

MIL-H-8775(ASG)
2 AUGUST 1954

MILITARY SPECIFICATION

HYDRAULIC SYSTEM COMPONENTS, AIRCRAFT, GENERAL SPECIFICATION FOR

This specification has been approved by the Department of the Air Force and by the Navy Bureau of Aeronautics.

1. SCOPE

1.1 This specification establishes the general requirements that are common to hydraulic components used in aircraft hydraulic systems conforming to Specification MIL-H-5440.

2. APPLICABLE DOCUMENTS

2.1 The following specifications, standards, drawings, and publications, of the issue in effect on date of invitation for bids, form a part of this specification to the extent specified herein:

SPECIFICATIONS

Federal

NN-B-591	Boxes, Fiberboard, Wood-Gleated (For Domestic Shipment)
NN-B-621	Boxes; Wood, Nailed and Lock-Corner
NN-B-631	Boxes; Wood, Wirebound (For Domestic Shipment)
LLL-B-631	Boxes; Fiber, Corrugated (For Domestic Shipment)
LLL-B-636	Boxes; Fiber, Solid, (For Domestic Shipment)
PPP-B-601	Boxes, Wood, Gleated-Plywood
PPP-B-676	Boxes, Set-Up, Paperboard

Military

MIL-A-1140	Adhesive, Water-Resistant, Waterproof Barrier-Material
MIL-A-8625	Anodic-Coatings, for Aluminum and Aluminum Alloys
MIL-C-5501	Closure; Aircraft, Tubing Protective
MIL-C-5541	Chemical Films for Aluminum and Aluminum Alloys
MIL-D-5028	Drawings and Data Lists: Preparation of Manufacturers' (For Production Aircraft, Guided Missiles, Engines, Accessories, and Other Auxiliary Equipment)
MIL-D-8512	Design; Special Support Equipment, (For Aeronautical and Associated Equipment)

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MIL-D-8513	Drawings and Data Lists: Preparation of, for Special Support Equipment (For Aeronautical and Associated Equipment)
MIL-E-7894	Electric Power, Aircraft Characteristics of
MIL-G-5510	Gasket; Straight Thread Tube Fitting, Boss
MIL-H-5440	Hydraulic Systems; Design, Installation and Tests of Aircraft (General Specification for)
MIL-I-6866	Inspection, Penetrant Method of
MIL-I-6868	Inspection Process, Magnetical Particle
MIL-M-8609	Motors, Direct-Current, 28-Volt System, Aircraft, General Specification for
MIL-O-5606	Oil; Hydraulic, Aircraft, Petroleum Base
MIL-O-6083	Oil; Preservative, Hydraulic Equipment
MIL-P-116	Preservation, Methods of
MIL-P-5514	Packings; Installation and Gland Design of Aircraft Hydraulic and Pneumatic (General Specification for)
MIL-P-5516	Packings and Gaskets; Hydraulic, Aircraft
MIL-P-5517	Plastic Parts in Aircraft Hydraulic Equipment; General Tests for
MIL-P-6906	Plates, Information and Identification
MIL-R-5521	Rings; Aircraft Hydraulic Packing Back-Up
MIL-S-4040	Solenoid, Electrical, General Specification for
MIL-S-6743	Switches; Push Button and Limit
MIL-S-7742	Screw Threads, Standard, Aeronautical
JAN-P-106	Packaging and Packing for Overseas Shipment - Boxes; Wood, Nailed
JAN-P-108	Packaging and Packing for Overseas Shipment - Boxes, Fiberboard (V-Board and W-Board), Exterior and Interior
JAN-P-120	Packaging and Packing for Overseas Shipment - Cartons, Folding, Paperboard
JAN-P-125	Packaging and Packing for Overseas Shipment - Barrier-Materials, Waterproof, Flexible

Air Force-Navy Aeronautical

AN-P-51 Petrolatum

STANDARDSMilitary

MIL-STD-10	Surface Roughness, Waviness, and Lay
MIL-STD-129	Marking for Shipment and Storage
MIL-STD-130	Identification Marking of U. S. Military Property
MS28782	Ring - Packing, Back-Up, Teflon
MS28783	Ring - Gasket, Back-Up, Teflon
MS33540	Safety Wiring, General Practices for

National Aircraft Standards Committee

NAS50	Rings - Internal Retainer
NAS51	Rings - External Retainer

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DRAWINGSAir Force-Navy Aeronautical Standard Drawings

