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SUPERSEDING
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MILITARY SPECIFICATION

ACTUATORS: AERONAUTICAL LINEAR UTILITY, HYDRAULIC, GENERAL SPECIFICATION FOR

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

1. SCOPE

1.1 Scope. This specification establishes the general requirements for hydraulic linear actuators when used in any aircraft hydraulic system except flight controls. The complete actuator assembly may incorporate other components, such as check valves, solenoid valves, bypass valves, and pressure switches, in addition to the actuator. The actuator may be controlled by mechanical linkage, electrical means, or direct hydraulic power.

1.2 Classification. Actuators shall be of the following types as specified (see 6.2):

Type I - -54°C to 71°C (-65°F to 160°) fluid temperature range

Type II - -54°C to 135°C (-65°F to 275°F) fluid temperature range

2. APPLICABLE DOCUMENTS

2.1 Government documents

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

SPECIFICATIONS

FEDERAL

QQ-C-320	Chromium Plating (Electrodeposited)
PPP-B-601	Boxes, Wood, Cleated-Plywood
PPP-B-636	Boxes, Shipping, Fiberboard
PPP-C-843	Cushioning Material, Cellulosic

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: ASD/ENES, Wright-Patterson AFB, OH 45433-6503 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A

FSC 1650

MILITARY

MIL-P-116	Preservation, Methods of
MIL-B-121	Barrier Material, Greaseproofed, Waterproofed, Flexible
MIL-B-131	Barrier Materials, Water Vaporproof, Greaseproof, Flexible, Heat-Sealable
MIL-H-5440	Hydraulic Systems, Aircraft, Types I and II, Design and Installation Requirements for
MIL-C-5501	Caps and Plugs, Protective, Dust and Moisture Seal, General Specification for
MIL-G-5514	Gland Design; Packings, Hydraulic, General Requirements for
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-H-8775	Hydraulic System Components, Aircraft and Missiles, General Specification for
MIL-C-11796	Corrosion Preventive Compound, Petrolatum, Hot Application
MIL-P-25732	Packing, Preformed, Petroleum Hydraulic Fluid Resistant, Limited Service at 275°F(135°C)
MIL-H-46170	Hydraulic Fluid, Rust Inhibited, Fire Resistant Synthetic Hydrocarbon Base
MIL-H-83282	Hydraulic Fluid, Fire Resistant, Synthetic Hydrocarbon Base, Aircraft, NATO Code Number H-537

STANDARDS

MILITARY

DOD-STD-100	Engineering Drawing Practices
MIL-STD-129	Marking for Shipment and Storage
MIL-STD-143	Standards and Specifications, Order of Precedence for the Selection of
MIL-STD-453	Inspection, Radiographic
MIL-STD-889	Dissimilar Metals
MS8516	Wrench - 1/2 Inch Square Drive Adjustable Spanner (3.5 to 6 Inches Dia.)
MS15002	Fittings, Lubrication (Hydraulic) Leakproof, 1/8 Pipe Threads, Steel, Type II
MS15006	Fittings, Lubrication (Hydraulic) Leakproof, 1/8 Pipe Threads, Steel, Type VI
MS28776	Scraper, Piston Rod
MS28903	Ring, Wiper, Hydraulic and Pneumatic, Piston Rod, Dirt
MS28932	Felt Strip, Packing Gland
MS33649	Bosses, Fluid Connection-Internal Straight Thread
MS33675	Scraper, Installation, Packing Gland Ring

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

AN814	Plug and Bleeder-Screw Thread
AN6204	Valve, Hydraulic Bleeder
AN8514	Wrench-3/8 Inch Square Drive Adjustable Spanner (.75 to 2 Inches Dia.)
AN8515	Wrench-1/2 Inch Square Drive Adjustable Spanner (1.75 to 4 Inches Dia.)
AND10067	Valve Installation-Hydraulic Bleeder (Standard Dimensions for)

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

2.2 Other publications. The following document(s) for a part of this specification to the extent specified herein. The issues of the documents which are indicated as DOD adopted shall be the issue in the current DODISS and the supplement thereto, if applicable.

AMERICAN NATIONAL STANDARDS INSTITUTE

ANSI B46.1 Surface Texture: Surface Roughness, Waviness and Lay

(Application for copies should be addressed to the American National Standards Institute, 1430 Broadway, New York, NY 10018.)

(Industry association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal agencies.)

2.3 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein, the text of this specification shall take precedence.

3. REQUIREMENTS

3.1 First article. When specified, a sample shall be subject to first article inspection (see 4.4 and 6.2).

3.2 Materials and processes. Materials and processes used for the manufacture of utility actuators shall be of high quality, suitable for the purpose, and shall conform to applicable government specifications. Specifications and standards for all material and processes 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.

3.2.1 Metals. All metals used in the construction of utility actuators shall be of a corrosion-resistant type or shall be suitably protected to resist corrosion during the normal service life of the actuator. The use of dissimilar metals, in intimate metal-to-metal contact, shall be avoided wherever practicable. Dissimilar metals are defined in MIL-STD-889.

