, an O-ring, pressure seal, or a diaphragm style. The valve shall consist of a body with inlet and outlet, a pressure relief device as required, internal working parts, valve stem, seat, bonnet or packing nut and packing as required. A handwheel or wrench or key shall be furnished, as specified in the applicable specification sheet. An outlet cap or plug, with chain and retaining ring, shall be supplied when specified. A dip tube or eductor tube shall be furnished installed in accordance with 3.6.1.6 when specified.

3.6 Construction.

3.6.1 Valve components.

3.6.1.1 Valve body. The valve body shall be as specified herein for the applicable valve style, and as follows.

3.6.1.1.1 Inlet. The inlet threads shall conform to FED-STD-H28. The thread symbol shall be as specified in the applicable specification sheet. All valve bodies constructed from aluminum alloy conforming to QQ-A-225/1 shall have straight threads. Valve bodies having a 0.375 inch (9.525 mm) or a 0.50 inch (12.70 mm) inlet shall have an inlet channel clear opening, from the inlet to the seat, of not less than the cross sectional area of a 0.125 inch (3.18 mm) diameter circle. All other valve bodies shall have an inlet channel clear opening of not less than the cross sectional area of a 0.25 inch (6.35 mm) diameter circle. Unless otherwise specified in the applicable specification sheet, when the valve is equipped with a dip tube the inlet shall be internally threaded to accept the dip tube.

3.6.1.1.2 Outlet. Unless otherwise specified in the applicable specification sheet, the outlet shall conform to FED-STD-H28, outlet number as specified in the applicable specification sheet.

3.6.1.1.3 Pressure relief approach channel. When a pressure relief device is specified in the applicable specification sheet, the approach channel shall be located between the inlet and valve seat. Valve bodies having a 0.375 inch (9.525 mm) or a 0.50 inch (12.70 mm) inlet shall have an approach channel clear opening from the inlet channel to the pressure relief device, of not less than the cross

sectional area of a 0.125 inch (3.18 mm) diameter circle. All other valve bodies shall have an approach channel clear opening of not less than the cross sectional area of a 0.1875 inch (4.76 mm) diameter circle. In all cases the minimum flow requirements of CGA Pamphlet S-1.1 must be met.

3.6.1.1.4 Valve seat. The valve seat shall have a clear opening of not less than the cross sectional area of a circle having a diameter as follows:

Valves used in liquefied gas service (class 05)	0.25 inch (6.35 mm)
Valves having a 0.375 inch or a 0.50 inch inlet	0.0625 inch (1.59 mm)
All other valves	0.125 inch (3.18 mm)

3.6.1.1.5 Wrenching surfaces. The body shall have two or more wrench flats. The wrench flats shall be diametrically opposite each other and parallel to a plane determined by the centerlines of the valve inlet and valve outlet. When the valve has a pin index outlet, the dimensions of the wrench flats shall conform to the body dimensions specified in FED-STD-H28. When the valve has a threaded outlet, the wrench flats shall be accessible for the use of conventional cylinder valve wrenches in both manual and power applications without damage or deformation to any components of the valve.

3.6.1.2 Stem. The stem material shall be as specified herein for the applicable valve style (see 3.9). The stem shall have a shank to fit a handwheel, a wrench or a key as specified herein and in the applicable specification sheet. When used with a handwheel, the upper end of the stem shall be designed to transmit handle torque through the wrench flats or a spline and be either threaded externally to mate with a nut, or internally for a machine screw for securing the handwheel. A positive mechanical fastener may be used in lieu of a threaded fastener. When the stem is supplied with a disk insert, the insert shall fit in a counterbore in the bottom of the stem or in the bottom of the lower spindle of a two-piece stem. The inserts shall conform to ASTM D4066, type 1 for polyamide plastics or MIL-I-24768/9 for phenolic-resin laminates. Any lubricant applied to stems shall be compatible with the gas of intended use and shall be subject to approval of the qualification activity.

3.6.1.2.1 Stem hardness. Carbon steel, cast steel or nickel steel alloy stems used in compression packed valves shall have a Rockwell C surface hardness of not less than 30, to a depth of not less than 0.020 inch (.508 mm) on the portion of the stem in contact with the packing.

3.6.1.3 Bonnet packing nut and packing washer. The bonnet packing nut and packing washer shall be as specified herein for the applicable valve style. The bonnet packing nut shall be threaded to engage mating threads on the valve body. Bonnet or packing nut surfaces which seal directly against the sealing material shall be machined to provide a leak free seal. The bonnet packing nut shall be provided with wrenching flats.

3.6.1.4 Handwheel. The handwheel shall be a circular, oval or crossed spoke fingergrip type. The handwheel shall be not less than 2.50 inches (63.5 mm) and not greater than 2.75 inches (69.9 mm) in diameter. When used on a pressure seal valve, the handwheel shall bear against a friction reducing thrust washer located between the handwheel and the packing nut or bonnet. The handwheel shall be fabricated of die-cast zinc, die-cast aluminum, or forged brass. Polyamide plastic handwheels 2.00 inches (50.8 mm) in diameter shall be acceptable for valves operating with opening and closing torque less than 60 inch pounds (6.78 Nm).

3.6.1.5 Strainer. When specified in 6.6, a strainer shall fit over or into a recess in the valve body inlet. The strainer shall not interfere with the inlet threads nor be greater than 60 mesh metal screen. It shall be fabricated of brass, nickel copper alloy, or composition 302 or 304 corrosion-resisting steel wire.

3.6.1.6 Dip tube. The dip tube shall be 0.25 inch (6.35 mm) steel pipe unless otherwise specified. One end of the dip tube shall be externally threaded with 0.25-18 NPT threads conforming to FED-STD-H28. The

dip tube inlet shall be cut on a 45° angle. The dip tube shall be of sufficient length and shall be bent on a suitable radius so as to empty a cylinder of the specified length. When specified the dip tube shall be furnished assembled to the valve and secured in the opposite direction from the valve outlet by brazing or by silver soldering.

3.6.1.7 Pressure relief device. The pressure relief device shall be provided and installed as a unit by the contractor as required by the Dept of Transportation, Title 49, with its reference to CGA Pamphlet S-1.1. The pressure relief device outlet cross sectional area and the cross sectional area of the approach channel in the valve body shall be as specified in 3.6.1.1.3. The pressure relief device shall be of the type specified in the applicable specification sheet.

3.6.1.7.1 Type 1, frangible disk. The frangible disk pressure relief device shall consist of a frangible disk, a sealing washer, and a cap or plug. Type 1 pressure relief devices shall be provided in valves for cylinders subjected to filling pressures 10 percent above the permanently marked service pressure in accordance with DOT CFR 173.302, (c).

3.6.1.7.1.1 Frangible disk. The frangible disk shall be metal and shall be designed to burst in tension over a radiussed burst edge or by shear over a sharp burst edge. The fragments shall not obstruct the radial outlet passages in the cap or plug. At 160° F. (71°C) the disk shall have a maximum burst pressure of not greater than 1.67 times the marked service pressure on the cylinder and shall not burst at less than 1.50 times the service pressure. Unless otherwise specified, disks shall be provided to conform with Table I. When the cylinder service pressure is not specified, the frangible disk shall be supplied for a service pressure of 1800 psig (12400 kPa) and used in combination with a fusible plug.

TABLE I. Disk Burst Requirement.

Cylinder Service Pressure psig (kPa) DOT 3A or 3AA	Disk Required Burst Range	
	Minimum psig (kPa)	Maximum psig (kPa)
1800 (12400)	2700 (18620)	3000 (20680)
2015 (13890)	3025 (20860)	3360 (23170)
2216 (15280)	3324 (22919)	3693 (25463)
2265 (15620)	3375 (23270)	3775 (26030)
2400 (16550)	3600 (24820)	4000 (27580)
3000 (20680)	4600 (31720)	5000 (34470)
3500 (24130)	5250 (36200)	5800 (39990)
4500 (31027)	6750 (46541)	7500 (51712)
6000 (41370)	9000 (62055)	10000 (68950)

3.6.1.7.1.2 Sealing washer. The sealing washer shall be aluminum, fully annealed copper, polyamide plastic composition polyhexamethylene adipamide, polyamide plastic composition polycaprolactam, or polytetrafluoroethylene plastic. The sealing washer shall be a component of an approved pressure relief device provided by the contractor.

3.6.1.7.1.3 Caps and plugs for frangible disk pressure relief device. The caps and plugs design for the frangible disks provided by the contractor shall be as required by the Dept of Transportation, Title 49, with its reference to CGA Pamphlet S-1.1. Caps shall have internal threads which conforms to FED-STD-H28 for pressure relief device threads. The closed end of the cap or plug as applicable shall be drilled radially with not less than 4 relief holes having a total cross-sectional area of not less than that of the relief channel. The relief channel may be the contractor's qualified size but not less than 0.281 inch (7.14 mm) in diameter. The cap or plug shall not extend from the centerline of the valve to a greater radial distance than the corresponding valve outlet except for pin-index medical valves where clearance of

standard yokes shall be the limiting factor. Caps and plugs shall be designed to prevent blockage of relief holes by fragmentation of frangible disks. Wrenching flats of caps or plugs shall be either 0.8125 or 0.9375 inches (20.64 mm or 23.81 mm) diametrically across opposite surfaces.