AN814	Plug and Bleeder - Screw Thread
AN995	Wire - Lock
AN6227	Packing - "O" Ring Hydraulic
AN6230	Gasket - "O" Ring Hydraulic
AN6244	Ring - Hydraulic Gasket Back-Up
AN6246	Ring - Hydraulic Packing Back-Up
AN6290	Gasket - Straight Thread Tube Fitting, Boss
AN6291	Ring - Hydraulic Fitting, Gasket Back-Up
AND10050	Bosses - Standard Dimensions for Gasket Seal Straight Thread
AND10056	Fitting End - Standard Dimensions for Flared Tube Connection and Gasket Seal
AND10057	Fitting End - Standard Dimensions for Bulkhead Flared Tube Connections
AND10064	Fittings - Installation of Flared Tube, Straight Threaded Connectors
AND10074	Boss Spacing - Hydraulic

PUBLICATIONSAir Force-Navy Aeronautical Bulletins

No. 143	Specifications and Standards; Use of
No. 391	Changes; Engineering, to Aircraft Engines, Propellers, and Aeronautical Equipment in Production and Service

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

3. REQUIREMENTS

3.1 General.- In case of conflict between the requirements of this specification and a detail specification covering the requirements for a specific item of hydraulic equipment, the requirements of the detail specification shall take precedence over those of this specification.

3.2 Qualification.- The hydraulic system components furnished under this specification shall be a product which has been tested and has passed the Qualification tests specified herein.

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. Acceptance or approval of materials for design or during the course of manufacture shall in no case be construed as guaranty of acceptance of the finished component.

3.3.1 Metals.- Metals shall be so selected as to be compatible with the fluid and intended temperature, functional, service, and storage conditions, to which the component will be exposed. The metals shall possess adequate corrosion-resisting characteristics or shall be suitably protected by the use of plated coatings in order to resist corrosion which may result from the existence of dissimilar metal combinations, thin film conditions, moisture, high-temperature deterioration, etc. Internal surfaces which are in constant contact with hydraulic fluid may be considered adequately protected against corrosion. The use of magnesium shall be subject to the approval of the procuring activity for the specific application involved.

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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.

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 ANA Bulletin No. 143, except as provided in the following paragraph.

3.3.3.1 Standard parts.-- Standard parts (MS, AN, or JAN) shall be used wherever they are suitable for the purpose, and shall be identified on the drawing by their part numbers. Commercial utility parts such as screws, bolts, nuts, cotter pins, etc, may be used, provided they possess suitable properties and are replaceable by the standard parts (MS, AN, 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 components shall conform to the requirements of the applicable AN or MS Standard drawings. Nonstandard components shall conform to the applicable manufacturer's drawing.

3.4.2 Temperature range.-- Except where otherwise specified, the tests of the detail specifications shall be conducted at room temperature between 70° and 90°F, and an oil temperature between 70° and 110°F. The component shall be designed to operate satisfactorily throughout a temperature range from -65° to +160°F, unless the component will be subjected to operating temperatures exceeding 160°F, in which case the higher temperature shall govern the design. The actual temperatures shall be recorded.

3.4.3 Plugs.-- All plugs, except permanently installed plugs that will not have to be removed during the life of the component, shall conform to Drawing AN814 and shall be sealed with gaskets conforming to Drawing AN6290. Permanently installed plugs may be pipe-threaded or of any form suitable for the purpose.

3.4.4 Bosses.-- All internally threaded bosses for connecting fittings and AN814 plugs shall conform to Drawing AND10050. External threaded tube connections shall conform to Drawing AND10056 or AND10057. Spacing of ports for connecting fittings shall conform to Drawing AND10074.

3.4.4.1 Boss marking.-- All ports for tube connections shall be clearly and permanently marked to indicate the connections to be made. 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.

3.4.4.2 Boss clearance.-- Care must be taken by providing either sufficient depth to bosses or fitting stops to prevent damage to internal mechanism or blocking of ports when universal fittings are screwed into the bosses to excessive depths.

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3.4.5 Seals.- All packings and gaskets shall be in accordance with Drawing AN6227, AN6230 or AN6290 in order to conform to the requirements of Specification MIL-P-5516 or MIL-G-5510. Back-up rings shall be in accordance with Drawing AN6244, AN6246, or AN6291 in order to conform to Specification MIL-R-5521. Teflon back-up rings in accordance with Standard MS28782 or MS28783 may be used in lieu of leather back-up rings. Installations of packings shall conform to Specification MIL-P-5514 and Drawing AND10064. Components shall be so designed that in the assembly of parts sufficient clearance exists to permit assembly of the component without damage to "O" rings, where they pass threaded parts or sharp corners.

