INCH-POUND

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MILITARY SPECIFICATION

VALVE; RELIEF, HYDRAULIC PRESSURE

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

1. SCOPE

1.1 Scope. This specification establishes the requirements for hydraulic pressure relief valves.

1.2 Classification. Relief valves shall be furnished in the following types and classes as specified.

Type I Rectangular envelope, conforming to Drawings AN6200 and AN6279

Type II Cylindrical envelope, conforming to Standard MS28887

Classes:

Class YZ - Adjustable from 100 to 1,000 psi at rated relief flow
Class AB - Adjustable from 1,000 to 2,300 psi at rated relief flow
Class CD - Adjustable from 2,300 to 3,850 psi at rated relief flow
Class - Relief valves adjustable to the range of more than one class shall carry in the part number the abbreviated letter designation of the lowest and highest pressure class and shall conform to the applicable envelope, for example: A valve adjustable from 1,000 to 3,850 psi would be AN6279AD or MS28887AD.

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation (see 6.2).

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Oklahoma City Air Logistics Center/TIMLA, Tinker AFB OK 73145-5990 by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A FSC 4820

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SPECIFICATIONS

Federal

QQ-C-320	Chromium Plating (Electrodeposited)
QQ-N-290	Nickel Plating (Electrodeposited)
QQ-S-365	Silver Plating, Electrodeposited, General Requirements For
VV-P-236	Petrolatum, Technical
PPP-B-601	Boxes, Wood, Cleated Plywood
PPP-B-636	Box, Shipping Fiberboard

Military

DOD-D-1000	Drawing, Engineering And Associated List
MIL-P-116	Preservation, Methods Of
MIL-H-5440	Hydraulic Systems, Aircraft Types I And II, Design, and Installation, Requirements For
MIL-G-5514	Gland Design, Hydraulic, General Requirements For
MIL-P-5516	Packing, Preformed, Petroleum Hydraulic Fluid Resistant, 160°F.
MIL-C-5541	Chemicals, Conversion Coating on Aluminum Alloys Materials For Aluminum And Aluminum Alloys
MIL-H-5606	Hydraulic Fluid, Petroleum Base, Aircraft, Missile And Ordnance
MIL-H-6083	Hydraulic Fluid, Petroleum Base, For Preservation And Testing
MIL-S-7742	Screw Threads, Standard, Optimum Selected Series, General Specification For
MIL-A-8625	Anodic Coatings, For Aluminum And Aluminum Alloys
MIL-H-8775	Hydraulic System Components, Aircraft And Missiles, General Specification For
MIL-T-10727	Tin Plating, Electrodeposited or Hot-Dipped, For Ferrous And Nonferrous Metals
MIL-C-26074	Coating, Nickel-Phosphorous, Electroless Nickel, Requirements For
MIL-C-83488	Coating, Aluminum, Ion Vapor Deposited

STANDARDS

Military

MIL-STD-129	Marking For Shipment And Storage
MIL-STD-130	Identification Marking Of U.S. Military Property
MIL-STD-889	Dissimilar Metals
MIL-STD-970	Specification And Standard Order Of Precedence For The Selection Of
MIL-STD-1130	Minimum Guidelines For Level C Preservation, Packing and Marking
MIL-STD-1949	Inspection, Magnetic Particle

MIL-STD-2073/1A	DOD Material Procedures For Development And Application Of Packaging Requirement
MS16624	Ring, Retaining, External, Basic (Tapered Section Type)
MS16625	Ring, Retaining, Internal, Basic (Tapered Section Type)
MS20995	Wire, Lock
MS21343	Boss Spacing - Hydraulic, Design Standard For
MS21344	Fitting, Installation Of Flared Tube, Straight Threaded Connectors, Design Standard For
MS28774	Retainer, Packing Backup, Single Turn, Tetrafluorethylene
MS28775	Packing, Preformed, Hydraulic, Plus 275 Deg.F. ("O" Ring)
MS28777	Ring, Hydraulic Fitting, Gasket Back-Up
MS28778	Packing, Preformed, Straight Thread Tube Fitting Boss
MS28782	Retainer, Packing, Back-Up, Teflon
MS28783	Ring, Gasket, Back-Up, Teflon
MS28887	Valve, Relief, Cylindrical, Type II System
MS33540	Safety Wiring, General Practices For
MS33649	Bosses, Fluid Connection-Internal Straight Thread

Air Force-Navy Aeronautical Standard Drawings

AN814	Plug and Bleeder-Screw Thread
AN6200	Valve, Hydraulic Pressure Relief, Class AB
AN6230	Gasket, "O" Ring Hydraulic
AN6244	Ring-Hydraulic Gasket Back-Up
AN6248	Pump Hydraulic Hand, Type 3000
AN6279	Valve-Hydraulic Pressure Relief - Two Port

PUBLICATIONS

Air Force - Navy Aeronautical Bulletin

ANA No. 147	Specifications And Standards Of Non-Government Organizations Released For Flight Vehicle Construction

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Standardization Document Order Desk, Bldg 4D, 700 Robbins Ave, Philadelphia, PA 19111-5094.)

2.1.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issue are those cited in the solicitation.

American Standards Association

ASA B46.1 1962 Surface Texture, Waviness and Lay

(Applications for copies should be addressed to the American Standards Association, Inc., 70 East 45th Street, New York 17, N.Y.)

National Standards Association

NAS50	Rings - Internal Retainer
NAS51	Rings - External Retainer
NAS669	Ring - Internal Retainer
NAS670	Ring - External Retainer

(Applications for copies should be addressed to the National Standards Association, Inc., 1321 Fourteenth Street, N.W., Washington, D.C. 20005.)

2.2 Non-Government publications. The following document(s) form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted are those listed in the issue of the DODISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS are the issues of the documents cited in the solicitation (see 6.2).