3.6.1.7.2 Type 2, fusible plug, 165° F (74° C) nominal yield point. The type 2, fusible plug shall be fabricated with fusible metal having a yield point between 157° F (69° C) and 170° F (77° C), (165° F (74° C) nominal). The plug shall be made of free-cutting brass or carbon steel stock as specified for the valve in the applicable specification sheet. The plug body shall be externally threaded in conformance with FED-STD-H28 for 0.125-27 NGT, 0.25-18 NGT or 0.375-18 NGT threads as specified. The clear through opening in the plug shall be not less than 0.2187 inch (5.55 mm) in diameter except for medical post valves when 0.1562 inch (3.97 mm) in diameter shall be acceptable. The external end of the plug shall have a screwdriver slot, hexagonal wrenching flats or a hexagonal wrenching socket. Open ended plugs shall be either cone-bored, or straight-threaded to anchor the fusible metal for a leak-free metal-to-metal juncture. Blind plugs with radially venting shall be straight bored with not less than 4 vent holes having a total cross-sectional area not less than that of the cross-sectional area of the applicable relief channel.

3.6.1.7.2.1 Fusible metal, (165° F (74° C) or 212° F (100° C) nominal). The fusible metal shall conform to CGA Pamphlet S-1.1 for fuse metal with yield points in the applicable range.

3.6.1.7.2.2 Valve body drilled fusible plug. As specified in the applicable specification sheet a pressure relief device, allowing a channel not less than 0.073 inch (1.85 mm) in diameter, shall be drilled and threaded into the valve body and filled with molten fusible metal effecting a leak-free plug.

3.6.1.7.3 Type 3, fusible plug, 212° F (100°C) nominal yield point. The type 3, 212° F (100°C) nominal yield point fusible plug pressure relief device shall be as specified for type 2, except that the fusible metal shall have a yield or melting point of not less than 208° F (98°C) and not greater than 220° F (104°C), (212° F (100°C) nominal).

3.6.1.7.4 Type 4, combination frangible disk-fusible plug, 165° F (74°C) nominal yield point. The type 4, pressure relief device shall be as specified for type 1, except that the cavity beyond the frangible disk shall be filled with fusible metal having a yield or melting point of not less than 157° F (69° C) and not greater than 170° F (77° C), (165° F (74° C) nominal). At 132° F (55° C) ±2° F (1.11° C) the fusible metal core shall not extrude and shall prevent the disk from bursting at its minimum burst pressure.

3.6.1.7.5 Type 5, combination frangible disk-fusible plug, 212° F (100° C) nominal yield point. The type 5 pressure relief device shall be as specified for type 4, except that the fusible metal shall have a yield or melting point of not less than 208° F (98° C) and not greater than 220° (104° C), (212° F (100° C) nominal).

3.6.1.7.6 Type 7, pressure relief device. The type 7, pressure relief device shall consist of a cap or plug insert, spring, and an insert retainer. Unless otherwise specified, the spring tension shall be adjusted so that the relief device shall start to discharge at not less than 75% and shall reseal at not less than 70% of the designated cylinder's minimum test pressure. The device shall reach full flow position at not greater than 100% of the cylinder's minimum test pressure. The flow capacity of the pressure relief device shall conform to Pressure Relief Device Standards Pamphlet S-1.1, of the Compressed Gas Association for the water capacity of the cylinder of intended use. The pressure relief device shall not bind or seize while opening and closing. When installed on the valve, the pressure relief device cap or plug shall be soldered, crimped, or otherwise mechanically locked to prevent tampering with the spring tension adjustment.

3.6.1.7.6.1 Pressure relief device, cap or plug. The pressure relief device cap or plug shall be fabricated from free-cutting brass. The exterior surface of the cap shall be cylindrical. The cap or plug

shall provide a means for securing the cap or plug to the valve body and for adjusting the spring tension. The threads shall be right hand, UNS conforming to FED-STD-H28.

3.6.1.7.6.2 Pressure relief device spring. The pressure relief device spring shall be helical and shall be fabricated of corrosion-resisting steel wire, conforming to ASTM A313, A580, compositions 302 or 304, condition B.

3.6.1.7.6.3 Retainer. The retainer shall have a shroud or guide surface to align the spring and a counterbore to retain the insert.

3.6.1.7.6.4 Pressure relief device insert. The pressure relief device insert seal shall be polyamide plastic, phenolic resin laminate or rubber meeting the stability provisions specified herein.

3.6.1.8 Outlet cap and plug. When specified, valves with threaded outlets shall have a permanent metal mating plug or cap in accordance with figures 1 and 2. The metal plug or cap shall be supplied with retaining chain and clip to secure the plug or cap to the valve. The metal plug or cap shall effectively seal the valve against leakage when tested as specified herein.

3.6.1.8.1 Outlet cap or plug retaining chain. The valve outlet cap or plug retaining chain shall consist of two bronze wire rings connected by a brass safety chain. The ends of the wire forming the rings shall be formed into eyes without twisting and shall be brazed or clipped together after the chain has been inserted in the eye. One ring shall fit with a sliding fit, in the ring groove of the outlet cap or plug. The other ring shall fit loosely around the valve body immediately above the inlet connection threads in accordance with figures 1 and 2. The retaining chain shall be of such length that it does not interfere with the cylinder flange threads when the cap or plug is installed on the valve outlet, but shall be of sufficient length to permit the cap or plug to hang over the cylinder flange threads when removed. When specified, a disposable dust cap or plug shall be furnished without retaining chain.

3.7 Performance characteristics.

3.7.1 Pressure. The valve shall not leak and shall not deform at the pressures specified in Table II. When the valve is fully open, and half open, there shall be no leakage around the stem, between the packing nut or bonnet and the body, at the inlet connection, at the outlet connection, nor at the pressure relief device connection. There shall be no leakage at the seat when the valve is closed at the specified torque. The valve shall show no evidence of leakage, failure or permanent deformation when subjected to specified pressures.

3.7.1.1 Service pressure. Service pressure shall be as specified for a specific cylinder application. Maximum service pressure shall be as specified for the applicable class (see Table II).

TABLE II. Service and proof pressures.

Valve class	Maximum service pressure psig	Maximum service pressure kPa	Hydrostatic proof pressure psig	Hydrostatic proof pressure kPa
05	500	3447	833	5743
30	3000	20680	5000	34470
40	4000	27580	6666	45962
55	5500	37922	9166	63200
75	7500	51712	12500	86187

* Note: For testing purposes class 05 valves with type VII pressure relief devices shall have the safety capped or plugged when the maximum service pressures are applied.

3.7.1.2 Proof pressure. The proof pressure shall be applied hydrostatically. The proof pressure shall not be less than 1.67 times the maximum service pressure specified herein for the applicable class (see Table II).

3.7.2 Torque. When operated at maximum service pressure, the torque required to open and close the valve shall not be greater than that specified in Table III. When opened and closed at the specified torque, and when closed at the specified overtorque the valve shall not leak or deform, the stem shall not bind, or gall, and the seat disk insert shall not crack or flow.

TABLE III. Opening and closing torque, inch-pounds (Nm).

Valve description	Open	Close	Overtorque
All valves with 0.375-inch inlets.	60 (6.78)	60 (6.78)	120 (13.56)
All valves with pin-index outlets.	60 (6.78)	60 (6.78)	120 (13.56)
Two-piece stem valves with O-ring or pressure seal, 0.50-inch or larger inlets.	60 (6.78)	60 (6.78)	200 (22.60)
Diaphragm seal valves.	100 (11.30)	150 (16.95)	200 (22.60)
All one-piece stem valves having seat disk inserts and 0.50-inch or larger inlets.	100 (11.30)	100 (11.30)	200 (22.60)
All one-piece stem valves 0.50-inch or larger inlets.	150 (16.95)	150 (16.95)	300 (33.90)

3.7.3 Spring compression. When the valve contains a spring loaded spindle, the spindle shall not check closed from the open position when exposed to an instantaneous service pressure backflow from the outlet.

3.7.4 Vibration. With the valve at the maximum service pressure the valve shall withstand vibration for 1 hour at a frequency of 3400 to 3600 vibrations per minute and at an amplitude of 0.0312 to 0.0625 inches (0.79 mm to 1.59 mm). The valve shall withstand vibration in the open position, in the half open position and in the closed position at a closing torque not greater than specified herein. The valve shall not leak, become deformed, or fail; the threaded connections shall not loosen; the seat disk insert, the strainer, and the stem tang shall not become detached; and the stem shall not bind, seize, or gall.

3.7.5 Outlet failure. When torqued to failure, the outlet connection, or the outlet threads shall fail prior to cracking, deformation, or failure of the valve body.