3.4.6 Safetying.- All threaded parts shall be positively locked or safetyed by safety-wiring, self-locking nuts, or other approved methods. Safety wire shall be applied in accordance with the practice outlined in Standard MS33540, and shall conform to Drawing AN995.

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 hydraulic system components in any location where failure of the ring will allow blow-apart of the unit due to internal hydraulic 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 or snap ring applications other than those where retention of hydraulically pressurized components is involved, such as locking in place nonpressurized end caps, etc, the rings shall be in accordance with Standard NAS50 and NAS51 or other approved designs, and capable of being installed and removed with standard pin-type pliers or other standard tools developed for use with the specified retainer rings.

3.4.8 Structural strength.- The components shall have sufficient strength to withstand all loads or combination of loads resulting from hydraulic pressure, temperature variations, actuation or operation and torque loads for connection of tube fittings.

3.4.9 Ruggedness.- Where a control lever, etc, is integral in a component, the lever, mechanism, and stops shall be capable of withstanding a limit torque of 50R pound-inches if the control radius is less than 3 inches, 75R pound-inches for radii 3 to 6 inches, and 150R pound-inches for radii greater than 6 inches. In the case of components which incorporate stops but do not have an integral control means, the stops shall be capable of withstanding a limit torque of 1,800 pound-inches.

3.4.10 Rated flow capacity.- The rated flow capacity and capacity to withstand pressure differential with flow shall be as specified on applicable drawings and specifications.

3.4.11 Pressure drop at rated flow.- The component shall be so designed as to offer the minimum restriction to flow consistent with the other requirements of this specification. Pressure drop at rated flow shall not exceed the values specified on the applicable drawing or specifications.

3.4.12 Bleeding.- The configuration of components shall favor scavenging of entrapped air when installed for normal use. Auxiliary bleed ports shall be provided when necessary.

3.4.13 Function-adjustment screws.- Function-adjustment screws, if used, 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 1/2 inch hex. For pressure adjustment screws, a suitable seal, permanently marked with the pressure setting, shall be attached to the lock wire.

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

3.4.15 Electrically controlled components.-

3.4.15.1 Electro-hydraulic components.- Hydraulic components which have electric motors, solenoids, switches, or other electrical units as an integral part of the component, shall not have the hydraulic fluid in contact with any current-carrying electrical parts.

3.4.15.2 Electrically actuated valves shall be designed to operate on 28-volt d-c or 115-volt a-c, 250- to 420-cps electrical systems having characteristics as specified in Specification MIL-E-7894, and as covered in the detail specifications. Electrical failure shall not affect manual override when such is provided.

3.4.15.3 Voltage.- Electrically actuated valves, designed for 28-volt d-c systems, shall operate at a minimum of 18 volts with operating pressure applied to the valve, and shall operate at 1-1/2 times operating pressure at 28 volts. Electrically actuated valves designed for 115-volt a-c systems shall operate at a minimum of 85 volts with operating pressure applied to the valve, and shall operate at 1-1/2 times operating pressure at 115 volt ac.

3.4.15.4 Limit switches.- When limit switches are used, they shall conform to Specification MIL-S-6743 and be driven by positively secured means.

3.4.15.5 Electric motor-operated components.- The characteristics of electric motors for operating components shall conform generally to Specification MIL-M-8609, including the oil-proof and explosive-proof requirements.

3.4.15.6 Solenoid-operated valves.- Solenoids for operating valves shall be in accordance with Specification MIL-S-4040, and the following requirements.

3.4.15.6.1 Solenoids shall be provided with single-coil windings.

3.4.15.6.2 External ground connections only shall be used.

3.4.15.6.3 Clutches or brakes.- On assemblies using clutches or brakes to limit over-travel, the design shall be such as to prevent overtravel sufficient to cause malfunctioning of the component, even with oil on the clutch or brake surfaces. Positive mechanical stops shall be incorporated to assure accurate positioning.

3.5 Interchangeability.- All parts having the same manufacturer's part number shall be directly and completely interchangeable with each other with respect to installation and performance. Changes in manufacturer's part numbers shall be governed by the drawing number requirements of Specification MIL-D-5028. 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 Threads.- Except for permanently installed pipe-threaded plugs, or as necessitated by functional purposes, and unless otherwise specified on the applicable drawing, only straight threads conforming to Specification MIL-S-7742, National Fine Thread Series, class 3 (NF3), or Unified Thread Series, classes 3A or 3B shall be used. Male threaded fitting ends in accordance with Drawing AND10056 or AND10057 shall be made from steel in sizes below 1/2 inch tube size. For tube sizes 1/2 inch and above, these ends may be of aluminum alloy or steel.

