

**Hydraulic System Components, Aircraft and
Missiles, General Specification For**

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1. SCOPE:

1.1 Scope:

This specification covers the general requirements that are common to most hydraulic components (see 6.2), used in aeronautical hydraulic systems (see 6.1).

1.2 Classification:

Aircraft hydraulic systems in which components covered by this specification are to be used shall be of the following types, as specified:

Type I -65° to +160°F fluid temperature range

Type II -65° to +275°F fluid temperature range

2. APPLICABLE DOCUMENTS:

- 2.1 The following documents of the issue in effect on date of invitation for bids or request for proposal, form a part of the specification to the extent specified herein.

SPECIFICATIONS

Federal

QQ-C-320	Chromium Plating (Electrodeposited)
QQ-N-290	Nickel Plating (Electrodeposited)
QQ-P-416	Plating, Cadmium (Electrodeposited)
QQ-S-365	Silver Plating, Electrodeposited, General Requirements for
QQ-Z-325	Zinc Coating, Electrodeposited, Requirements for

Military

MIL-C-5015	Connectors, Electric "AN" Type
MIL-H-5440	Hydraulic Systems, Aircraft Types I and II, Design, Installation, and Data, Requirements for
MIL-C-5501	Cap and Plug, Protective, Dust and Moisture Seal
MIL-P-5510	Packing, Preformed, Straight Thread Tube Fitting Boss
MIL-G-5514	Gland Design, Packings, Hydraulic, General Requirements for
MIL-C-5541	Chemical Conversion Coatings on 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 Operation
MIL-I-6866	Inspection, Penetrant Method of
MIL-I-6868	Inspection Process, Magnetic Particle
MIL-M-7969	Motor, Alternating Current, 400-Cycle, 115/200-Volt System, Aircraft, General Specification for

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2.1 (Continued):

Military (Continued)

MIL-M-8609	Motors, Direct Current, 28-Volt System, Aircraft, General Specification for
MIL-A-8625	Anodic Coatings, for Aluminum and Aluminum Alloys
MIL-R-8791	Retainer, Packing, Hydraulic, and Pneumatic, Tetrafluoroethylene Resin
MIL-S-8879	Screw Threads, Controlled Radius Root with Increased Minor Diameter, General Specification for
MIL-T-10727	Tin Plating, Electrodeposited or Hot-Dipped, for Ferrous and Nonferrous Metals
MIL-H-25475	Hydraulic Systems, Missile, Design, Installation Tests, and Data Requirements, General Requirements for
MIL-P-25732	Packing, Preformed, Petroleum Hydraulic Fluid Resistant, 275 Deg. F.
MIL-C-26074	Coating, Electroless Nickel, Requirements for
MIL-F-27656	Filter Unit, Fluid, Pressure MXU-408/M, Absolute 5 Micron, Hydraulic
MIL-C-38999	Connector, Electrical, Circular, Miniature, High Density Quick Disconnect
MIL-G-81322	Grease, Aircraft, General Purpose Wide Temperature Range
MIL-S-81733	Sealing and Coating Compound, Corrosion Inhibitive
MIL-F-81836	Filter and Disposable Element, Fluid Pressure, Hydraulic, 3 Micron Absolute
MIL-H-83282	Hydraulic Fluid, Fire Resistant Synthetic Hydrocarbon Base, Aircraft
MIL-P-83461	Packings, Preformed, Petroleum Hydraulic Fluid Resistant, Improved Performance of 275 Degrees F., Sizes and Tolerances
MIL-C-83982	Compound, Sealing, Fluid Resistant

STANDARDS

Federal

FED-STD-791	Lubricant, Liquid Fuel and Related Products, Methods of Testing
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Military

MIL-STD-100	Engineering Drawing Practices
MIL-STD-129	Marking for Shipment and Storage
MIL-STD-130	Identification Marking of U.S. Military Property
MIL-STD-143	Standards and Specifications, Order of Precedence for the Selection of
MIL-STD-454	Standard General Requirements for Electronic Equipment
MIL-STD-461	Electromagnetic Interference Characteristics, Requirements for Equipment
MIL-STD-462	Electromagnetic Interference Characteristics, Measurement of
MIL-STD-463	Definition and System of Units, Electromagnetic Interference Technology
MIL-STD-490	Specification Practices
MIL-STD-704	Electric Power, Aircraft, Characteristics and Utilization of
MIL-STD-785	Reliability Program for Systems and Equipment Development and Production
MIL-STD-810	Environmental Test Methods
MIL-STD-889	Dissimilar Metals

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2.1 (Continued):

Military (Continued)