3.7.6 Combustibility. When intended for use with oxygen or oxidative gases, organic components of the valve shall be stable when exposed to oxygen. The material shall not react, discolor, or show any evidence of change in appearance under the following conditions:

a. Exposure for 1 hour to oxygen at a pressure of 2,000 psig (13790 kPa) and a temperature of 302° F (150° C) ±2° F (1.11° C).

b. Instantaneous exposure to oxygen at a pressure of 2,000 psig (13790 kPa) while heated to a temperature of 160° F (71° C) ±2° F (1.11° C).

Polytetrafluoroethylene plastic conforming to ASTM D1710 and polyamide plastic FM-101 conforming to ASTM D4066 composition polyhexamethylene adipamide shall be acceptable in valve use.

3.8 Environmental requirements. The valve shall conform to the following environmental requirements.

3.8.1 Low temperature.

3.8.1.1 Operation. The valve shall operate at the maximum service pressure specified for type and class, and at an ambient temperature of -50° F (-45° C) ±2° F (1.11° C) without leaking or requiring an opening or closing torque greater than that specified in Table III and without damage or permanent deformation of any component.

3.8.1.2 Storage. The valve shall withstand storage at the maximum service pressure specified herein, for 8 hours at a temperature of -60° F (-51° C) ±2° F (1.11° C) without leaking, when closed at a closing torque not greater than that specified in Table III and without damage or permanent deformation of any components.

3.8.2 High temperature.

3.8.2.1 Operation. The valve shall operate at the maximum service pressure specified herein and at an ambient temperature of 120° F (49° C) ±2° F (1.11° C), the valve shall not leak, require an opening or closing torque greater than that specified in Table III nor show any evidence of leakage, failure or permanent deformation of any component.

3.8.2.2 Storage. The valve shall withstand storage at a pressure of not less than the maximum service pressure specified herein, for 8 hours at a temperature of 155° F (68.8° C) ±20 F (1.11° C) without leaking, when closed at a closing torque not greater than that specified in Table III and without failure or permanent deformation to any component.

3.9 Detailed requirements. The valve styles and compositions shall be as follows.

3.9.1 Style I valve. - Style I valve shall have a compression packed seal and shall be used for service pressures not greater than 500 psig (3450 kPa), class 05, and compositions A, B, or C as specified in the applicable specification sheet.

3.9.1.1 Compression packed valve. Unless otherwise specified in the applicable specification sheet, the compression packed valve shall have a vertical stem and an outlet centerline at 90 degrees to the stem centerline. When specified in the applicable specification sheet, the stem and outlet shall be suitably angled. The compression packed valve shall have a one-piece stem except for medical post application. The stem or upper stem shall backseat in the fully open position. Sealing shall be by compressed packing. The packing shall be compressed by tightening a threaded packing nut or bonnet. The packing shall be compressed inside the valve body. The packing shall effect a seal against the circumferential surface of the stem and against the interior wall of the valve body. The surfaces exerting compressive force against the packing may be angled so that the height of the packing bore is greater than the height at the periphery of the packing. The bottom of the packing shall be seated against a shoulder in the valve body or against a washer. The top of the packing shall be seated against a packing washer or against the end of the packing nut, except that a packing washer shall be used when the packing does not have an inherently low coefficient of friction. When specified in the applicable specification sheet, the compression packed valve shall conform to Chlorine Institute Drawings No. 110, 112, and 113 except the outlet cap shall be supplied with a retaining chain and ring as specified in 3.6.1.8.

3.9.1.1.1 Style I - composition A valve. Style I-A valve bodies shall be made of forging brass as specified herein, with an integral seat to mate with a one-piece stem for a leak-free seal. In the fully open position the stem shall backseat against the packing to insure a leak-free seal at the packing-stem

junction. The stem shall be made of corrosion-resisting steel, class 302, 303, 304, 416, or 420; carbon steel, nickel-steel alloy, nickel-copper alloy, free-cutting brass or aluminum bronze; as specified herein. Carbon steel and nickel alloy steel stems shall be chromium plated (as per QQ-C-320 class I) or cadmium plated (as per QQ-P-416 class I type II) to reduce friction and corrosion. The plating of the stem may be eliminated when either polyethylene, polyamide, or polytetrafluoroethylene plastic is used as a packing material. The packing shall be polyethylene plastic, polyamide plastic, or polytetrafluoroethylene plastic as specified herein for stable control of the gas as specified in the applicable specification sheet. The packing nut or bonnet, packing washer, pressure relief device and outlet cap or plug shall be made from forging or free-cutting brass.

3.9.1.1.2 Style I - composition B valve. Style I-B valve bodies shall be made of cast steel or forged steel as specified herein. The stem shall be one piece, machined to mate with valve seat to effect a leak-free seal. When specified in the applicable specification sheet the valve seat shall be an insert of 99.5 percent pure tin firmly anchored to the valve body. When fully open the stem shall backseat against the packing effecting a leak-free seal at the stem-packing junction. The stem shall be made of carbon steel or corrosion-resisting steel, as specified herein. The class of corrosion-resisting steel shall be class 302, 303, 304, 416, or 420. Packing shall be of materials listed for style I-A valve selected for stable control of the gas service as specified in the applicable specification sheet. The packing nut or bonnet, packing washer pressure relief device and outlet cap or plug shall be made from carbon steel, casting steel or forging steel.

3.9.1.1.3 Style I - composition C valve. Style I-C valve bodies shall be made of aluminum-silicon bronze, as specified herein. For chlorine service the valve body and components shall conform to drawing Nos. 110, 112, and 113 by the Chlorine Institute for chlorine valves. For applications other than chlorine service, aluminum-silicon bronze shall be as specified in 3.4.6.3, except iron, nickel, manganese, tin, zinc, and tellurium shall not be required. The body shall have an integral seat to mate with a one-piece stem. The stem shall be made of nickel-copper alloy or aluminum bronze. The packing shall be of materials listed for style I-A valve selected for stable control of the gas service as specified in the applicable specification sheet. The packing nut or bonnet, packing washer, pressure relief device and outlet cap or plug shall conform to the Chlorine Institute drawings above.

3.9.1.1.4 Style I - composition D valve. Style I-D valve shall be for medical post (pin-index) applications and shall have a machined brass body. The valve shall have a two-piece stem coupled by a tang and slot or a stud and socket. The lower stem shall be made of freecutting brass or naval brass and fitted with an polyhexamethylene adipamide plastic seat insert, which shall mate with a machined seat in the valve body. The lower stem shall be threaded to mate threads in the valve body and when turned clockwise, shall close the valve for a leak-free seal. The upper stem shall be made of free-cutting brass, naval brass or corrosion-resisting steel as specified herein and packed with a polytetrafluoroethylene plastic and compressed with a brass packing nut to effect a leak-free packing to stem junction. The upper stem may be spring loaded against the packing to effect the seal. The packing nut or bonnet, packing washer, and pressure relief device shall be made from free-cutting brass or forging brass.

3.9.2 Style II valve. Style II valve shall be of the O-ring seal design and shall be used for service pressures not greater than 500 psig (3447 kPa).

3.9.2.1 O-ring valve. The O-ring valve shall have a one-piece or a two-piece stem. The stem shall have a groove to retain the O-ring. The groove shall be designed so that the O-ring rolls between the stem and the body as the stem is raised or lowered. The O-ring shall effect a seal against a finished surface inside the valve body or the bonnet. The lower end of the bonnet shall seal against a shoulder inside the valve body by means of a metal-to-metal seal or a sealing washer. The stem shall backseat against the bonnet when in the fully open position.

3.9.2.1.1 Style II - composition A valve. Style II-A valve bodies shall be made of forging brass. The body shall have an integral seat to mate with the disk insert in the lower end of the stem. The o-ring seal shall be of sufficient thickness to create a compressive sealing pressure between the bottom of the stem groove and the interior wall of the valve body or bonnet. The compressive pressure shall cause the O-ring to roll on itself when the stem is raised or lowered in the valve body. The O-ring shall be rubber. The one-piece, O-ring sealed stem shall be threaded to close when turned clockwise. The stem shall have a surface for backseating in the fully open position. The stem shall have a groove to retain the O-ring. The groove shall be designed to permit the O-ring to roll on itself. The stem shall be fabricated of corrosion-resisting steel, nickel-copper alloy, free-cutting brass, or aluminum bronze. Corrosion-resisting steel shall be class 302, 303, 304, 416, or 420. The upper stem of the two-piece, O-ring sealed stem shall be threaded to close the valve when turned clockwise. The upper stem shall backseat against the bonnet when in the fully open position. The upper stem shall be counterbored, internally grooved, and gated to accommodate a mating flanged stub on the lower stem or spindle. Opening and closing action shall be transmitted to the spindle through the flanged stub. The spindle shall not rotate while being opened or closed. The lower stem shall have a groove to retain the O-ring. The groove shall be designed to permit the O-ring to roll on itself in the groove. The spindle shall have a disk insert. The upper stem and the spindle shall be fabricated of corrosion-resisting steel, free-cutting brass, nickel-copper alloy, or aluminum bronze. Corrosion-resisting steel shall be class 302, 303, 304, 416, or 420. The packing nut or bonnet, packing washer, pressure relief device, and outlet cap or plug shall be made from forging or free-cutting brass.