American Society for Testing and Materials

ASTM-B633	Electrodeposited Coatings of Zinc on Iron And Steel, Specification For

(Application for copies should be address to: ASTM, Standardization Document Order Desk, Bldg 4D, 700 Robbins Ave, Philadelphia, PA 19111-5094.)

(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 Classification of requirements. The requirements for the product are classified herein as follows:

a.	Qualification	3.2
b.	Materials	3.3
c.	Design and Construction	3.4
d.	Performance	3.5
e.	Interchangeability	3.6
f.	Weight	3.7

g.	Finish	3.8
h.	Lubricants	3.9
i.	Physical Defects Inspection	3.10
j.	Identification of Product	3.11
k.	Hydraulic Pressure Setting	3.12
l.	Workmanship	3.13

3.2 Qualification. When specified (see 6.2), a sample shall be subjected to first article inspection (see 6.3) in accordance with 4.4.

3.3 Materials. Materials shall conform to applicable specifications and shall be as specified herein. Materials which are not covered by applicable specifications or which are not specifically described herein, may be used provided it can be demonstrated that their use will result in a superior product.

3.3.1 Metals. All metals shall be compatible with the fluid and intended temperature, functional, service, and storage conditions to which the components will be exposed. The metals shall possess adequate corrosion-resistant characteristics or shall be suitably protected by the use of coatings equivalent to those listed in Table I to resist corrosion which may result from such conditions as dissimilar metal combinations, moisture, salt spray, and high temperature deterioration, as applicable. Where not indicated, class or type is at the option of the manufacturer, subject to approval by the procuring activity. Dissimilar metals are defined in MIL-STD-889.

3.3.1.1 Copper or Aluminum Alloys. All copper alloys shall be suitably protected with a coating selected from Table I, except that cadmium and zinc plating shall not be used in applications subject to abrasion. Other metallic coatings, which shall have been demonstrated to be satisfactory to the Government, such as electroless nickel and electrodeposited 85 percent tin, 15 percent cadmium alloy, may be used. All aluminum alloys shall be anodized in accordance with MIL-A-8625, type II coating, except that in the absence of abrasive conditions the anodize may be type I coating, where applicable, or may be a chemical film in accordance with MIL-C-5541.

TABLE I. Metal Coatings

Coating	Specification
Zinc Plating	ASTM B633
Chromium Plating	QQ-C-320
Nickel Plating	QQ-N-290
Silver Plating	QQ-S-365
Tin Plating	MIL-T-10727, Type I
Electroless Nickel	MIL-C-26074
Aluminum Coating	MIL-C-83488, Type I or II

3.3.1.2 Type I components. Except for internal surfaces in constant contact with hydraulic fluid, ferrous alloys shall have a chromium content of not less than 12 percent, or shall be suitably protected against corrosion as specified in 3.3.1, 3.3.1.1 and Table I. O-ring grooves for external seals shall not be considered as internal surfaces in constant contact with hydraulic fluid. Use of magnesium shall be subject to the approval of the procuring activity.

3.3.1.3 Type II components. Ferrous alloys shall have a chromium content of not less than 12 percent, or shall be internally and externally protected against corrosion as specified in 3.3.1, 3.3.1.1 and Table I. In addition, cadmium and zinc plating shall not be used for internal parts or or internal surfaces in contact with hydraulic fluid or exposed to its vapors. Magnesium shall not be used for Type II components.

3.3.1.4 Residual magnetism. Parts made of material that is capable of retaining residual magnetism, but are not intended to function as magnets, shall be demagnetized sufficiently to prevent system or component malfunction, including malfunction due to accumulation of magnetic contaminants.

3.3.2 Plastic parts. The use of plastic parts shall be subject to the approval of the procuring activity for the specific application involved. Valves shall not contain plastic parts; other than AN or MS standard parts, unless otherwise authorized by the contracting activity.

3.3.3 Selection of materials. Specifications and standards for all materials, parts, and Government certification and approval of processes and equipment, which are not specifically designated herein and which are necessary for the execution of this specification, shall be selected in accordance with MIL-STD-970 and ANA Bulletin No. 147, except as provided in the following paragraph.

3.3.3.1 Standard parts. Standard parts (MS, AN, NAS, or JAN) shall be used wherever they are suitable for the purpose, and shall be identified on the drawing by their (MS, AN, NAS, or JAN) part numbers. Commercial utility parts, such as screws, bolts, nuts, and cotter pins may be used, provided they possess suitable properties and are replaceable by the standard parts (MS, AN, NAS, or JAN) without alteration, and provided the corresponding standard part numbers are referenced in the parts list and, if practicable, on the contractor's drawings. In the event there is no suitable corresponding standard part in effect on date of invitation for bids, commercial parts may be used provided they conform to all requirements of this specification.

3.4 Design and construction.

3.4.1 General. The configuration, dimensions, and other details of design of standard valves shall conform to AN6200, AN6279, or MS28887. Non-standard parts of components shall conform to the applicable manufacturer's drawing as governed by MIL-H-5440 or MIL-H-8775.

3.4.2 Temperature range. Valves shall be designed and so constructed as to insure satisfactory operation throughout the temperature range of:

(1) -65 to 160 degrees fahrenheit for Type I valves.

(2) -65 to 275 degrees fahrenheit for Type II valves.

3.4.3 Threads. Straight threads conforming to MIL-S-7742, Unified Fine Thread Series, classes UNF-3A and UNF-3B shall be used, unless it can be demonstrated that the use of other threads will result in a superior product. Pipe threads shall not be used except for permanently installed plugs.