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3.7 Lubricants.- It is desired that only hydraulic fluid conforming to Specification MIL-O-5606 be used to lubricate seals during installation and assembly of hydraulic components. A light coating of petrolatum, conforming to Specification AN-P-51, shall 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.

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

3.9 Finish.-

3.9.1 Surface roughness.- Surface roughness finishes where required shall be established and shall be specified in the manufacturer's drawings as outlined in Standard MIL-STD-10. The determination of surface finish shall be made by profilometer, comparator brush analyzer, or other suitable comparison equipment with an accuracy of ± 5 microinches at the level being measured.

3.9.2 Aluminum-alloy parts.- Unless otherwise authorized, all aluminum-alloy parts shall be covered with an anodic film conforming to the requirements of Specification MIL-A-8625.

3.9.3 Steel or copper-alloy parts.- All steel, except for corrosion-resisting alloys, and all copper-alloy parts shall be suitably protected as indicated in paragraph 3.3.1, and as recommended in the notes contained in Section 6.

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

3.9.5 No finishes or paints, other than those specified above, or color markings specified herein or otherwise authorized by the Services, shall be applied to the components either externally or internally prior to installation in the airplane.

3.10 Physical defect inspection.- All magnetizable highly stressed parts shall be subjected to magnetic inspection in accordance with Specification MIL-I-6868. Aluminum or aluminum-alloy parts which have been treated with Specification MIL-C-5541 material must be inspected after treatment by a process conforming to Specification MIL-I-6866. Where such inspection is necessary, it shall be called for on the manufacturer's drawings. Cracks or other injurious defects disclosed by the inspection shall be cause for rejection. Where Specification MIL-C-5541 material is used for touch up on parts which have been anodized, the above inspection process will not be required.

3.11 Changes.- No changes affecting interchangeability, weight, or function shall be made in the assembly or detail parts of an approved standard component, without prior approval of the Qualification test activity and notification of such approval received from the Aeronautical Standards Group. In the case of nonstandard components, no changes may be made without approval of the procuring activity.

3.12 Nonstandard components.- In the event Government detail specifications do not cover the characteristics of components that are required in the design of new hydraulic systems, the contractor shall furnish an industry-prepared specification, including drawings, if applicable, to the procuring activity for each component upon which specific approval is requested. The specification shall supplement this specification in stating all requirements and tests necessary to describe its requisite qualities. The tests shall not be referred to as Qualification tests, but shall reference all requirements and tests necessary to determine adequacy of the industry-developed equipment. These components will not be listed in a Qualified Products List unless a Government detail specification is prepared

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and the item is subsequently covered by the Qualification tests of the detail specification. Nonstandard components will normally be intended for use in a specific model airplane. The operating features of the components will, in many cases, be similar to those of components for which a Military specification exists, but with additional or modified requirements pertinent to the specific airplane installation. The airframe manufacturer shall therefore require from the component manufacturer, test data to satisfy the requirements of such industry-prepared specifications. The specifications and data shall be submitted to the procuring activity directly by the airframe manufacturer, and approval, when given, is to the airframe manufacturer for specific use of the component rather than to the component manufacturer for general use of the component in other aircraft.

3.12.1 Test specification or drawing.- Each item of nonstandard equipment shall be governed by a detail specification, written to cover that item, or a specification control drawing and listing or referencing the applicable approval and Acceptance tests. In lieu of either of the foregoing methods, these specification requirements may be covered by a test or waiver report, if desired.

3.12.2 Similarity.- At the option of the Service concerned and in cases where a nonstandard component comprises elements on which tests have already been received and accepted by that Service, all or a portion of the tests may be waived by the Service and a report substantiated by drawings showing similarity to the approved device accepted in lieu of actual tests.

3.12.3 Report submission.- Test reports covering nonstandard components on which approval is desired shall be submitted in duplicate together with a letter requesting approval, to the Service, by the airframe manufacturer. The test report shall describe preparation of test specimens and method of testing, explain test procedures, present test results and data, provide necessary complementary analysis and draw conclusions as to the extent of compliance with requirements.

3.13 Performance.- Standard components shall satisfy the performance test specified in the detail specification applicable to that particular component. Nonstandard components shall satisfy the applicable tests of this specification, and as specified on the assembly drawing or covering specification.

3.14 Special tools.- The design shall be such that special or unusual tools will not be required for normal maintenance and inspection of the component. Special tools and commercial standard tools are defined in Specifications MIL-D-8512 or MIL-D-8513.