3.9.3 Style III valve. Style III valves shall be of the pressure seal design and shall be used in applications not greater than 7500 psig (51712 kPa).

3.9.3.1 Pressure sealed valve. The pressure sealed valve shall have a two-piece stem. The upper stem shall be spring loaded so that an integral seating surface on the stem is backseated constantly against the packing. The packing shall be seated against a counterbore or a finished surface in the packing nut or bonnet, and against a shoulder in the valve body. The upper stem and the packing shall be designed so that spring-pressure backseating of the upper stem is aided by internal gas pressure when the valve is in service. Style III, class 05, shall further resist leakage when used in low pressure service. The lower stem or spindle shall be threaded to mate with threads in the valve body. The lower stem shall be driven by a tang and slot connection or by a socket and shank connection.

3.9.3.1.1 Style III - composition A. Style III-A valve bodies shall be fabricated of forging brass as specified herein. The body shall have an integral seat to mate with the stem disk insert. The upper stem and the seat plug shall be fabricated of corrosion-resisting steel, aluminum bronze, manganese bronze, copper-silicon alloy, naval brass, or free-cutting brass, as specified herein. Corrosion-resisting steel shall be class 302, 303, or 304. The upper stem spring shall be phosphor bronze wire or corrosion-resisting steel wire. Corrosion-resisting steel wire shall be composition 302 or 304, condition B. The seal shall fit in a counterbore in the bonnet or packing nut. The packing shall seal against a shoulder in the valve and against a mating surface in the bonnet or packing nut. The packing shall be polyamide plastic, composition polyhexamethylene adipamide, or shall be polytetrafluoroethylene plastic. The valve shall have a two-piece, pressure sealed stem. The upper stem shall have a backseating surface which shall seal against the packing. The backseated seal shall be maintained by spring pressure and shall be supplemented by gas pressure when the valve is in service. Spring pressure shall be maintained by a shrouded spring fitted in a counterbore in the top of the handwheel, or by a spring inside the valve body. The upper stem shall drive the lower stem or plug by a slot and tang connection, or by a socket and shank connection. The tang may be integral to a corrosion-resisting steel or naval brass stem or shall be made of corrosion-resisting steel, class 302, 303, or 304. When not integral to the stem, the tang shall be attached to the upper stem. The socket and shank connection shall consist of a square or a prismatic socket in the upper or the lower stem, and a mating shank on the other stem. The lower stem or plug shall be threaded to close when turned clockwise. The lower stem shall have a disk insert. The packing

nut or bonnet, packing washer, pressure relief device, and outlet cap or plug shall be made form free-cutting brass or forging brass.

3.9.4 Style IV valve. Style IV valves shall be of the diaphragm seal design. The diaphragm shall be used for applications up to 3000 psig (20680 kPa) service pressure.

3.9.4.1 Diaphragm valve. The diaphragm valve shall have a threaded upper stem which, when turned clockwise, shall depress a lower stem or spindle onto a valve seat. Action shall be transferred through a sealed diaphragm located between the upper stem and the spindle. When the upper stem is turned counter-clockwise, the spindle shall be raised from the seat by a spindle spring. The diaphragm shall be compression sealed between a lip or shoulder in the body and a mating surface in the bonnet.

3.9.4.1.1 Style IV - composition A. Style IV-A valve bodies shall be fabricated of forging brass. The body shall have an integral seat to mate with the stem disk insert. During opening and closing of the valve, the spindle spring shall not inhibit the spindle movement and shall not bind in the valve body. The spring shall be retained in position by machined seats, by a bushing, by a spindle guide, or by a combination of these. The spindle shall have a disk insert. The upper stem and the spindle of the diaphragm sealed valve shall be fabricated of corrosion-resisting steel, aluminum bronze, aluminum-silicon bronze composition 1, manganese bronze, copper-silicon alloy, free-cutting brass or naval brass. Corrosion-resisting steel shall be class 302, 303, or 304. The bushing and the spindle guide when applicable shall be fabricated of free-cutting brass, naval brass, or corrosion-resisting steel. Corrosion-resisting steel shall be class 302, 303, or 304. The spindle spring shall be phosphor bronze wire or corrosion-resisting steel wire. Corrosion-resisting steel wire shall be composition 302 or 304, condition B. The diaphragm shall be impervious to gas from inlet service pressure and from outlet back pressure in the fully open position, the half open position, and the closed position. The diaphragm shall consist of one or more plastic, rubber, or metallic elements. Metallic elements shall be corrosion-resisting steel flat wire, phosphor bronze flat stock, copper-beryllium alloy, or nickel silver alloy. Corrosion-resisting steel shall be composition 302, 303, or 304. For valves in class 30 and higher, only metallic diaphragms shall be allowed. The bonnet or packing nut, packing washer, pressure relief device and outlet cap or plug shall be made from free-cutting brass or forging brass.

3.9.4.2 Style IV - composition D. Style IV-D valve bodies shall be fabricated of free-cutting brass. The body shall have an integral seat to mate with the stem disk insert of polyamide plastic for medical post application. The stem, bushing and spring of the style IV-D valve shall be as specified for the style IV-A valve. The bonnet or packing nut, packing washer, pressure relief device and outlet cap or plug shall be made from free-cutting brass or forging brass. The diaphragm seal shall be as specified for the style IV-A valve, except only metal diaphragms shall be allowed.

3.10 Dimensions. Unless otherwise specified, the overall length of the valve shall not be greater than 5 inches (127 mm). When equipped with a dip tube, the dip tube shall not be included as part of the overall length. When the valve has a pin-index outlet, the maximum projection of the valve from the centerline of its inlet connection shall not be greater than 0.9375 inches (23.81 mm). The maximum projection of a threaded outlet valve, including the outlet cap or plug, from the centerline of the inlet connection shall not be greater than 1.625 inches (41.28 mm) and the maximum overall width of the valve shall not be greater than 3.0625 inches (77.79 mm).

3.11 Weight. When the valve has a pin-index outlet, the weight of the valve shall not be greater than 16 ounces (453.6 grams). When the valve has a threaded outlet the weight of the valve including the outlet cap or plug shall not be greater than 40 ounces (1134 grams).

3.12 Finish. All valve bodies shall be finished in the base metal of fabrication except that unless otherwise specified, valves for medical use shall be chromium over nickel plated. Chromium plating shall

conform to QQ-C-320, class 1, type I and thickness shall be 0.00001 inch (0.00025 mm) minimum. Chromium plating shall be applied over intermediate nickel coatings. Intermediate nickel coating shall conform to QQ-N-290, class 1, grade G for brass and steel valve bodies. When subjected to a salt spray test for 72 hours, the chromium plated valves shall show no evidence of corrosion, pitting or flaking. The bottom of the valve inlet connection including five to eight threads shall be left unplated.

3.13 Marking. The valve shall be identified as specified below.

3.13.1 Body marking. The valve shall be permanently marked by etching, stamping or embossing. The use of noncorrosive metal tags or durable plastic tags is not acceptable for valve identification in lieu of marking. Marking in the metal shall not be less than 0.0156 inch (0.396 mm) nor greater than 0.0312 inch (0.792 mm) in depth. Markings shall not be less than 0.0937 inch (2.38 mm) high except on valves with 0.375 inch (9.52 mm) inlet when 0.0625 inch (1.59 mm) high lettering will be acceptable. Markings in the metal shall be on a plane parallel to a plane determined by the centerlines of the valve inlet and the valve outlet. Markings shall include the following:

a. The manufacturer's identification.

b. Valves required for use with a specific gas shall be marked with the name of the gas on at least one side of the valve body as specified in the applicable specification sheet.

c. Unless otherwise specified, valves required for use with a gas within one of the following groups of compatible gases (LPG, REFRIGERANT AND INERT) shall be marked with the group name instead of the name of the specific gas.

3.13.1.1 Medical valves. All medical valves shall be marked permanently by stamping or embossing the metal surface. Each valve shall carry the full name of the gas of intended use. Each valve shall be marked "MED" not less than 0.125 inch (3.18 mm) high. If there is insufficient area to mark the full name of the gas, the valve shall be stamped or embossed with the CGA connection number.

3.13.2 Handwheel. The direction of rotation for opening the valve shall be marked on the handwheel by embossing or by stamping.

3.13.3 Burst pressure. When the valve contains a pressure relief device with a frangible disk, the maximum burst pressure shall be stamped on the face of the cap of the pressure relief device.

3.13.4 Yield temperature. When the valve contains a pressure relief device with fusible metal, the nominal yield temperature of the fusible metal shall be stamped on a face of the device except for medical post (pin-index) valves, or when the fusible metal is poured into place in the valve body in accordance with the applicable specification sheet.

3.13.5 Opening pressure. When the valve contains a spring-loaded pressure relief device, the start to discharge pressure and the flow capacity in cubic feet per minute or a representative code shall be stamped on the device.

3.14 Workmanship. All parts, components, and assemblies of the valve including castings, forgings, molded parts, stampings, seals, and machined surfaces shall be clean and free from sand, dirt, fins, pits, sprues, scale, and other harmful extraneous material. All edges shall be rounded or chamfered.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.1.1 Component and material inspection. The contractor is responsible for insuring that components and materials used are manufactured, examined, and tested in accordance with referenced specifications and standards.