3.4.4 Fluids. Components shall be designed to operate with MIL-H-5606 hydraulic fluid.

3.4.5 Seals.

3.4.5.1 General. Components shall be so designed that, in assembly of parts, sufficient clearance exists to permit assembly of the components without damage to O-rings or backup rings where they pass threaded parts or sharp corners. MIL-P-5514 and MS21344 shall be used for Type I system packing installation and as a guide for Type II system packing installation.

3.4.5.2 Type I valves. All packing and gaskets shall be in accordance with AN6230, MS28775, or MS28778. Backup rings shall be in accordance with AN6244, MS28774, MS28777, MS28782, or MS28783.

3.4.5.3 Type II valves. All packings shall be in accordance with MS28775. Backup rings shall be in accordance with MS28774.

3.4.6 Safetying. All threaded parts shall be securely locked or safetied by safety wiring, self-locking nuts, or other approved methods. Safety wires shall be applied in accordance with MS33540 and shall conform to MS20995. Star washers and jam nuts shall not be used as locking devices.

3.4.7 Retainer rings. Except where they are positively retained from being dislodged from their grooves, retainer or snap rings shall not be used in any location where failure of the ring will allow blow-apart of the valve caused by internal pressure. Neither shall they be used in locations where the buildup of clearances and manufacturing tolerances will allow destructive end play in the assembly contributing toward failure of packings or gaskets, brinelling, or fatigue failure of parts. For retainer ring applications other than those where retention of hydraulically pressurized parts is involved, such as locking in place nonpressurized end caps, etc., rings shall be in accordance with NAS-50 and NAS-51, NAS-669 and NAS-670, MS16625 and MS16624, or other approved designs. The rings shall be capable of being installed and removed with standard Pin-type pliers, or other standard tools developed for use with the specified rings.

3.4.8 Function-adjustment screws. Function-adjustment screws shall be so designed and constructed that they can be positively locked to prevent loosening under vibration or flow. It shall be possible to adjust and lock the adjustable screws with a standard wrench or screw driver, and in addition, lockwire may be used to insure positive lock, if required. Where practicable, the adjustment means shall be such that the adjustment can be made under full system pressure with negligible loss of fluid during the adjustment. Standard countersunk hex head (Allen type or equivalent) steel adjustment screws may be used in sizes up to 0.50 inch hex. For pressure adjustment screws, a suitable seal, permanently marked with the pressure setting, shall be attached to the lock wire.

3.4.9 Structural strength. The valves shall have sufficient strength to withstand all loads or combinations of loads resulting from hydraulic pressure, temperature variations, actuation or operations, and torques loads for connection of tube fittings. Standard type II parts or components shall be designed to withstand 275'F proof pressure and burst pressure tests, 4.4.2.3.1.2 and 4.4.2.3.2, respectively

after loss of strength of the material caused by aging at 275°F for 1,000 hours. Nonstandard type II parts or components shall be designed to withstand 275°F proof pressure and burst pressure tests as specified in 4.4.2.3.1.2 and 4.4.2.3.2.2, respectively, after loss of strength of the material caused by aging at 275°F for a time period as designated by the procuring activity.

3.4.10 Rated flow capacity. The rated flow shall be as specified herein and the applicable detail standard.

3.4.11 Pressure drop at rate flow. Pressure drop at rated flow shall not exceed the values specified herein and the applicable detail standard. Type II system valves shall be designed to permit free reverse flow when pressure is applied to the outlet port.

3.4.12 Fluid Connections.

3.4.12.1 Bosses. All internally thread bosses for connecting fittings and AN814 plugs shall conform to MS33649. Spacing of ports for connecting fittings shall conform to MS21343. Bosses shall be made sufficiently deep or shall incorporate fitting stops to prevent damage to internal mechanism or restriction of fluid flow when universal fittings are screwed into the bosses to excessive depths.

3.4.12.2 Fluid Connection marking. All ports for tube connections shall be clearly and permanently marked to indicate the connections to be made using nomenclature in accordance with MIL-STD-130. Where applicable, the directions of flow shall be indicated. The use of abbreviations should be avoided, but if used shall be the general industry accepted abbreviations as applicable for the marking. Use of a single letter for marking such as "P" for pressure and "C" for cylinder is not acceptable. Decalcomanias shall not be considered a permanent marking.

3.4.12.3 Plugs. All plugs, except permanently installed plugs that will not have to be removed during the life of the component, shall conform to AN814 for types I and II systems.

3.4.13 Alignment. All plungers, poppets, balls, pistons, etc., shall be accurately guided to prevent misalignment or chattering on their seats.

3.5 Performance. Valves shall be so designed as to be capable of performing under conditions specified herein (Section 4) and under conditions of the system in which they are installed.

3.6 Interchangeability. All parts having the same manufacturer's part number shall be directly and completely interchangeable with each other with respects to installation and performance. Changes in manufacturer's part number shall be governed by the drawing number requirements of DOD-D-1000. Subassemblies composed of selected mating components must be interchangeable as assembled units, and shall be so indicated on the manufacturer's drawings. The individual components of such assembled units need not be interchangeable.

3.6.1 Special tools. The design shall be such that special or unusual tools will not be required for normal maintenance and inspection of the valve.

3.7 Weight. Weight shall be maintained as low as possible, consistent with the requirements of this specification. The weight of the assembled valve shall be specified in the manufacturer's assembly drawings.

3.8 Finish

3.8.1 Surface Roughness. Surface roughness finish, as required, shall be established, and shall be specified on the manufacturer's drawing in accordance with American Standards Association (ASA) B46.1 1962. Determination of surface finishes shall be made with stylus type instruments as specified in ASA B46.1. If surface defects are unacceptable, it shall be specifically designated that all imperfections will be within stated limits or that prescribed special inspection procedures will be followed. At least where a surface of 16 micro-inch roughness height or finer is designated, the essential process description for its generation shall be in addition to surface measurements that constitute part of the requirement for compliance. When necessary, waviness and lay shall be specified.