3.15 Identification of product.-

3.15.1 Nameplate.- Each component shall be clearly and permanently identified by a durable nameplate conforming to Specification MIL-P-6906 and Standard MIL-STD-130 with the following information:

Name of component
 Rating and pertinent characteristics
 MS or AN Part No. or MIL Specification No.
 Stock No. (USAF or Navy, as applicable)
 Manufacturer's Part No.
 Manufacturer's Serial No.
 Contract or Order No.
 Manufacturer's name or trade-mark
 US

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The nameplate shall be securely attached to the component by the use of screws, rivets, or welding. Nameplates which are attached by use of adhesives will require prior approval of the procuring activity.

3.13.2 Use of AN or MIL designations.- AN or MIL designations shall not be applied to a product, except for Qualification test samples, nor referred to in correspondence, until notice of approval has been received from the activity responsible for qualification, or from the Aeronautical Standards Group.

3.14 Workmanship.- All details of workmanship shall be of a sufficiently high grade to insure proper operation and service life.

4. QUALITY ASSURANCE PROVISIONS

4.1 Classification of tests.- The inspection and testing of hydraulic system components shall be classified as follows:

- (a) Qualification tests: Qualification tests are those tests performed on samples submitted for approval as qualified products.
- (b) Acceptance tests: Acceptance tests are those tests performed on individual lots which have been submitted for acceptance.

4.2 Qualification tests.-

4.2.1 Assembly and detail drawings.- Two sets of assembly and detail drawings and a list of materials and plated coatings employed in the parts that make up the component shall be furnished to each Service with each new model component submitted for Qualification tests, with a letter to the activity responsible for qualification indicating the desire to submit specimens for the Qualification tests. Assembly drawings shall show a cut-away section of all details in their normal assembly position and shall carry part numbers of all details and subassemblies. Data such as: material, tensile strength, hardness, surface finish, surface protection, dimensional tolerances, etc, which are pertinent to the proper manufacture and function of each part, shall be indicated in the detail drawings. The following data shall be furnished on or together with all assembly drawings:

- (a) Mounting dimensions
- (b) Port dimensions
- (c) Over-all dimensions
- (d) Rated flow capacity
- (e) Dry weight
- (f) Maximum operating pressure
- (g) Complete dismantling procedure and description of special tools needed
- (h) Any special installation or operating instructions considered necessary

4.2.2 Sampling instructions.- Upon approval of the above drawings by the activity responsible for qualification, the manufacturer shall fabricate two specimens of the device for Qualification tests. The specimens shall be properly identified, tests conducted, and test reports submitted as outlined in the following paragraphs.

4.2.2.1 Minimum clearance specimen.- One of these specimens shall be assembled of parts which have been selected to provide that the clearance, with regard to linear, diametral, and concentric tolerances, between moving and nonmoving members conducive to wear, leakage, or malfunctioning at extreme temperatures, or as a result of prolonged

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operation, will be within 10 percent of the minimum clearance permitted by the manufacturer's drawings submitted above. "O"-ring packing glands conforming to Specification MIL-P-5514 may be fabricated to nominal dimensions. For cases of certain sliding seals where packing friction would influence the performance of the device, such as where pistons are operated by springs, the maximum packing friction anticipated shall be induced in the test specimen. This may be accomplished by use of packings which have been preswelled by aging in high-swell fluid. 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 tolerance. This specimen shall be marked No. 1.

4.2.2.2 Maximum clearance specimen.— The second specimen shall be assembled of parts which have been selected to provide that the clearances, with regard to linear, diametral, and concentric tolerances, between moving and nonmoving members conducive to wear, leakage, or malfunctioning at extreme temperatures, or as a result of prolonged operation, will be within 10 percent of the maximum clearance permitted by the manufacturer's drawings submitted above. "O"-ring packing glands conforming to Specification MIL-P-5514 may be fabricated to nominal dimensions. This specimen shall be marked No. 2.

4.2.2.3 The manufacturer shall subject specimen No. 1 to the Extreme temperature functioning tests and the Acceptance tests set forth in the detail specification. The manufacturer shall subject specimen No. 2 to all of the tests of the detail specification, except that the Extreme temperature tests need not be conducted. Upon satisfactory completion of these tests, the manufacturer shall forward two copies of a report of these tests, to the activity responsible for qualification indicated in the detail specification, with duplicate copies of each to the other Service. Upon acceptance of the report by the activity responsible for qualification, notice of authorization of Qualification tests and shipping instructions for the No. 1 and No. 2 specimens will be forwarded to the manufacturer. Upon receipt of the specimens, the activity responsible for qualification will subject specimen No. 1 to all the tests of the detail specification and use specimen No. 2 for inspection and comparison of results, provided the component has not failed during the Burst pressure test.