4.2 Classification of inspection. The inspection requirements specified herein are classified as follows:

a. Qualification inspection (see 4.3 and 6.3).
b. Quality conformance inspection (see 4.4).
c. Inspection of packaging (see 4.6).

4.3 Qualification inspection. Five valves of each style and composition as applicable shall be submitted for qualification inspection (see 6.3). When different forgings are utilized to accommodate various outlet connections, valves shall be submitted for each forging. Identical valves with varying outlets shall be qualified without need of individual testing. Each valve outlet shall be identified by two scale drawings submitted by the contractor in the Qualification Test Report (see 4.3.3). When the intended use of the valve dictates that it be equipped with a pressure relief device, each valve shall be complete with a pressure relief device. For valve styles III and IV where more than one type of pressure relief device is required to meet all intended uses of the basic valve, two of the additional pressure relief devices shall be submitted. When frangible disks are required for different service pressures, two disks for each of the service pressures shall be submitted for testing in accordance with 3.6.1.7.1.1, as specified in 4.5.2.3.

4.3.1 Examination. Each valve shall be examined as specified in 4.5.1. Presence of one or more defects shall be cause for rejection.

4.3.2 Tests. Four valves of each classification shall be tested as specified in 4.5.2.1 through 4.5.2.19 as applicable for the style, class and composition. The fifth valve shall be used as a test control. Failure of any test shall be cause for rejection.

4.3.3 Test report. After completing the qualification tests, a test report shall be prepared in accordance with MIL-STD-831 and three copies furnished to the qualification activity.

4.4 Quality conformance inspection.

4.4.1 Examination. Individual valves shall be examined for defects as specified in 4.5.1. Presence of any defect shall be cause for rejection of the valve.

4.4.2 Tests. Samples for inspection and acceptance shall be in accordance with ANSI-Z1.4. Any departure from a specified requirement shall be classified as a defect. Any defect shall be cause for rejection of the entire lot.

4.5 Inspection procedures.

4.5.1 Examination. The valve shall be examined as specified herein for the following defects.

Requirement Number	Defect	paragraph
101.	Material not as specified.	3.4
102.	Materials not resistant to corrosion and deterioration or treated to be made resistant to corrosion and deterioration.	3.4.1
103	Dissimilar metals not in accordance with MIL-STD-889.	3.4.1.1
104	Material and material finish or treatment information not available.	3.4.1.2
105	Used, rebuilt or remanufactured components, pieces, or parts incorporated in the valves.	3.4.2
106	Parts or components missing or incomplete.	3.6.1
107	Inlet threads not as specified.	3.6.1.1.1
108	Inlet channel opening not as specified.	3.6.1.1.1
109	Outlet not as specified.	3.6.1.1.2
110	Outlet channel opening not as specified.	3.6.1.1.2
111	Relief approach channel not as specified.	3.6.1.1.3
112	Valve seat not as specified.	3.6.1.1.4
113	Valve seat opening not as specified.	3.6.1.1.4
114	Wrenching surfaces not as specified.	3.6.1.1.5
115	Lubricants on stem or body not as specified.	3.6.1.2
116	Handwheel, wrench or stem not as specified.	3.6.1.4
117	Strainer not as specified.	3.6.1.5
118	Dip tube not as specified.	3.6.1.6
119	Relief device not as specified.	3.6.1.7
120	Dimensions not as specified.	3.10
121	Weight not as specified.	3.11
122	Finish not as specified.	3.12
123	Marking not as specified.	3.13
124	Stem rotation open and close not as specified.	3.13.2
125	Workmanship not as specified.	3.14

4.5.2 Tests.

4.5.2.1 Fusible plug bond. Connect the inlet end of the plug to a suitable pressure source and apply an air or nitrogen pressure of not less than the service pressure specified in 3.7.1.1. Place the plug in an oven or immerse in a liquid and heat to a temperature of 132° F (55° C) ±2° F (1.11° C). Maintain the pressure and temperature for 8 hours, then examine the outlet end of the plug. Evidence of leakage or extrusion of fusible metal shall constitute failure of this test.

4.5.2.2 Bond test for frangible disk-fusible plug pressure relief device. Connect the inlet end of the device, including frangible disk and sealing washer, to a suitable pressure source. Immerse the device in a liquid bath at a temperature of 132° F (55° C); apply air, nitrogen or hydrostatic pressure equal to the minimum bursting pressure of the frangible disk; maintain the temperature and pressure for 10 minutes, then examine the pressure relief device. Extrusion of fusible metal or bursting of the frangible disk shall constitute failure of this test. As an alternate to this test, the frangible disk may be removed and the fusible plug tested as specified in 4.5.2.1.

4.5.2.3 Frangible disk. This test shall be performed with no fusible metal backing the frangible disk. Close the valve and plug or cap the outlet. Maintain a constant temperature of 160° F (71° C) at the valve. Subject the valve to an internal gas pressure, equal to the applicable service pressure of the valve, for 30 seconds. Raise the internal pressure at a rate of 50 psig (345 kPa) every 30 seconds until the frangible disk bursts. Note the pressure at which the disk fails. Examine the cap or plug for obstruction of the outlet passages. Nonconformance to 3.6.1.7.1.1 shall constitute failure of this test. Test may be performed at room temperature, provided that the relation of bursting pressure at room temperature to the bursting pressure at 160° F (71° C) has been established by previous tests. After having successfully tested two frangible disk holders (cap or plug) of like design and dimension, any required additional tests of frangible disks may be performed in a hardened steel fixture having a pressure opening identical in dimensions and configuration to that of the frangible disk holder in which the disk is to be used.

4.5.2.4 Yield temperature test for fusible metal before pouring into pressure relief device. Prepare two sticks from each batch of fusible metal. Each stick shall be 8 inches (203.2 mm) long. Cut 2-inch (50.8 mm) specimens from the sticks and suspend two specimens on knife-edge supports. The supports shall be 1-inch (25.4 mm) apart. The specimens shall overhang the supports by 0.50 inch (12.7 mm). The specimens and supports shall be immersed in a glycerin or oil bath. There shall be clearance of not less than 0.25 inch (6.35 mm) between the specimens and the bottom of the bath. The bath shall be suspended in and the temperature controlled by an outer glycerin or oil bath. A thermometer shall be suspended midway between the two specimens and shall not touch the bottom or the bath. The temperature of the bath shall start at 5° F (-15° C) below the lower rating of the fusible metal yield point range. From this temperature, raise the temperature of the bath at a rate of 1° F (.56° C) every 3 minutes. The yield temperature shall be taken as that temperature at which the second of the four ends of the specimens loses its rigidity and drops. A yield temperature that does not fall within the rated range of the fusible metal as specified in 3.6.1.7.2.1, 3.6.1.7.4 or 3.6.1.7.5 as applicable, shall constitute failure of this test.

4.5.2.5 Yield temperature test for fabricated pressure relief devices. Remove the frangible disk, if one is present, from the pressure relief device. Suspend the device, with the centerline of the fusible metal vertically in an oil or glycerin bath. The bath shall be equipped with a mechanical stirrer and not less than two thermometers of the bulb-immersion type. At any given time, the temperature of the bath shall be uniform. At the time of immersion, the temperature of the bath shall be 5° F (-15° C) below the lower rating of the fusible metal yield range. Increase the temperature at the rate of 1° F (.56° C) every 3 minutes. At every increase in temperature, pass the bulb of a thermometer across the surface of the fusible metal. Note the temperature when the bulb dips into the fusible metal. At this temperature, the fusible metal has become fluid. A temperature reading (at which the fusible metal becomes fluid) that does not fall within the yield range specified in 3.6.1.7.2.1, 3.6.1.7.3, 3.6.1.7.4, or 3.6.1.7.5 as applicable shall constitute failure of this test. Where the fusible metal is part of a nonremovable pressure relief device, the test specified in 4.5.2.4 shall be used.

4.5.2.6 Spring-loaded pressure relief device. Cap or plug the valve outlet. Open the valve. Connect the valve inlet to an air source having a thermometer, a pressure gage, and provisions for metering the air flow. Immerse the valve in water, apply 300 psig (2070 kPa) of air at 70° F (21° C) and examine the relief device for leaks. Increase the air pressure on the valve until the pressure relief device opens. Determine the air pressure at which the relief device opens. Determine the flow rate of air in cubic feet per minute that escapes through the relief device after the valve internal pressure has been increased to 100% of the designated cylinder's minimum test pressure at ambient temperature of 70° F (21° C). Decrease the internal pressure until the relief device has resealed. Determine the internal pressure at which the relief device resealed. Nonconformance to 3.6.1.7.6 shall constitute failure of this test.

4.5.2.7 Stress corrosion test for brass forgings. After having been subjected to the hydrostatic test specified in 4.5.9.17, brass forgings shall be subjected to the tests specified per ASTM G 37. Evidence of cracks shall constitute failure of this test.