MIL-STD-961	Outline of Forms and Instructions for the Preparation of Military Standards and Association Documents
MS20659	Terminal, Lug, Crimp Style, Copper, Uninsulated, Ring Tongue, Type I, Class I
MS20995	Wire, Safety or Lock
MS21209	Insert, Screw Thread, Coarse and Fine, Screw Locking, Helical Coil, Cres
MS21343	Boss Spacing-Hydraulic Design, Standard for
MS21344	Fitting-Installation of Flared Tube, Straight Threaded Connectors, Design Standard for
MS27595	Retainer, Packing Backup, Continuous Ring, Tetrafluoroethylene
MS28772	Packing, "D" Ring, Shock Strut
MS28774	Retainer, Packing Backup, Single Turn Tetrafluoroethylene
MS28775	Packing, Preformed, Hydraulic, Plus 275 Deg. F. ("O" Ring)
MS28778	Packing, Preformed, Straight Thread Tube Fitting Boss
MS28782	Retainer, Packing, Back-Up, Teflon
MS28783	Ring, Gasket, Back-Up, Teflon
MS33514	Fitting End, Standard Dimensions for Flareless Tube Connection and Gasket Seal
MS33515	Fitting End, Standard Dimensions for Bulkhead Flareless Tube Connections
MS33540	Safety Wiring and Cotter Pinning, General Practices for
MS33547	Pin, Spring, Functional Limitations of
MS33649	Boss, Fluid Connection - Internal Straight Thread
MS33656	Fitting End, Standard Dimensions for Flared Tube Connection and Gasket Seal
MS33657	Fitting End, Standard Dimensions for Bulkhead Flared Tube Connections

Air Force-Navy Aeronautical

AN814	Plug and Bleeder - Screw Thread
AN6227	Packing, "O" Ring Hydraulic
AN6230	Gasket, "O" Ring Hydraulic
AND10476	Washer - Limitations on Usage of Lock

PUBLICATIONS

Air Force - Navy Aeronautical Bulletin

MIL-147	Specifications and Standards of Non-Government Organizations Released for Flight Vehicle Construction
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2.1 (Continued):

Military Bulletin

MIL-HDBK-5	Metallic Materials and Elements for Aerospace Vehicle Structures
MIL-HDBK-221	Fire Protection Design Handbook for U.S. Navy Aircraft Powered by Turbine Engines

(When requesting applicable documents, refer to both title and number. Copies of unclassified documents may be obtained from the Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, Pennsylvania 19120. Requests for copies of classified documents should be addressed to the Naval Publications and Forms Center, via the cognizant Government representative.)

2.2 Other publications:

The following document forms a part of this specification to the extent specified herein, unless otherwise indicated, the issue in effect on the date for bids or request for proposal shall apply.

American National Standards Institute

ANSI B46.1 1962 Surface Texture (Surface Roughness, Waviness and Lay)

(Copies of the above publication may be obtained from the American National Standards Institute, 10 East 46th Street, New York, New York 10017.)

Society of Automotive Engineers

ARP 603	Impulse Testing of Hydraulic Hose Assemblies, Tubing and Fittings
ARP 1383	Impulse Testing of Hydraulic Actuators, Valves, Pressure Containers and Similar Fluid System Components

(Copies of the above publication may be obtained from the Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, Pennsylvania 15096.)

National Aerospace Standards Association, Inc.

NAS 1638 Cleanliness Requirements for Parts Used in Hydraulic Systems

(Application for copies should be addressed to the National Aerospace Standards Association, Inc., 1321 Fourteenth St., N.W., Washington, DC 20005.)

3. REQUIREMENTS:

3.1 Contractor's general component specification:

In those cases where, by mutual agreement between the contractor and the procuring activity, it is determined that this specification cannot be readily applied to a particular hydraulic system, or the number of deviations necessary would make this specification impracticable, the contractor shall prepare a general component specification similar to this specification, in conformance to MIL-STD-490 and MIL-STD-961 and submit it to the procuring activity for approval. This document shall specify the performance, design, and testing requirements for all the components in the hydraulic system and also shall be the controlling document for components not otherwise covered by an applicable detail component specification.

3.2 Materials:

Materials used in the manufacture of hydraulic components shall be of high quality, suitable for the purpose, and shall conform to applicable Government specifications. Materials conforming to contractor's specifications may be used, provided it can be clearly demonstrated that they are at least equivalent to Government specifications with respect to operating characteristics and that a savings in weight or cost can be accomplished. Contractor's specifications must be satisfactory to the Government and contain provisions for adequate tests. The use of contractor's specifications will not constitute waiver of Government inspection.

3.2.1 Metals: All metals shall be compatible with the fluid and intended temperature, functional, service, and storage conditions to which the components will be exposed. Metals shall be limited to those specified by the detail specification. 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. Unless otherwise specified herein, physical properties of all metals shall meet the minimum requirements of MIL-HDBK-5.