3.8.2 Coating. Upon request of the procuring activity, the contractor shall provide test data or perform specific tests which are considered necessary to determine that the material and plated coatings employed in the component are suitable for the intended service.

3.9 Lubricants. It is desired that only hydraulic fluid conforming to MIL-H-5606 be used to lubricate seals during installation and assembly of hydraulic components. A light coating of petrolatum conforming to VV-P-236 or hydraulic fluid conforming to MIL-H-6083 will be permitted. If other lubrication is necessary, the means of lubrication and the lubricant used must be approved by the procuring activity. Lubrication shall be so accomplished that no disassembly for relubrication is necessary during endurance testing or normal service life. Copious use of petrolatum shall be avoided.

3.10 Physical defects inspection. All magnetizable highly stressed parts shall be subjected to magnetic inspection in accordance with MIL-STD-1949. Non-magetizable highly stressed parts shall be inspected by a suitable process for detecting physical defects. Where such inspection is necessary, it shall be specified on the manufacturer's drawings.

3.11 Identification of product.

3.11.1 Name plate. Each valve shall be identified by means of a durable identification plate clearly and permanently marked with the following information, and shall be attached in accordance with MIL-STD-130.

Valve, Relief, Hydraulic Pressure (Relief pressure range)
Type I or II (as applicable)
Specification MIL-V-5523
MS or AN Part No.

Stock No.
Manufacturer's Part No.
Manufacturer's Serial No.
Contract or Order No.
Manufacturer's Name or Trade Mark or Code

3.12 Hydraulic pressure setting. All hydraulic pressure relief valves which are furnished under contract, other than direct Government procured and indirect shipment such as spares, shall be set by means of a power-driven pump to deliver rated flow at the differential pressure required by the specific contract (+25, -0 psi for Class YZ, +50, -0 psi for Class AB, and +100, -0 psi for Class CD), with a

return port back pressure of 200±25 psi for Class AB and CD valves only. This pressure setting shall be impressed on a led seal, or equivalent, attached to the lockwire of the unit. As the pressure adjustment is altered, this seal shall be destroyed and replaced with a new seal properly stamped with the new pressure setting and attached to the lockwire. When emergency circumstances dictate, the valve may be set with a hand pump to first flow at the minimum rate of 1.5 cc (30 drops) per minute, at the pressure of 95 percent of the specified setting value. This is the emergency setting pressure.

3.12.1 Government procured and indirect shipment such as spare valves shall be tagged with a tag containing the following:

NOTICE

Valve requires pressure setting adjustment. Valve will be set by means of a power-driven pump to deliver rated flow (2.5, 7, 12, and 32 GPM minimum for dash 4, 6, 8, and 12, respectively) at the differential pressure required by the specific application (see applicable manual - [+25, -0 psi for class YZ, +50, -0 psi for class AB and +100, -0 psi for class CD]), with a return port back pressure of 200 ±25 psi for class AB and CD valves only. This pressure setting shall be impressed on a lead seal, or equivalent attached to the lockwire of the unit. As the pressure adjustment is altered, this seal will be destroyed and replaced with a new seal properly stamped with new pressure setting. When emergency circumstances dictate, the valve may be set with a hand pump to first flow at the minimum rate of 1.5 cc (30 drops) per minute, at the pressure of 95 percent of the specified setting value. Remove tag when pressure setting has been completed.

3.13 Workmanship. Workmanship shall be high grade throughout to insure proper operation and service life.

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 (examinations and tests) as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other 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 this specification where such inspections are deemed necessary to ensure supplies and services conform to prescribed requirements.

4.1.1 Responsibility for compliance. All items shall meet all requirements of sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of manufacturing operations, is an acceptable practice to ascertain conformance to requirements, however, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to accept defective material.

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

a. Qualification inspection (see 4.4)
b. Quality conformance inspection (see 4.5)

4.3 Inspection conditions. Unless otherwise specified, all inspections shall be performed in accordance with the test conditions specified in paragraph 4.3.1 in this specification.

4.3.1 Qualification inspections. Qualification inspections shall be performed with oil conforming to MIL-H-5606. Acceptance tests shall be performed with oil conforming to MIL-H-5606 or MIL-H-6083.

4.3.2 Filtration. The test fluid shall be continuously filtered in order to obtain Society of Automotive Engineers (SAE) Class 3 contamination limits (or better), in accordance with tentative SAE standard for contamination limits, specified as follows:

Size (Microns)	Particle Count Per 100 Milliliters
5-10	24000
10-25	5360
25-50	780
50-100	110
100-Up	11

4.3.3 Temperatures. Except where otherwise specified, the test of this specification shall be performed at room temperature (70 to 90 degrees fahrenheit) and an oil temperature of 70 to 100 degrees fahrenheit. The actual ambient temperatures shall be recorded.

4.4 Qualification inspection.

4.4.1 Test sample. The test sample consist of three valves fabricated in accordance with manufacturer's drawings. The valves shall be identified with the manufacturer's part number and such other information as required by the qualifying activity. The valves shall be prepared as follows:

4.4.1.1 Minimum clearance specimen. One specimen shall be assembled of parts which have been selected to provide that the clearance with regard to linear and diametrical tolerances between moving and nonmoving members, conducive to malfunctioning at extreme temperatures, will not exceed 110 percent of the minimum designed clearance permitted by the manufacturer's drawings. For cases of sliding parts where packing friction would influence the performance of the component, such as pistons operated by spring, etc., the maximum packing friction anticipated shall be induced in the test specimen. In these cases O-ring packing glands shall be fabricated to provide maximum design O-ring squeeze, including the effect of adverse O-ring cross section tolerances and high-swell fluids. This specimen shall be marked "MIN".