4.2.2.4 In the case of series of devices which are intended to serve the same general function in a system, qualification of one device of the series may at the discretion of the Services, be applied to any other device of the series if all of the internal working parts are identical in every detail with the corresponding internal working parts of the qualified device and provided it meets Proof and Burst pressure tests and such operation requirements as may be designated by the Services. For example, qualification of this type would apply to all devices which differ from previously qualified devices only insofar as port size, port location, external body dimensions, and external body configuration are concerned.

4.2.2.5 Qualification approval applies only to the design, materials, construction, and nominal dimensions of the specimens tested. Such features shall be identified by the manufacturer's part number submitted in his test report. Any change in any of these features may require new Qualification tests at the option of the activity responsible for qualification. Such changes shall be made in conformance with the requirements of Specification MIL-D-5028 or ANA Bulletin No. 391, and shall receive Air Force-Navy approval prior to incorporation in production. At the option of the Government, minor changes in these features may be approved without an attendant change in the part number. The contractor shall submit to both Services a list of all parts which make up the component giving drawing numbers with dated revisions at the time of submittal for Qualification tests. This list shall be revised and resubmitted when any changes are incorporated.

4.2.3 Tests.— The Qualification tests shall consist of all the tests of this specification, as described under "Test methods," and those specified in the detail specification. The Qualification tests may be supplemented with tests under actual service conditions, at the option of the procuring activity.

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4.3 Acceptance tests.- The Acceptance tests shall consist of Individual tests and Sampling tests.

4.3.1 Individual tests.- Each component furnished under contract shall be subjected to the following Acceptance tests described under "Test methods," and to the applicable Individual tests specified herein and in the detail specification, in the case of standard components; or those specified in the component specification or specification control drawing, in the case of nonstandard components:

- (a) Examination of product
- (b) Proof pressure
- (c) Actuation or operation (See detail specification or control drawing)
- (d) Leakage

4.3.2 Sampling tests.- Components up to 2 percent of the contract may be selected for any other tests specified in the applicable detail specification which the Inspector considers necessary to determine conformance with the requirements of the detail specifications.

4.3.3 Rejection and retest.- Failure of any component subjected to Acceptance tests in the presence of a Government Inspector, to conform to the applicable requirements of this specification or the detail specification shall be cause for the rejection of that component. If, for any reason, the test is not performed on all of the components under a contract, but is performed on representative samples (such as a destructive test), failure shall be cause for rejection of the components represented by that sample. Components which have been rejected in the course of test in the presence of a Government Inspector, may be reworked or have parts replaced to correct the defects found in the original and resubmitted for acceptance. Before resubmitting, full particulars concerning previous rejection and the action taken to correct the defects found in the original shall be furnished the Inspector. Components rejected after such retest shall not be resubmitted without approval of the procuring activity.

4.4 Samples subjected to destructive tests shall be in addition to the quantity specified in the contract or order, and shall be furnished without additional cost to the Government.

4.5 Test conditions.-

4.5.1 Test fluid.- Qualification tests on AN or MS standard component shall be performed with oil conforming to Specification MIL-O-5606. Qualification tests on non-standard components and Acceptance tests shall be performed with the fluid specified in the contract or detail specification.

4.5.1.1 Filtration.- The test fluid shall be continuously filtered so as to be free of all foreign matter (lint, dirt, metal particles, etc.) over 10 microns in size. The filter used shall be inspected and changed regularly to avoid clogging.

4.5.2 Temperatures.- Except where otherwise specified, the tests of this specification shall be conducted at a room temperature between 70° and 90°F, and an oil temperature between 70° and 110°F. The actual temperatures shall be recorded.

4.5.3 Sequence of tests.- All components which are to be subjected to Qualification tests shall, where applicable, be subjected to the Immersion test prior to conducting any other test.

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4.6 Test methods.-

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

4.6.2 Immersion.-

4.6.2.1 Plastic parts.- Components containing plastic parts shall be tested in general conformance with Specification MIL-P-5517 in addition to the tests specified herein.