3.2.1.1 Cylinder-barrels. The cylinder barrels of actuating cylinders shall be manufactured from steel or aluminum alloy forgings produced by hollow forging without flash formation or from steel seamless tubing or bar stock. When aluminum alloy cylinders are used with steel piston, the bearing areas of the piston head shall be chrome plated. Both the internal and external surfaces of aluminum cylinders shall be shot peened or roller burnished to produce a compressive residual stress pattern. Light honing, depth not to exceed 10 percent of the depth of the compressive zone resulting from shot peening, is permitted to obtain final dimensions and surface finish requirements. Exceptions to the compression requirements are materials which have been demonstrated to be as free from susceptibility to stress corrosion cracking as 7075 (T73 heat treat) aluminum alloy. Pistons other than chromium plated steel may be used with aluminum-alloy cylinder barrels if data to substantiate adequate service life expectancy and protection from corrosion, including corrosion during storage periods, is submitted to and approved by the acquisition activity. Aluminum alloy shall not be used on the bearing surface of the piston head.

3.2.1.2 Surface plating. All chromium plating used on piston rods or sliding surfaces shall be in accordance with class 2 of QQ-C-320. Other surface coatings may be used provided prior approval of such coating is obtained from the acquisition activity.

3.3 Design and construction

3.3.1 General design. The design shall conform to MIL-H-8775, as applicable. Loss of strength due to degradation of materials after exposure to high temperatures shall be considered in the design of the actuator. Rod ends, bearings, and jam nuts may operate in a different environment than the actuator; therefore, the actual condition should be considered in design and tests.

3.3.2 Joints. All adjoining parts shall be positively locked to prevent loosening when the actuator is subjected to operational loads or vibration. Welding, hydrogen brazing, or other approved methods may be used to join parts providing adequate strength in such joints is shown by subsequent tests. Sweat soldered threaded connections shall not be used to join any parts. Threaded joints which transmit reversing loads shall be securely locked in the assembled position to prevent loss of torque in the connection due to load reversal. Use of lockwire alone is not considered positive locking means. The use of jam nuts is not considered positive locking means unless lockwired or otherwise retained.

3.3.3 Piston head. The piston head shall have adequate bearing area on the barrel wall to carry any of the compression, bending, and vibration loads which may be imposed and to provide for satisfactory operation and service life.

3.3.4 Rod bearing overlap. The actuator bearing overlap, which is considered to be the distance between the extreme faces of the rod bearing and the piston bearing when the piston is fully extended, should be sufficient to give

satisfactory operation and service life. Consideration must be given to the structural compliance of the actuator under its own weight, high acceleration, vibration, and compression loads or any combination of these loads.

3.3.5 Rod bearing length. The piston rod bearing shall be of sufficient length to insure satisfactory operation and service life. This length shall be at least equal to the diameter of the piston rod. When determining rod or piston head bearing length, the seal grooves shall not be considered as a bearing surface.

3.3.6 Seals. Type I and type II actuator seals shall be in accordance with MIL-P-25732. MS standard seals shall be used unless the designer or vendor submits data showing that a standard seal is not adequate for the specific application, and the use of a special seal is approved by the acquisition activity. Seal glands shall conform to MIL-G-5514.

3.3.7 Scraper and wipers. Landing gear strut actuators and utility actuators whose piston rods are exposed to ice shall use scraper rings conforming to MS28776 installed in a groove in accordance with MS33675. Other utility actuators exposed to dirt or foreign matter shall use scraper rings conforming to MS28776 or MS28903. Actuator rods extended for long periods of time or subjected to high accelerated forces may be lubricated with felt wipers in accordance with MS28932. The use of felt wipers for temperatures exceeding 93°C(200°F) shall be approved by the acquisition activity. Actuators exposed to extreme sand and dust conditions may be provided with scrapers or wipers of nonstandard design suitable for the purpose, provided prior approval is obtained from the acquisition activity.

3.3.8 Bosses. All bosses for fluid connection fittings shall conform to MS33649 unless otherwise specified by the acquisition activity. Tube fittings and tubing, if incorporated in the actuator, shall conform to MIL-H-5440.

3.3.9 Bleeder plugs. When required to conform to MIL-H-5440 for bleeding of entrapped air, suitable bleeder plugs shall be provided at the highest practicable point in the actuator. Suggested types are AN814 plugs or AN6204 valves installed in boss conforming to AND10067 or MS33649. Other types may be used subject to approval of the acquisition activity.

3.3.10 Integral components. Other hydraulic components may be integrated into the actuator design provided such components can be replaced either as a unit or by detail part, and that such components can be replaced either as a unit or by detail part, and that such component is designed in accordance with the applicable military specifications.

3.3.11 Dashpot. When a dashpot is built into an actuator, an analysis shall be made to insure sufficient structural strength resulting from high hydraulic pressures encountered during operation. The use of packings or seals shall be avoided when possible. If packings or seals are used, the design shall be approved by the acquisition activity.