4.4.1.2 Maximum clearance specimen. The second specimen shall be assembled of parts which have been selected to provide that the clearance with regards to linear and diametrical tolerances between moving members, conducive to malfunctioning as a

result of wear associated with prolonged operation will be not less than 90 percent of the maximum designed clearance permitted by the manufacturer's drawings. This specimen shall be marked "MAX".

4.4.1.3 Typical specimen. A specimen assembled from parts conforming to manufacturer's drawings. This specimen shall be marked TYP.

4.4.1.4 Tolerance considerations. In machining these specimens, surface finishes shall be of no finer degree than the surface finishes as will be produced on production units. Packing glands may be fabricated to nominal dimensions. Lapped or selectively fitted parts need not be made to adverse limits. To facilitate fabrication of adverse tolerance units, it is permissible for one of the mating parts required to produce the critical clearance to be outside of drawing tolerances, provided that the clearance as established falls within the range specified. In the event that the design clearances in themselves are extremely close, the 10-percent limitations on clearance may be adjusted or waived entirely, but at the discretion of the qualifying activity. In case of waiver of adverse tolerance specimens, tests shall be conducted on two representative production samples, and the test report shall analyze the effects of adverse tolerance conditions.

4.4.2 Qualification inspections. Qualification inspections shall be performed on each valve of the test sample, except where a specific valve is identified in the test. The qualification inspection shall consist of the following tests and shall be performed in the sequence listed:

a.	Examination of Product	(4.4.2.1)
b.	Immersion	(4.4.2.2)
c.	Proof Pressure	(4.4.2.3.1)
d.	Normal Temperature Performance	(4.4.2.4)
e.	Extreme Temperature Performance	(4.4.2.5)
f.	Burst Pressure	(4.4.2.3.2)

4.4.2.1 Examination of product. Each valve shall be examined in accordance with the requirements of paragraph 4.5/5.1.

4.4.2.2 Immersion.

4.4.2.2.1 Other nonmetallic parts. Components containing nonmetallic parts other than plastic parts or MS or AN standard seals in glands conforming to MIL-P-5514 shall be immersed in hydraulic fluid for a period of 7 days at a temperature of not less than 160°F prior to conducting the qualification tests specified herein. All internal parts shall be in contact with the fluid during this period. If this test is necessary as a result of the use of nonstandard packing installations, or if the packings pass over holes, ports, step diameters, threads, etc., and if the inside diameter, outside diameter, or sides of the seal are unrestrained during any part of their normal operation, the packing used in the test samples shall be fabricated of

a compound approved by MIL-P-5516 having the highest swell, and the fluid shall be that approved by MIL-F-5606 having the highest swell characteristics. (The Government will designate the applicable high-swell packing compound and fluid upon request to the activity responsible for qualification.) After the above immersion, the equipment shall remain in the high-swell fluid at normal room temperature until ready for test. It shall not be exposed to air for any appreciable length of time during the tests.

4.4.2.3 Pressure Tests.

4.4.2.3.1 Proof Pressure.

4.4.2.3.1.1 Type I system valves. Proof pressure, as specified for its class in Table II, shall be applied simultaneously to both the pressure and return ports at a rate not exceeding 25,000 psi per minute and held for at least 2 minutes. There shall be no evidence of external leakage, permanent set, or other damage.

4.4.2.3.1.2 Type II system valves. The typical valve specimen shall be aged at 275±5 degrees fahrenheit for 1000 hours. (Seals may be installed after aging.) The temperature shall be restablilized at 275±5 degrees F. Proof pressure as specified for its class in Table II shall be applied simultaneously to both the pressure and return ports at a rate not exceeding 25,000 psi per minute and held for at least 2 minutes. There shall be no evidence of external leakage, permanent set, or other damage.

4.4.2.3.2 Burst Pressure.

4.4.2.3.2.1 Type I system valves. With all ports except the pressure port plugged, pressure shall be applied at a rate not exceeding 25,000 psi per minute, as specified for burst pressure in Table II. This pressure shall be held for at least 2 minutes. At this point rupture shall not occur. If desired, the pressure may then be increased until rupture occurs to obtain the actual burst pressure.

4.4.2.3.2.2 Type II system valves. The typical valve specimen shall be aged 275±5 degrees fahrenheit for 1000 hours. (Seals may be installed after aging.) The temperature shall be restabilized at 275±5 degrees F. With all ports except the pressure ports plugged, pressure shall be applied at the rate not exceeding 25,000 psi per minute, as specified for burst pressure in Table II. This pressure shall be held for at least 2 minutes. At this point rupture shall not occur. If desired, the pressure may be increased until rupture occurs to obtain actual burst pressure.

TABLE II

Operational Requirements at Normal and High Temperatures							
Class	Rated Flow Press. Setting (psi) (Min)	(Max)	Min Reseat Press. (Percent of Rated Flow Pressure)	Emergency Setting Press. (Percent of Rated Flow Press.) (Min)	(Max)	Proof Press (psi)	Burst Press (psi)
YZ	100	1000	82	85	100	1500	2500
AB	1000	2300	82	85	100	3000	5000
CD	2300	3850	82	85	100	4500	7500

4.4.2.4 Normal Temperature Performance.

4.4.2.4.1 Minimum setting. A typical setup for this test is illustrated by figure 2. The power-driven pump shall be used for the following tests. With a pressure at the outlet port of 200±25 psi, for class AB and CD valves only, the test valve shall be adjusted to deliver rated flow, as specified on the applicable drawing, at a differential pressure equivalent to the minimum pressure setting specified for its class in Table II. Inlet pressure shall be decreased gradually until leakage corresponding to a maximum value leakage as shown in Table III can be determined. This pressure will be considered as the reseat pressure, and its value shall meet that specified in Table II. The reduction of pressure shall be continued slowly, and leakage shall be observed at pressure values equivalent to approximately 0.75, 0.50, and 0.25 of the rated flow pressure setting of the valve. Leakage shall not exceed .5 cc (10 drops) per hours. The pressure shall then be increased gradually, and leakage shall be observed at pressure values equivalent to approximately 0.25, 0.50, and 0.75 of the rated flow pressure setting of the valve. The pressure shall then be increased slowly until a leakage equivalent to 3 times the value specified in Table III is noted. The pressure at this value shall not be less than 91 percent of the rated flow pressure. Leakage shall be equivalent to that observed during the reduction of pressure portion of this test. Rated flow shall occur at the original pressure setting. In all instances leakage shall be observed at the outlet port and it shall be taken during the third minute following a 2-minute waiting period.