4.6.2.2 Other nonmetallic parts.- Components containing nonmetallic parts other than plastic parts or AN standard seals in glands conforming to Specification MIL-P-5514 shall be immersed in hydraulic fluid for a period of 7 days at a temperature of $158^{\circ} \pm 2^{\circ}\text{F}$ prior to conducting the Qualification tests specified herein and in the detail specification. All internal parts shall be in contact with the fluid during this period. If this test is necessary as the result of the use of nonstandard packing installations and 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 packings used in the test samples shall be fabricated of the approved AN packing compound listed in QPL-5516 (latest revision) having the highest swell, and the fluid used shall be the hydraulic fluid listed in QPL-5606 (latest revision) having the highest swell producing characteristics. (The Services will designate the applicable high-swell packing compound and fluid upon request.) After the above immersion, the component 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.

4.6.3 Pressure tests.-

4.6.3.1 Proof pressure test.- A proof pressure as listed in Specification MIL-H-5440, shall be applied at least two successive times and held 2 minutes for each pressure application. The component shall be operated in its normal function between applications of the test pressures. There shall be no evidence of external leakage, failure, excessive distortion, or permanent set. This test is required in all categories of testing.

4.6.3.2 Burst pressure test.- A burst pressure as listed in Specification MIL-H-5440, shall be applied to the component at a maximum rate of 25,000 psi per minute. The component shall not rupture under this pressure. The pressure may be increased above that specified during Qualification tests in order to secure data on actual burst pressure. This should be the last test performed, because of its destructive nature.

4.6.4 Leakage tests.-

4.6.4.1 External leakage.- There is no specified test for external leakage, but during the course of all the tests listed in this specification external leakage, other than a slight seepage, through gasket seals, shall be cause for rejection.

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4.6.4.2 Internal leakage.-

4.6.4.2.1 Qualification test.- This test shall be performed with the component held in the position most conducive to leakage. The component shall be tested for leakage by applying 5 psi, 50 percent of working pressure, and working pressure for a minimum period of 30 minutes each. The leakage measurement period shall begin 2 minutes after the application of the required pressure. The component shall be actuated between pressure applications. The rates of internal leakage shall not exceed those specified in the detail specification, in the case of standard components; or in the component specification or specification control drawing, in the case of nonstandard components.

4.6.4.2.2 Acceptance test.- This test shall be performed with the component held in the position most conducive to leakage. Pressures of 5 psi and working pressure shall be held for a period of 5 minutes each. In each case the leakage measurement shall consist of the last 3 minutes of the 5-minute period. The component shall be actuated between pressure applications. The rate of leakage shall not exceed that specified for the Qualification test. Low-rate not readily measurable seepage shall not be considered as leakage.

4.6.5 Pressure drop.- Pressure-drop characteristics for a flow range of 0 to 150 percent of rated flow as prescribed in the detail specification shall be determined for the component. A manometer across the component may be used for accurate measurement of the pressure drop where the pressure-drop range is low enough to permit its use. In the case of a component where the pressure-drop range is not low enough to permit the use of a manometer, accurate calibrated pressure gages may be used. The pressure drop observed at rated flow shall not exceed the value permitted by the applicable specification.

4.6.6 Extreme temperature functioning tests.-

4.6.6.1 Low temperature - Low pressure.- The component shall be connected to a static head of 1 to 3 feet or working pressure of the test fluid, whichever is the more critical condition. This arrangement shall be maintained at a temperature not warmer than -65°F for 3 hours after the temperature has stabilized at -65°F. After this period the component shall be actuated at least 2 times. Variation of actuating forces or regulation, as applicable, shall not exceed that permitted by the detail specification. The Acceptance test prescribed for leakage shall be performed after each actuation and the requirements of the test satisfied.

4.6.6.2 Intermediate temperatures - Low pressure.- Immediately following the low temperature test the test arrangement shall be warmed rapidly to a temperature of 160°F. While the temperature is being raised, the component shall be actuated at maximum increments of 36°F to determine satisfactory operation throughout the temperature range. These check tests shall be made without waiting for temperature of the entire component to stabilize.

4.6.6.3 High temperature - Low pressure.- In the case of AN or MS Standard components the temperature shall be maintained at 160°F, or in the case of nonstandard components the temperature shall be maintained at the highest value which the component is expected to encounter for a length of time sufficient to allow all parts of the component to attain that temperature. In no case shall the temperature at which this test is conducted be less than 160°F. The component shall then be actuated at least 2 times. In cases of pressure actuation or regulation the variation from room temperature actuation or regulation shall not be exceeded by a greater percentage than that permitted under paragraph 4.6.6.1. The Acceptance test for leakage shall be performed after each actuation and the requirements of the test satisfied.