3.2.1.1 Copper and Aluminum alloys: All copper alloys except for bearing surfaces 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 electrodeposited 85 percent tin and 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
Cadmium plating	QQ-P-416, type II, class 2
Zinc plating	QQ-Z-325, type II, class 2
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

- 3.2.1.2 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 3.2.1, 3.2.1.1, and Table I. In addition, cadmium and zinc plating shall not be used for internal parts or on internal surfaces in contact with hydraulic fluid or exposed to its vapors. 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.
- 3.2.1.3 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 3.2.1, 3.2.1.1, and Table I. In addition, cadmium and zinc plating shall not be used for internal parts or on internal surfaces in contact with hydraulic fluid or exposed to its vapors. Magnesium shall not be used for type II components.
- 3.2.1.4 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. Where a component or system is vulnerable to malfunction due to residual magnetism, the component detail specification shall specify the maximum allowable flux density.
- 3.2.1.5 Magnets: Permanent magnets and electromagnets shall be shielded where required to prevent system or component malfunction. The detail specification shall specify the maximum allowable flux density outside the shield.
- 3.2.2 Plastic parts: The use of plastic parts shall be subject to the approval of the procuring activity for the specific application involved.

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3.2.3 Selection of materials, parts and processes: 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-143 and MIL 147, except as provided in the following paragraph.

3.2.3.1 Standard parts: Standard parts (MS, AN or Specification sheet) shall be used wherever they are suitable for the purpose, and shall be identified on the drawing by their (MS, AN or Specification sheet) 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 or Specification sheet) 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 and the detail specification.

3.3 Design and construction:

3.3.1 General: The configuration, dimensions, and other details of design of standard components shall conform to the applicable MS, AN or Specification sheet standards. Non-standard components shall conform to the applicable manufacturer's or procuring activity drawing as governed by MIL-H-5440 or MIL-H-25475.

3.3.2 Temperature range: Components shall be designed and so constructed as to insure satisfactory operation throughout the temperature range specified in the detail specification.

3.3.3 Threads: Straight threads shall conform to MIL-S-8879, Unified Fine Thread Series, classes UNJF-3A and UNJF-3B. Other type threads shall be subject to approval of the procuring activity. Pipe threads shall not be used except for permanently installed plugs.

3.3.4 Fluids: Components shall be designed to operate with MIL-H-5606 hydraulic fluid. When specified by the detail specification or approved by the procuring activity a fire resistant fluid such as MIL-H-83282 hydraulic fluid shall be used.

3.3.5 Orifices: Orifices larger than 0.012 inch but smaller than 0.070 inch in diameter shall be protected by adjacent strainer elements having screen openings 0.008 to 0.012 inch in diameter. Orifices smaller than the above range may be protected by adjacent elements having openings smaller than the orifices with the approval of the procuring activity. Orifices and strainer elements shall be strong enough to absorb system design flow and pressure up to and including blocked flow without rupture.

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3.3.6 Packing:

- 3.3.6.1 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-G-5514 and MS21344 shall be used for type I system packing installation and as a guide for type II system packing installation.
- 3.3.6.2 Type I system components: All packings and gaskets shall be in accordance with MS28778, AN6227, AN6230, MS28772, or MS28775. Backup rings shall be in accordance with MS28774, MS28782, MS28783, or MS27595. Packing shall conform to MIL-P-25732 (excluding boss applications). Packings used in bosses shall conform to MIL-P-5510.
- 3.3.6.3 Type II system components: Packings conforming to MIL-P-25732 shall be used within the performance constraints reflected by qualification requirements and tests of MIL-P-25732. Non-Standard packing or MIL-P-83461 packing may be used subject to approval of procuring activity. The major performance constraints of MIL-P-25732 are summarized below.
- 3.3.6.3.1 Maximum fluid temperature of 225°F: If the maximum fluid temperature does not exceed 225°F, the standard seal is suitable for the normal life reflected by Endurance Test "B" of MIL-P-25732.
- 3.3.6.3.2 Maximum fluid temperature between 225°F and 275°F: If maximum fluid temperature is between 225°F and 275°F, the life expectancy of the standard seal shall be reduced proportionally from the normal life reflected by Endurance Test "B" of MIL-P-25732 to the reduced life reflected by Endurance Test "A" of MIL-P-25732. (The total accumulated time of exposure to 275°F during qualification tests is approximately 80 hours.) The reduced life expectancy shall be clearly defined in all appropriate publications. Packings used in bosses shall be subject to the approval of the procuring activity.
- 3.3.6.4 Back-up rings: Back-up rings shall conform to MIL-R-8791.
- 3.3.7 Safetying: All threaded parts shall be securely locked or safetied by safety wiring, self-locking nuts, or other approved methods. Safety wire shall be applied in accordance with MS33540 and shall conform to MS20995. Star washers and jam nuts shall not be used as locking devices. Use of lock washers shall be governed by limitations set for in AND10476.
- 3.3.7.1 Safetying internal parts of fluid chambers: Permanently deformed safetying devices, such as safety wire or cotter pins, that are subject to breaking off shall not be used internally in fluid chambers.
- 3.3.7.2 Threaded Inserts: All threaded holes in non ferrous parts to be used for mounting screws or bolts shall incorporate self-locking inserts conforming to MS21209.