TABLE III. Allowable leakage.

Tube Size	Max Leakage cc/min
-4	.5
-6	.5
-8	2
-12	3

4.4.2.4.2 Maximum setting. The tests outlined under paragraph titled "Minimum setting" shall be repeated with the valve adjusted to deliver rated flow at a differential pressure equivalent to the maximum pressure setting specified for its class in Table II.

4.4.2.4.3 Pressure drop with reverse flow. This test is applicable to type II valves only. With the pressure setting unaltered after completion of maximum setting tests, pressure shall be applied to the return port in order to produce rated flow. The differential pressure between valve ports shall not exceed 50 psi.

4.4.2.4.4 Leakage and emergency setting pressure. With the pressure setting unaltered after completion of maximum setting tests and by use of the hand pump illustrated by fig. 2, leakage readings shall be taken at pressure values equivalent to approximately 0.25, 0.50, and 0.75 of the rated flow pressure setting of the valve under conditions of increasing as well as decreasing pressure. Leakage during the third minute after a 2-minute waiting period shall not exceed 0.5 cc (approximately 10 drops) per hour. Pressure shall then be increased until leakage exceeds the value specified in Table III. This value shall be considered as the emergency setting pressure and shall be within the limits specified in Table II.

4.4.2.4.5 Endurance. A typical setup for life cycling is illustrated by figure 1. The endurance test shall be performed on the maximum clearance specimen and shall consist of adjusting the valve to the maximum pressure setting at rated flow at

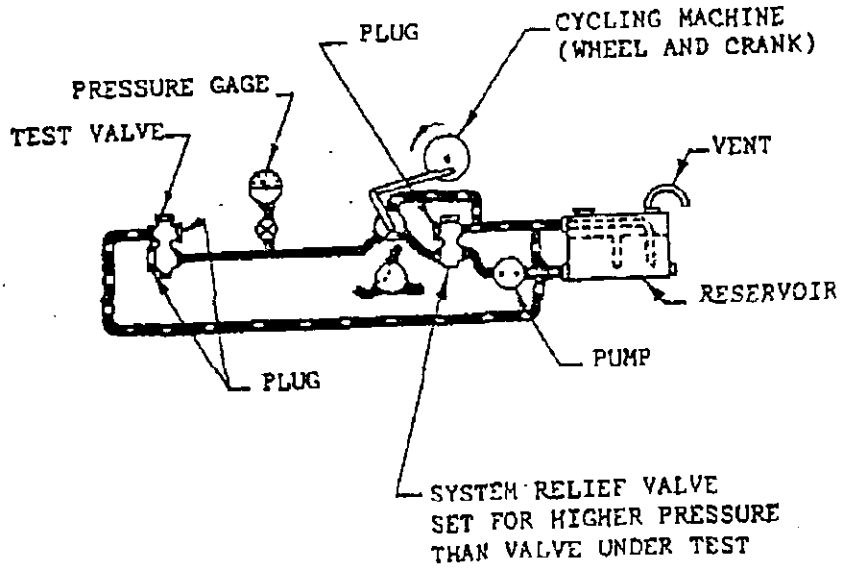


FIGURE 1. Typical relief valve endurance test installation.

normal temperature as specified in Table II, and the cycling at the rate of 5 to 35 cpm for 50,000 cycles. Each cycle shall consist of imposing rated flow through the valve, and reducing pressure to substantially zero. After completion of this test, internal leakage at the reseat pressure and 0.25, 0.50, and 0.75 of the rated flow pressure setting, shall be a maximum of two times the values permitted in 4.4.2.4.2.

4.4.2.4.6 External leakage. There shall be no evidence of external leakage during performance of the above tests.

4.4.2.5 Extreme temperature performance. Extreme temperature tests shall be conducted on a valve (or valves) assembled with parts to the most adverse tolerances conducive to binding at the temperature tested.

4.4.2.5.1 Low temperature performance. A typical setup for this test is illustrated by figure 3. On the test valve (minimum clearance specimen) apply pressure and flow to this valve with the hand pump at the rate of one full stroke per minute. Note the highest pressure which can be developed at room temperature. The temperature of the cold chamber shall be reduced to $-65^{\circ}F + 2^{\circ}F$ and held for a minimum of 3 hours with the valve unpressurized. The valve shall then be pressurized to approximately 90 percent of the minimum allowable reseat pressure specified in Table II and held for a minimum of 3 additional hours. The above hand pump test and the tests outlined under 4.4.2.4.4 shall be repeated. Leakage and pressure values obtained at $-65^{\circ}F$ shall not vary more than +10 percent or -5 percent from those obtained during room temperature tests.

4.4.2.5.2 High temperature performance. Using the test temperature setup illustrated by Figure 2, the minimum clearance valve specimen shall be adjusted to deliver rated flow at a differential pressure equivalent to the maximum pressure setting specified in Table II. The valve and hydraulic fluid of the test setup shall be stabilized at test temperature for a minimum period of 6 hours. The power driven pump tests outlined under 4.4.2.4.2 shall be repeated. Leakage and rated flow shall not be greater than those observed at room temperature, and reseat pressure shall meet the pressure value specified in Table II. Test temperature shall be:

(a) 160±5 degrees fahrenheit for Type I system valves.