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4.6.7 Endurance.- The component shall be subjected to cyclic operation in accordance with table I. The schedule or cycling, cyclic rates, strokes, rates of flow, loads, temperatures, etc, shall be as specified in the applicable detail specification for the component. When applicable, leakage, as specified in paragraph 4.6.4.2.1, shall be tested at 25, 50, 75 and 100 percent of the number of cycles required. At the conclusion of the Endurance test, the component shall operate satisfactorily and shall be disassembled and carefully inspected. There shall be no evidence of excessive wear in any part of the component.

TABLE I

Endurance test

Type and usage of component ^{1/}	Cycles of Endurance test
AN or MS Standard	See detail specification
Nonstandard - Emergency	5,000
- Infrequent (less than 10 cycles per flight)	20,000
- Frequent (more than 10 cycles per flight)	50,000
- Flight Control	200,000

^{1/} One change of all dynamic seals is permitted during the life test of a flight control component. The number of cycles after which the packing was changed shall be reported in the test report.

5. PREPARATION FOR DELIVERY

5.1 Application.- The requirements of Section 5 apply only to direct purchases by or direct shipments to the Government.

5.2 Preservation, packaging, and packing.- Unless otherwise specified in the detail specification, all parts of each component shall be flushed with a rust inhibitor fluid conforming to Specification MIL-O-6083. Each component shall be sealed by closures in accordance with Specification MIL-C-5501, and the component shall be packaged and packed for delivery in accordance with method ICI or method IA of Specification MIL-P-116. A unit pack container conforming to Specification PPP-B-676, JAN-P-108, or JAN-P-120 shall be provided unless a container of equivalent strength and rigidity is used in connection with the preservation method employed.

5.2.1 Domestic shipment.- Domestic-type exterior containers shall conform to Specification NN-B-591, NN-B-621, NN-B-631, LLL-B-631, LLL-B-636 or PPP-B-601. When fiberboard exterior containers are used, such containers shall be fabricated from fiberboard having a Mullen test of 275 pounds or more and shall be limited to not more than 90 pounds gross weight.

5.2.2 Overseas shipment.- Unless otherwise specified, for overseas shipment, the interior containers shall be packed in an exterior shipping container in accordance with Specification PPP-B-601 or JAN-P-106. Each exterior container shall be furnished with a sealed case liner fabricated from barrier material meeting the requirements of Specification JAN-P-125. All seams and closures of the case liner shall be sealed with adhesive in accordance with Specification MIL-A-140.

5.3 Marking of shipments.- Interior packages and exterior shipping containers shall be marked in accordance with Standard MIL-STD-129. The nomenclature shall be as follows: Specification *, Manufacturer's Part No. *, Name of Part *, AN or MS Part No. *, Federal Stock No. * (if no FSN available, leave space therefor), Name of Manufacturer, Date of Manufacture (month, year).

*Applicable information to be entered by the manufacturer.

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6. NOTES

6.1 Intended use.- The components covered by this specification are intended for use in aircraft hydraulic systems conforming to Specification MIL-H-5440, at operating pressures which do not exceed those specified in the applicable AN or MS drawing or detail specification, and with hydraulic fluid conforming to Specification MIL-O-5606.

6.1.1 The corrosion-resisting properties of ferrous metals shall be equivalent to those of the "300" series of corrosion-resisting steels, such as 18-8 steel; those of the nonferrous metals should compare with anodized 24ST aluminum alloy. Plated coatings of tin, 85-percent tin, 15-percent cadmium alloy, chromium, and nickel, are considered to offer satisfactory surface protection for hydraulic-system components. The type and thickness of the plating, however, should be so selected as to provide adequate protection against the corrosion and wear conditions under which the part must function. Internal surfaces which are in constant contact with hydraulic fluid may be considered adequately protected against corrosion.

6.2 Ordering data.- Contracts and orders should state the part number of the component to be furnished, and whether overseas packing is desired.

6.3 Provisions for Qualification tests.- In the procurement of products requiring qualification, the right is reserved to reject bids on products that have not been subjected to the required tests and found satisfactory for inclusion on a Qualified Products List. The attention of suppliers is called to this requirement, 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 orders for the products covered by this specification. Requests for information pertaining to qualification of products covered by this specification should be addressed to the Bureau of Aeronautics, Navy Department, Washington 25, D. C., or to the Commander, Wright Air Development Center, Wright-Patterson Air Force Base, Ohio, the activities responsible for qualification, with a copy to the other Service.

6.4 Definitions.- For the purpose of this specification, the term "component(s)" is used to mean a valve or similar device of a hydraulic system.

PATENT NOTICE: When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

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