4.5.2.8 Outlet failure. One valve of each class shall be tested to destruction by this test. Insert a plug with adapter head, or using a heavy duty steel cap, apply sufficient torque to the valve so as to cause failure in the outlet threads. Examine the body of the valve during the test. Fracture or deformation of the body prior to failure of the outlet threads shall constitute failure of this test.

4.5.2.9 Combustibility.

4.5.2.9.1 Contact with oxygen. Place 0.5 gram of the material to be tested in a reaction chamber connected to a source of oxygen that provides a pressure of 2,000 psig (13790 kPa). Heat the reaction chamber to a temperature of plus 302° F (150° C) and maintain this applied temperature ±2° F (1.11° C) and a pressure of 2,000 psig (13790 kPa) for 1 hour. Record the temperature within the reaction chamber at 5-minute intervals. A temperature rise shall be indicative of a reaction. After 1 hour, release the pressure within the chamber and let cool. Open the chamber and examine the material for discoloration or any change in appearance of the material indicating combustion. Three separate tests shall be conducted for each material. Any indication of a reaction or evidence of combustion shall constitute failure of this test.

4.5.2.9.2 Contact with oxygen under surge-pressure conditions. Place 0.5 gram of the material to be tested in a reaction chamber, raise the temperature the reaction chamber to plus 160° F (71° C) ±2° F (1.11° C), and maintain this temperature for 10 minutes. At the end of 10 minutes, apply surge of pressure of 2,000 psig (13790 kPa) of oxygen gas instantaneously. Maintain the applied temperature and pressure at a constant level for 5 minutes. At the end of this interval, release the pressure and reapply it instantaneously. A temperature rise during application of pressure or a discoloration or change in appearance of the sample under test shall be considered evidence of combustion and shall constitute failure of this test.

4.5.2.10 Hardness. Test the hardness of the packing seal surface of carbon or nickel steel stems in accordance with ASTM E18. The stem shall be from the valve used in preceding tests, except that in case of dispute the test shall be performed on the stem from the valve reserved as a test control. A hardness of less than Rockwell C-30 or a hardening depth of less than 0.020 inch (.50 mm) shall constitute failure of this test.

4.5.2.11 Chromium plating salt spray. Subject the class 1 chromium plating to a salt spray test for 72 hours in accordance with FED-STD-151, method 811.1. Evidence of corrosion, pitting, or flaking shall constitute failure of this test.

4.5.2.12 Service pressure. Half-open the valve, cap or plug the outlet, and subject the valve to an inlet air or nitrogen gas pressure equal to the maximum service pressure specified in table II while the valve is submerged in a suitable liquid. Determine whether the valve leaks. Repeat the test with the valve fully open. Determine whether the valve leaks. Repeat the test with the valve closed with a torque not greater than that specified in table III, and with the outlet cap or plug removed. Keep the valve submerged for not less than 1 minute. Determine whether the valve leaks. Leakage or evidence of deformation, cracks, pits, or fissures shall constitute failure of this test.

4.5.2.13 Torque and overtorque. Connect the valve inlet to a positive, open-and-close test fixture. There shall be no leakage through any of the connections between the valve under test and the test fixtures. The valve under test shall be dry. An air or nitrogen gas pressure of not less than the maximum service pressure specified in Table II shall be maintained on the valve inlet during testing. Perform the following operations:

a. Open the outlet of the valve in the test fixture. Determine the torque required to open and close the valve during the opening and closing cycles.

b. Close the outlet of the valve in the test fixture. Cycle the valve twice at the torque determined in (a). Determine whether the valve closes at this torque. If the valve does not close at the torque determined in (a), redetermine the torque required to open and close the valve. Check for leakage around the valve stem and the packing nut or bonnet threads.

c. Subject the valve to the overtorque specified in Table III. Check the stem for binding or seizure. Examine the visible components of the valve for permanent deformation or failure. Open the valve and check for leakage around the valve stem and the packing nut or bonnet threads.

d. Close the valve, open the outlet of the test fixture, and check for leakage through the valve seat.

Nonconformance to 3.7.2 shall constitute failure of this test.

4.5.2.14 Spindle spring compression. Open the valve fully. With zero psig at the valve inlet, apply an instantaneous gas pressure surge to the valve outlet equal to the maximum service pressure specified in Table II. Determine whether flow is interrupted by the spring allowing the spindle to check closed. Interruption of gas flow shall constitute failure of this test.

4.5.2.15 Vibration.

4.5.2.15.1 Vibration test with valve closed. Remove the valve outlet cap or plug. Close the valve with a torque not greater than the closing torque specified in Table III. Maintain an air or nitrogen inlet pressure at not less than the maximum service pressure specified in Table II. Vibrate the valve at an amplitude of 0.0312 to 0.0625 inch (.792 to 1.59 mm) with a frequency of 3,400 to 3,600 vibrations per minute, for 1 hour. At the end of the hour examine the valve. Evidence of leakage, deformation, failure, loosened threaded connections, detached components, wheeling open of the valve; or binding or seizure of the stem shall constitute failure of this test.

4.5.2.15.2 Vibration test with valve open for other than pin-index connection valves. Repeat test specified in 4.5.2.15.1 except that:

a. An outlet cap or plug shall be screwed in tightly.

b. The valve shall be fully open.

Leakage, deformation, loosened threaded connections, detached components, wheeling close of the valve, or binding or seizure of the stem shall constitute failure of this test.

4.5.2.15.3 Vibration test with valve half open. Repeat the test specified in 4.5.2.15.2 except that the valve shall be half open. Leakage, deformation, loosened connections, detached components, or binding or seizure of the stem shall constitute failure of this test.

4.5.2.16 Endurance. Maintain an internal air or nitrogen gas pressure at not less than the maximum service pressure specified in Table II during the test. The cycling rate shall not exceed one cycle per minute.

Procedure I for style I, II, and III valves.

Determine the initial opening torque. Determine the initial closing torque to completely seat the valve with no leakage. Cycle the valve at this torque for 1,000 cycles. Observe the compression packed valve for leakage around the stem during cycling. If required, tighten the packing nut. At the completion of 1,000 cycles, redetermine the closing torque required to completely seat the valve without leakage. Using this redetermined torque, cycle the valve for an additional 1,000 cycles. Repeat these procedures until the valve has been cycled 5,000 time. Upon completion of 5,000 cycles, re-examine the value. Leakage, loose or damaged components, or opening or closing torque greater than that specified in Table III or failure to meet the reliability requirements of 3.3 shall constitute failure of this test.

Procedure II for style IV valves.

Procedure II shall be identical to Procedure I except that the valve shall be cycled a total of 2,000 cycles in 200-cycle increments.

4.5.2.16.1 Special low pressure cycling for style III valves. When used for low pressure service style III valves shall be subjected to the following test. With the outlet capped, place each of four valves in a pressurized cycle machine. Set the closing torque as specified for style III valves in Table III. The machine should stop on opening just short of back seating. Adjust the inlet pressure to 50 psig (345 kPa) ±5 psig (34 kPa). Cycle the valve continuously for 1,000 cycles. Leak test the stem for full cycle at 250 cycles, at 500 cycles and at 750 cycles. At 1,000 cycles, raise the outlet pressure to 600 psig (4150 kPa) and leak test the stem for one full cycle. Repeat procedure for a total of 5,000 cycles for each valve. Leakage at any test shall constitute failure of this test.

4.5.2.17 Hydrostatic proof pressure. Remove the outlet cap. Replace the relief device with a solid cap or plug. Close the valve with torque not greater than the closing torque specified in Table III. Subject the valve inlet to the hydrostatic pressure specified in Table II for a period of 10 minutes. Examine the valve for leakage. After completion of this phase of the test, cap or plug the valve outlet. Open the valve to the same hydrostatic pressure for a period of 10 minutes. Leakage or evidence of deformation, cracks, pits, or fissures shall constitute failure of this test.

Note: The hydrostatic test shall be performed after completion of the endurance test specified in 4.5.2.16.

4.5.2.18 Temperature stability. The valves shall be in a dry condition.

4.5.2.18.1 Low temperature storage and operation. Connect the inlet of the valve to a pressure fixture and close the valve at a torque not greater than specified in Table III. Place the valve assembly in an atmosphere stabilized at -65° F (-54° C) ±2° F (1.11° C) for a period of 8 hours while maintaining an air or nitrogen pressure at the maximum service pressure specified in Table II. Examine the valve for leakage. Examine the valve for failure or deformation of components. While maintaining pressure, allow the valve to reach a stabilized temperature of -50° F (-46° C) ±2° F (1.11° C). Determine the opening and the closing torque. After opening and closing the valve not less than twice, examine the valve for leakage, deformation or damage. Evidence of leakage, deformation or component damage, or requirement for opening or closing torque greater than that specified in Table III shall constitute failure of this test.

4.5.2.18.2 High temperature storage and opening. Connect the valve to a pressure fixture in a controlled oven and stabilize the temperature of the valve assembly at 155° F (68.8° C) ±2° F (1.11° C).