(b) 275±5 degrees fahrenheit for Type II system valves.

4.5 Quality conformance tests. Quality conformance tests shall consist of individual tests and sampling tests,

4.5.1. Individual tests. Each valve is to be furnished under contract and shall be subjected to:

(a) Examination of product (4.5.5.1)

(b) Normal temperature performance (4.5.5.2)

(c) Proof pressure (4.5.5.3)

4.5.2 Sampling tests. Valves up to 2 percent of the contract may be selected for any other tests which the inspector considers necessary to determine conformance with the requirements of this specification.

4.5.3 Rejection and retest. When an item selected from a production run fails to meet the specification, no items still on hand or later produced shall be accepted until the extent and cause of failure have been determined and appropriately corrected. The contractor shall explain to the Government representative the cause of failure and the action taken to preclude recurrence. After correction, all the tests shall be repeated.

4.5.5 Test Method.

4.5.5.1 Examination of product. Each valve shall be carefully examined to determine conformance with the requirements of this specification for design, weight, workmanship, marking, conformance to applicable drawings, and for any visible defects. The manufacturer's drawings and the manufacturer's applicable specifications which were submitted when qualification approval was granted, shall be used by the inspector, as necessary, to determine that the valves submitted for acceptance under contract are identical to design when submitted for qualification.

4.5.5.2 Normal temperature performance. Unless otherwise specified, the valve shall be subjected to its rated flow by means of a power-driven pump at the maximum pressure settings specified in Table II, with a back pressure at the outlet port of 200 psi, for class AB and CD valves only, and the pressure differential between the ports observed. This is the setting pressure. The pressure shall then be reduced to the reseat pressure specified for its class in Table II, and the outlet port opened for observation of leakage. This pressure shall be maintained constant and the leakage observed during the third minute. Leakage shall not exceed that specified in Table III. The pressure shall then be increased slowly until a leakage equivalent to 3 times the value specified in Table III is noted. The pressure at this value shall be not less than 91 percent of the rated flow pressure.

4.5.5.3 Proof pressure. Proof pressure, as specified for its class in Table II, shall be applied simultaneously to both the pressure and return ports at a rate not exceeding 25,000 psi per minute and held for at least 2 minutes. There shall be no evidence of external leakage, permanent set or other damage.

4.6 Inspection of the preservation, packaging, packing and marking for shipment or storage. Sample items or packs and the inspection of the preservation, packaging, packing and markings for shipment and storage shall be in accordance with the requirements of Section 5, or the documents specified therein.

5. PACKAGING

5.1 Preservation. Preservation shall be Level A or C, as specified (see 6.2).

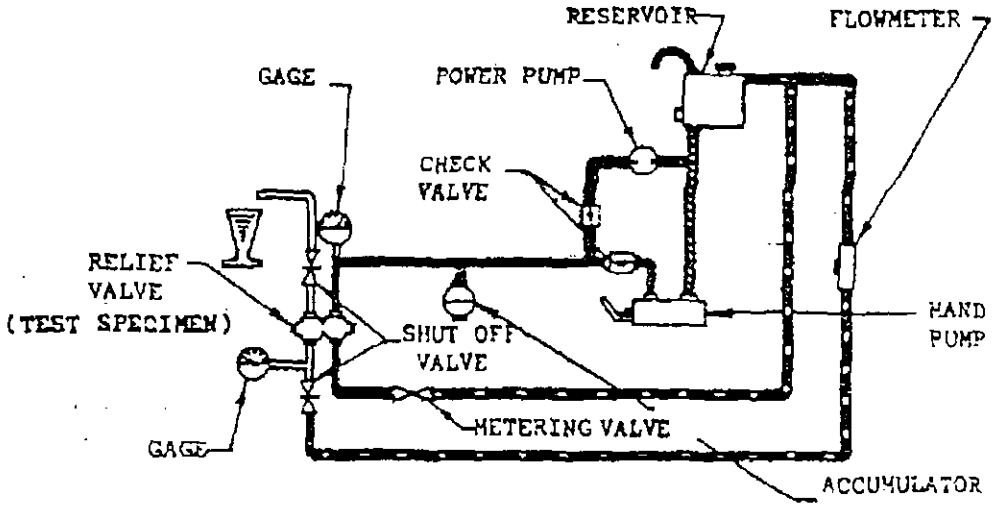
5.1.1 Level A. Preservation shall be in accordance with MIL-STD-2073/1A.

5.1.1.1 Cleaning. Valve shall be cleaned in accordance with process C-1 of MIL-P-116.

5.1.1.2 Drying. Valve shall be dried in accordance with process C-1 of MIL-P-116.

5.1.1.3 Preservative application. Preservative shall not be used.

5.1.1.4 Unit packaging. Unless otherwise specified by the contracting activity, each valve shall be packaged in quantity unit packs of one each in accordance with



GAGES SHALL BE PLACED AS CLOSE TO THE VALVE PORTS AS PRACTICABLE.

FIGURE 2. Typical schematic diagram for normal temperature performance tests.

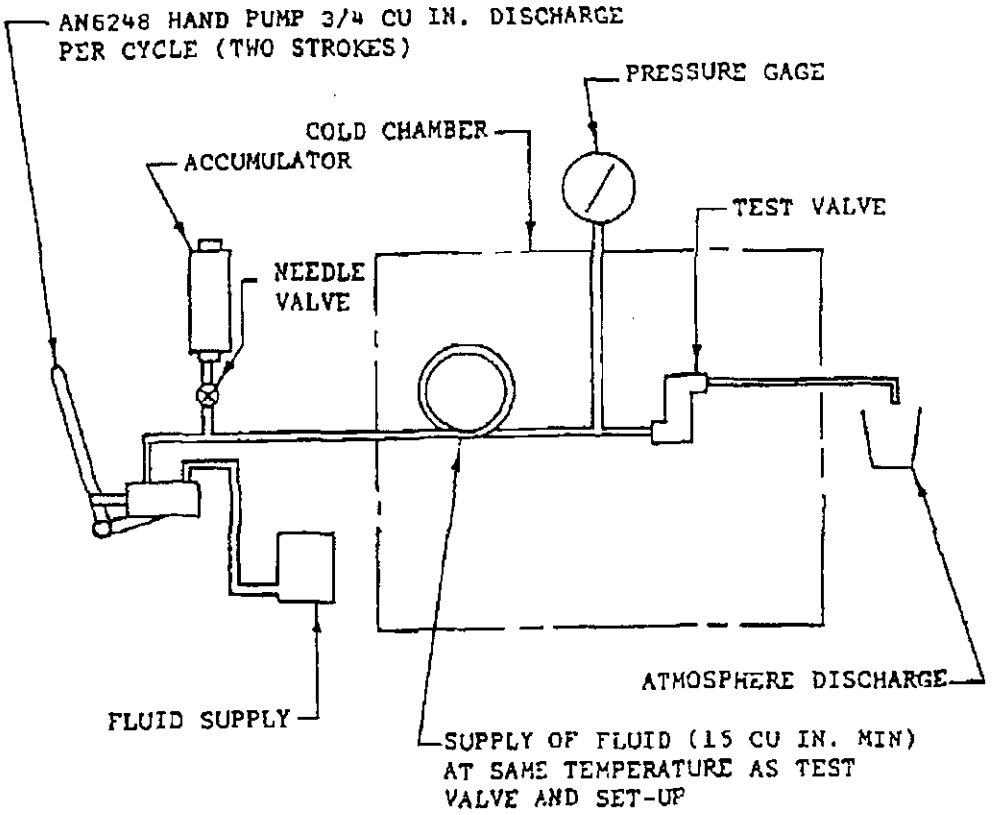


FIGURE 3. Typical schematic diagram for low temperature performance tests.

Method 1A-B of MIL-P-116. Each valve shall be placed in a PPP-B-636 fiberboard container, weather resistant, with sufficient cushioning material between bag and unit container of a type, density, and thickness to insure shock transmission does not exceed peak values in G's established for the valve when completed packs are subjected to the rough handling drop tests of MIL-P-116.

5.1.2 Level C. Each valve shall be provided preservation in accordance with MIL-STD-1190 to afford adequate protection against corrosion, deterioration, and physical damage during shipment from supply source to the first receiving activity.

5.1.3 Industrial. The industrial preservation of the valve shall be in accordance with ASTM D3951.

5.2 Packing. Packing shall be Level A, B, or C, as specified (see 6.2).

5.2.1 Level A. Valve packaged as specified in 5.1.1 shall be packed in shipping containers conforming to PPP-B-601, Styles A or B, Class overseas, unless otherwise specified by the contracting activity. Insofar as practical, exterior shipping container shall be of uniform shape, size, minimum tare, and cube consistent with the protection required.

5.2.2 Level B. Valve packaged as specified in 5.1.1 shall be packed in shipping containers conforming to PPP-B-636, Class weather-resistant, unless otherwise specified by the contracting activity. Other requirements as specified in 5.2.1 apply.

5.2.3 Level C. Packing shall be applied in accordance with MIL-STD-1190 to afford adequate protection during domestic shipment from the supply source to the first receiving activity for immediate use.

5.2.4 Industrial. The packaged valve shall be packed in accordance with ASTM D3951.

5.3 Marking. In addition to any other markings required by the contract or order (see 6.2), interior and exterior containers shall be marked in accordance with MIL-STD-129.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not manadatory.)

6.1 Intended use. The relief valves covered by this specification are intended for use in aircraft hydraulic systems, whose normal operations are covered by MIL-H-5440, to provide for relief of excessive pressures and should not be used with any hydraulic fluid other than that conforming to MIL-H-5606, unless otherwise specified by the procuring activity.

6.2 Acquisition requirements. Acquisition documents must specify the following:

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

b. Applicable government and manufacturer's part numbers.

c. Level of packaging and packing required (see Section 5).

d. Issue of DODISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.1).

6.3 First article. When a first article is required, the item will be tested and inspected in accordance with section 4 of this document. The contracting officer should include specific instructions in acquisition documents regarding arrangements for examinations, tests and approval of the first article.

6.4 Identification of changes. The margins of this specification are marked with an asterisk to indicate where changes (additions, modifications, correction, deletions) from the previous issue were made. This was done as a convenience only and the government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the last previous issue.

6.5 Detail and assembly drawings. Detail and assembly drawings should be furnished with each new model valve submitted for qualification tests. Assembly drawings should show a cutaway section of all details in their normal assembled position and should carry material, finish, plating, and part numbers of all details and subassemblies. The following data should be furnished on or together with all assembly drawings:

a. Mounting position and dimensions

b. Port dimensions

c. Over-all dimensions

d. Flow capacity

e. Pressure range

f. Dry weight

g. Method of adjusting pressure rating

h. Dismantling procedure and procedure for replacing synthetic packings, if needed.

i. Maximum calculated stress of springs and design calculations illustrating the springs endurance limits under adverse tolerances.

6.6 Subject term (key word) listing.

Aircraft
Hydraulic Fluid
Hydraulic Pressure
Hydraulic System
Rated Flow
Relief Valve

6.7 Changes from previous issue. Marginal notations are not used in the revisior to identify changes with respect to the previous issue due to the extensiveness of the changes.

Custodian:
AIR FORCE -99
Army -AV

Preparing Activity:
AIR FORCE -71

Project No:
4820-0600