Close the valve at a closing torque not greater than specified in Table III and pressurize the inlet with air or nitrogen pressure at the maximum service pressure as specified in Table II. Maintain the temperature for 8 hours. Examine the valve for leakage, failure or deformation. Allow the valve to cool to temperature of 120° F (49° C) ±2° F (1.11° C) while maintaining the pressure. Examine the valve for leakage. Open and close the valve not less than twice and determine the opening and closing torque for the valve. Evidence of leakage, damage or any component or deformation of the valve, or an opening or closing torque greater than specified in Table III shall constitute failure of this test.

4.5.2.19 Disassembly inspection. After completion of the tests specified in 4.5.2.12 through 4.5.2.18, disassemble the valve and examine for failures developed during the tests, as specified below. Nonconformance to the applicable requirements paragraph shall constitute failure of this inspection.

Failure	Requirements Paragraph
Deformation of internal components	3.7.1, 3.7.2, 3.7.4, 3.8
Cracked disk insert	3.3, 3.7.2
Thread failure or excessive wear	3.3
Detached components	3.3, 3.7.4
Cracks, pits, or fissures	3.7.1
Galling of the stem	3.7.4
O-ring worn flat, indicating lack of rolling	3.9.2
Spindle spring worn flat, indicating sliding against body or spindle	3.9.4

4.6 Inspection of packing.

4.6.1 Quality conformance inspection of pack.

4.6.1.1 Unit of product. For the purpose of inspection, a complete pack prepared for shipment shall be considered a unit of product.

4.6.1.2 Sampling. Sampling for inspection and acceptance shall be in accordance with ANSI-Z1.4. Any departure from a specified requirement shall be classified as a defect. Any defect shall be cause for rejection of the entire lot.

4.6.1.3 Examination. Samples selected in accordance with 4.6.1.2 shall be examined for the following defects.

126	Materials, methods and containers not as specified for level A or B. Each incorrect material, method or container shall constitute one defect.
127	Preservation not as specified for level A.
128.	Containers not as specified for level A or B.
129	Strapping not zinc coated as specified for level A.
130	Reinforcing tape and closure not as specified for level B.
131	Marking illegible, incorrect, incomplete, or missing.

5. PACKING

5.1 Preservation. Preservation shall be level A or commercial, as specified (see 6.2).

5.1.1 Level A. Each valve shall be preserved in accordance with MIL-P-116, method IC-1. Multiple quantities of valves shall be further packed in multiples of 10 or 12 in fiberboard boxes conforming to

PPP-B-636, W5c or W6c. The boxes shall be provided with fiberboard dividers to prevent the valves from contacting each other.

5.1.2 Commercial. Commercial preservation shall be in accordance with ASTM D 3951.

5.2 Packing. Packing shall be level A, level B, or commercial, as specified (see 6.2).

5.2.1 Level A. Valves of like description, preserved as specified in 5.1, shall be packed in close-fitting boxes conforming to PPP-B-601, overseas type, style I or J. The boxes shall be closed and strapped in accordance with the appendix to the box specification.

5.2.2 Level B. Valves of like description, preserved as specified in 5.1, shall be packed in close-fitting boxes conforming to PPP-B-636, V3c. The boxes shall be closed and reinforced as specified in the appendix to the box specification.

5.2.3 Commercial. Commercial packing shall be in accordance with ASTM D 3951.

5.3 Marking. In addition to any special marking required by the contract or purchase order, marking for military levels of protection shall be in accordance with MIL-STD-129. Commercial marking shall be in accordance with ASTM D 3951.

6. NOTES

6.1 Intended use. The valves covered by this specification in conjunction with applicable detail specification sheets are intended for installation on compressed or liquefied gas cylinders.

6.2 Ordering data. Acquisition documents should specify the following:

a. Title, number, and date of this specification.

b. Title, number, and date of applicable specification sheet.

c. Valve type designation (see 1.3).

d. When a metal outlet cap or plug with chain and retaining ring is require or when a plastic dust cap is acceptable (see 3.5 and 3.6.1.8).

e. Service pressure required (see 3.7.1.1), (3.6.1.7.6).

f. Cylinder diameter when a dip tube is specified on applicable specification sheet (see 3.6.1.6).

g. When a dip tube assembled to the valve and secured as specified is required (see 3.6.1.6).

h. When overall length of valve other than as specified is acceptable (see 3.10).

i. When marking of valves other than as specified is required (see 3.13.1(c)).

j. When chromium over nickel plated valves are not required for medical application (see 3.12).

k. Degree of preservation and degree of packing required (see 5.1 and 5.2).

l. When specified components parts for Medical valves shall be tested for oxygen compatibility in accordance with NHB-8060-1.

m. Specify when a strainer is required (see 3.6.1.5).

n. When data desired for the identification of materials and finishes is required (see 3.4.1.2).

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time set for opening of bids, qualified for inclusion in Qualified Products List (QPL No.) whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or purchase orders for the products covered by this specification. The activity responsible for the Qualified Products List is San Antonio Air Logistics Center, Attn: SFTH, Kelly AFB TX 78241-5603 and information pertaining to qualification of products may be obtained from that activity.

6.4 Specification sheets This specification contains general requirements for gas cylinder valves. Specific requirements by intended use are covered in separate specification sheets as listed in Table IV.

6.5 Classification changes and supersession data. Classification changes and supersession data between this revision of the specification and the previous edition is contained in the applicable specification sheets, Table IV. What was referred to in the previous edition as class is referred to as style in this revision. Class refers to maximum service pressure in this revision.

6.6 International Standardization Agreement. Certain provisions of this specification covering the pin-index system for medical valves are the subject of international standardization agreement QSTAG-236 (see 1.2.1). When amendment, revision, or cancellation of this specification is proposed which will modify the international standardization agreement concerned, the preparing activity will take appropriate action though international standardization channels, including departmental standardization offices, to change the agreement or make other appropriate accommodations.

6.7 Subject term (key word) listing.

Diaphragm valve
Dip tube
Frangible disk
Fusible plug
Handwheel
Inlet
Lubricants
Medical valve
O-ring valve
Outlet
Pressure relief device
Strainer

TABLE IV. Type designation cross listing of valves

Detail Spec. Number	Type Designation	Outlet App.	Inlet Size	Style	Class	MIL-V-2C Type Designation	Gas service	Remarks
MIL-DTL-2/1	V1-510-0	510	6	I II III IV	05	03-511-1	Acetylene	.75" inlet
MIL-DTL-2/2	V2-510-0	510	8	I II III IV	05	03-511-2	Acetylene	1.0" inlet
MIL-DTL-2/3	V3-200-1	200	3	I	05	03-201-4	Acetylene	.375" inlet
MIL-DTL-2/4	V4-660-1	660	6	I	30	20-621-1	Aerosol insecticide	
MIL-DTL-2/5	V5-346-2 V5-346-3 V5-346-4 V5-346-5 V5-346-6	346	6	III	30	06-581-1	Air for human respiration	
MIL-DTL-2/6	V6-590-2 V6-590-3 V6-590-4 V6-590-5 V6-590-6	590	6	III	30	06-591-2	Air, industrial	Oil tolerant
MIL-DTL-2/7	V7-240-0	240	6	I	05	09-241-1	Anhydrous ammonia	.75" inlet dished head
MIL-DTL-2/8	V8-240-0	240	6	I	05	09-241-2	Anhydrous ammonia	.75" inlet convex head
MIL-DTL-2/9	V9-240-0	240	8	I	05	09-241-3	Anhydrous ammonia	1.0" inlet dished head

MIL-DTL-2/10	V10-240-0	240	8	I	05	09-241-4	Anhydrous ammonia	1.0" inlet convex head
MIL-DTL-2/11	V11-580-2 V11-580-3 V11-580-4 V11-580-5 V11-580-6	580	6	III	30	14-581-1 07-581-1 05-581-1 05-581-2	Argon, helium, nitrogen, neon, or xenon	Inert-oil free
MIL-DTL-2/12	superseded							
MIL-DTL-2/13	superseded							
MIL-DTL-2/14	V14-510-1	510	6	II IV	05	10-511-1 08-511-1	Butane, propane, butane/propane mixture or MAPP Gas	
MIL-DTL-2/15	V15-320-3 V15-320-4	320	6	III	30	02-321-1	Carbon dioxide	
MIL-DTL-2/16	V16-320-4	320	6	III IV	30	02-321-2	Carbon dioxide	Medical
MIL-DTL-2/17	V17-940-4	940	4	I	30	02-941-3	Carbon dioxide	Medical/(Pin-index)
MIL-DTL-2/18	V18-350-2	350	6	III	30	25-351-1	Carbon monoxide	
MIL-DTLV-2/19	V19-350-3 V19-350-4 V19-350-5	350	6	III	30	21-351-1	Ethylene oxide/carbon dioxide mixture	
MIL-DTL-2/20	V20-820-1	820	6	I	05	13-661-2	Chlorine	
MIL-DTL-2/21	V21-820-1	820	6	I	05	13-661-4	Chlorine	

MIL-DTL-2/22	V22-660-1-225 V22-660-1-240 V22-660-1-300	660	6	I	05	17-621-1 26-621-1 24-621-1 18-621-1 12-621-1	Dichlorodi-fluoromethane Bromochloro-methane Bromotri-fluoromethane Methyl Chloride Sulfur Dioxide Monochlorodi-fluoromethane, or Dichlorote-trafluoroethane	
MIL-DTL-2/23	V23-300-1	300	6	I	05	19-301-1	Ethyl Chloride	
MIL-DTL-2/24	V24-510-1	510	6	I	05	22-511-1	Ethylene Oxide	
MIL-DTL-2/25	superseded							
MIL-DTL-2/26	V26-590-2 V26-590-3 V26-590-4 V26-590-5 V26-590-6	590	6	III	30	07-591-2	Helium or Nitrogen	Inert-oil tolerant
MIL-DTL-2/27	V27-280-2	280	6	III IV	30	16-541-2	Oxygen/Helium Mixture	Medical Helium not over 80 percent
MIL-DTL-2/28	V28-890-2	890	4	I	30	16-891-2	Oxygen/Helium Mixture	Medical (Pin-Index) Helium not over 80 percent
MIL-DTL-2/29	V29-350-2	350	6	III	30	04-351-1	Hydrogen	
MIL-DTL-2/30	superseded							
MIL-DTL-2/31	superseded							
MIL-DTL-2/32	superseded							
MIL-DTL-2/33	superseded							

MIL-DTL-2/34	superseded							
MIL-DTL-2/35	superseded							
MIL-DTL-2/36	superseded							
MIL-DTL-2/37	V37-326-4	326	6	III IV	30	15-321-1	Nitrous Oxide	Medical
MIL-DTL-2/38	V38-910-4	910	4	I	30	15-9111-2	Nitrous Oxide	Medical (Pin-index)
MIL-DTL-2/39	V39-540-2 V39-540-3 V39-540-4 V39-540-5 V39-540-6	540	6	III	30	01-541-1 01-541-2	Oxygen	
MIL-DTL-2/40	Superseded							
MIL-DTL-2/41	V41-540-2	540	6	III IV	30	01-541-4	Oxygen	Medical
MIL-DTL-2/42	V42-870-2	870.	4	I	30	01-871-5	Oxygen	Medical (Pin-Index)
MIL-DTL-2/43	V43-660-12	660	6	I	30	11-641-1	Phosgene	
MIL-DTL-2/44	V44-510-1	510	6	II IV	05	10-511-1	Butane, Propane or Butane/Propane Mixture	
MIL-DTL-2/45	Superseded							
MIL-DTL-2/46	V46-590-2 V46-590-3 V46-590-4 V46-590-5 V46-590-6	590	6	III	30	23-591-1	Sulfur Hexafluoride	

MIL-DTL-2/47	V47-950-2	950	4	I	30		Air for Human Respiration	Medical (Pin-Index)
MIL-DTL-2/48	V48-346-2	346	6	III IV	30		Air for Human Respiration	Medical
MIL-DTL-2/49	V49-920-4	920	4	I	30		Cyclopropane	Medical (Pin-Index)
MIL-DTL-2/50	V50-330-0	330	6	IV	05		Methyl Bromide	.50" NPT Outlet
MIL-DTL-2/51	V51-677-9	677	6	III	75		Argon, Helium, Nitrogen, Neon, Xenon or Krypton	Inert-oil free
MIL-DTL-2/52	V52-660-1-240 V52-660-1-300 V52-660-1-400	660	6	I	05		Halon	
MIL-DTL-2/53	V53-660-3 V53-660-4 V53-660-5	660	6	III	30		Hexafluoroethane	
MIL-DTL-2/54	V54-660-1-225 V54-660-1-240 V54-660-1-300	660	6	I	05		Sulfur Dioxide	
MIL-DTL-2/55	V55-540-2 V55-540-3 V55-540-4 V55-540-5 V55-540-6	540	4	III	30		Oxygen	

MIL-DTL-2/56	V56-680-8 V56-680-10 V56-680-11	680	6	III	55		Argon, Helium, Neon, Nitrogen, Xenon, or Krypton	Inert-oil free
MIL-DTL-2/57	V57-621-8 V57-621-10 V57-621-11	621	6	III	55		Helium and Nitrogen	Inert-oil tolerant
MIL-DTL-2/58	V58-677-9	677	8	III	75		Argon, Helium, Neon, Nitrogen, Xenon or Krypton	Inert-oil free
MIL-DTL-2/59	V59-347-8 V59-347-10 V59-347-11	347	6	III	55		Air for Human Respiration	
MIL-DTL-2/60	V60-500-2	500	6	III IV	30		Oxygen/Helium Mixture	Medical,Helium over 80 percent
MIL-DTL-2/61	V61-930-2	930	4	I	30		Oxygen/Helium Mixture	Medical (Pin-index), Helium not over 80 percent
MIL-DTL-2/62	V62-350-2	350	6	III	30		Methane	
MIL-DTL-2/63	V63-350-2	350	6	III	30		Natural Gas	
MIL-DTL-2/64	V64-330-2	330	6	III	30		Hydrogen Chloride	
MIL-DTL-2/65	V65-330-2	330	6	III	30		Hydrogen Sulfide	
MIL-DTL-2/66	V66-590-2 V66-590-3 V66-590-4 V66-590-5 V66-590-6	590	6	III	30		Mildly oxidizing mixtures	5 to 23 percent oxygen

MIL-DTL-2/67	V67-510-1	510	6	I	05		Low Pressure Flammable	
MIL-DTL-2/68	V68-580-2 V68-580-3 V68-580-4 V68-580-5 V68-580-6	580	6	III	30		Inert-oil free mixtures	Oxygen not over 5 percent
MIL-DTL-2/69	V69-330-0	330	6	IV	30		Corrosive (acidic) mixtures	
MIL-DTL-2/70	V70-350-2	350	6	III	30		High pressure, flammable or toxic mixtures	
MIL-DTL-2/71	V71-660-3 V71-660-4	660	6	III	30		High pressure, toxic and oxydizing mixtures	
MIL-DTL-2/72	V72-670-12	670	6	III IV	30		Fluorinating compound mixtures	
MIl-DTL-2/73	V73-705-0	705	6	I	05		Corrosive (basic) mixtures	
MIL-DTL-2/74	V74-660-1	660	6	III	05		Low pressure, toxic and oxydizing mixtures	
MIL-DTL-2/75	V75-577-8 V75-577-10	577	6	III	40		Oxygen	
MIL-DTL-2/76	V76-296-2 V76-296-3 V76-296-4 V76-296-5 V76-296-6	296	6	III	30		Oxydizing mixtures	
MIL-DTL-2/77	V77-660-1-225 V77-660-1-240 V77-660-1-300	660	6	I	05		Methyl Chloride	

Notes:

1. Materials: The cap or the plug shall be of the material specified for the respective MIL-DTL- / detail specification valve composition classification. The retaining rings shall be of round copper alloy wire, conforming to QQ-W-321/10, Alloy Number C24000, half hard temper. The chain shall conform to RR-C-271, TYPE II, CLASS 5, 6 or 7 BRASS, with no fewer than 18 links per foot and a breaking load of not less than 30 pounds. Chain length shall be 3.00 inches +0.50, -0.00 inch (76.2 mm +12.7, -00.00 mm).

2. Threads: Cap and plug threads, plug nose, and other connection details as specified herein shall be in accordance with either FED-STD-H28 or CGA Standard V-1.

3. Caps: Caps shall have a hexagonal wrenching surface. The dimension across the hex flats shall not be greater than that for the respective valve outlet connection hex nut specified in the reference of Note 2 above.

4. Length and configuration: The overall length and configuration of the cap or plug shall be such that when tightened to the seal on the respective valve outlet (with any possible orientation of the cap's hexagonal across-corners dimension). The cap or plug does not project more than 1.50 inches (38.1 mm) from the center line of the valve inlet connection threads as specified in the references of Note 2 above.

5. Retaining ring: One retaining ring shall be closed around the cap or plug ring groove. The depth and the width of the ring groove and the peripheral clearance between the retaining ring and the bottom of the ring groove shall be such that the retaining ring is not able to slip out of the groove and turns freely in the groove.

6. Second retaining ring: The second retaining ring shall be sized to fit loosely around the valve body immediately above the inlet threads of the largest inlet connection specified for the group of MIL-DTL-2 valves tabulated above. When the cap or plug is supplied separately from a valve. The retaining ring for encircling the valve shall be fastened to the chain and left open with a clamp having provisions for crimping to close the ring after installation on a valve.

7. Fiber disk: The cap shall have a fiber disk insert to seal against the respective valve outlet. The disk shall be installed so as not to be able to fall out of the cap. The disk material shall be compatible with the intended compressed gas usage.

8. O-ring: The plug may be designed for an O-ring seal. The O-ring shall fit in a circumferential groove on the plug nose, and the plug nose shall otherwise be in accordance with Note 2 above.

FIGURE 2. Notes.

Custodians:
Army - ME
Navy - SH
Air Force - 68

Preparing activity:
Air Force - 68

(Project 8120-1004)

Review activities:
Army - AV
Navy - AS, MC, YD1
DLA - GS