3.3.12 End caps, lock nuts, and adjustment nuts. End caps, lock nuts, and adjustments nuts may have wrench flats or hexes, be knurled, or contain milled

slots for spanner wrenches, as applicable to the design. If spanner wrench slots are used, they shall be dimensioned in accordance with figure 1. Drilled hole-type nuts requiring the use of pin-type spanner wrenches shall not be used in actuator designs. Lockwire or other suitable methods are to be used to prevent rotation of the end caps, lock nuts, and adjustment nuts.

3.3.13 Wrench flats. For designs using "screw-on" end caps, the actuator barrel shall have only wrench flats or hexes, preferably of the standard open-end wrench size. Such wrench flats or hexes shall be placed as near to the end cap as practicable.

3.3.14 Bearings. Replaceable bearings or bushings shall be used at all junction points where relative motion exists. Unless these are self-lubricating or permanently lubricated, lubricator fittings conforming to MS15002 shall be provided. For actuators requiring a smaller threaded fitting, lubrication fittings conforming to MS15006 may be used.

3.3.15 Self-aligning joints. Self-aligning ball bearings, plain spherical bearings, or universal joints shall be used wherever necessary in end connections to remove any bending loads unless all such loads are otherwise accounted for in design of the actuator.

3.3.16 Finish. Members such as piston rods, cylinder bores, and other gland diameters shall be held to the surface finish as specified in MIL-G-5514. The surface finish increments and specification shall be as specified in ANSI B46.1. Piston rods and all other wear surfaces shall be sufficiently hard and corrosion resistant to insure adequate service life.

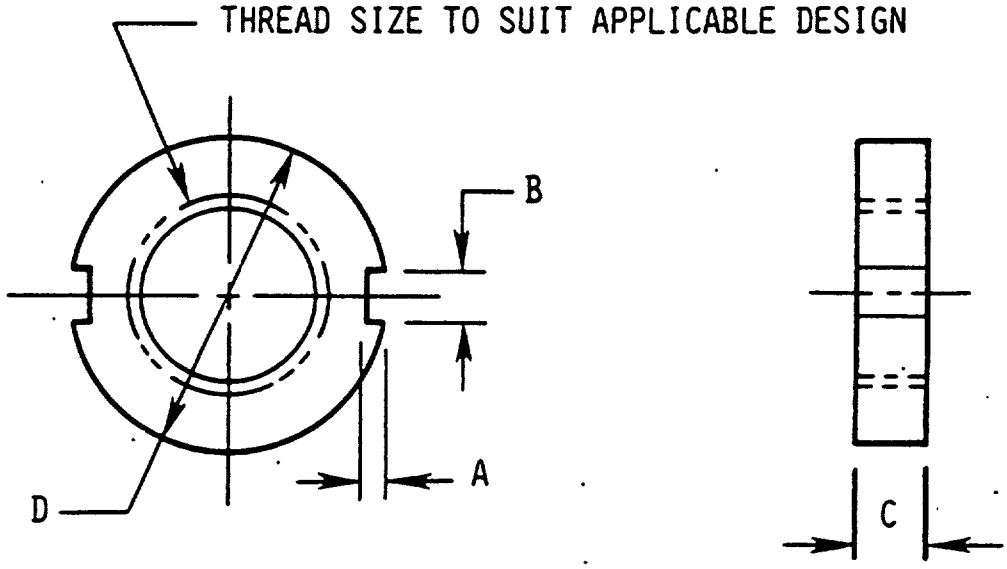
3.3.17 Ports. In order to avoid stress risers, all fluid port intersections with internal surfaces of cylinder barrels and end caps shall be perpendicular within 25 degrees unless full size component fatigue tests show that the port region is not fatigue critical.

3.3.18 Fillets. All internal fillets shall have radius of not less than 0.010 or 10 percent of the minimum wall thickness, whichever is greater, unless full size component fatigue tests show that the fillet area is not fatigue critical. O-ring groove requirements shall comply with MIL-G-5514.

3.4 Performance

3.4.1 Operation and leakage. Leakage shall not exceed the rate of one drop per packing per 25 cycles of operation at points where motion through external packing exists. No other external leakage sufficient in volume to form a drop shall be permitted.

3.4.2 Proof pressure and leakage. The actuator shall withstand a pressure equal to 1.5 times the actual differential pressure to be encountered (see 4.6.4.1) and the applicable proof pressure specified in MIL-H-5440 (see 4.6.4.2) without evidence of external leakage or evidence of internal leakage from the open port, unless specifically permitted by the design.



DIAMETER "D"	MINIMUM "A"	MINIMUM "B"	MINIMUM "C"
Inches	Inches	Inches	Inches
3/4 to 2	0.120	0.120	1/4
1-3/4 to 4	0.120	0.190	5/16
3-1/2 to 6	0.190	0.250	3/8

FIGURE 1. Dimensions for end caps and lock nuts for use with spanner wrenches AN8514, AN8515, and MS8516 key arm type only.

3.4.3 Extreme temperature performance. The actuator shall withstand temperatures ranging from -54°C (-65°F) to 71°C (160°F) or 135°C (275°F), as applicable (see 1.2).

3.4.4 Endurance. The actuator shall withstand the cyclic operation specified in 4.6.8.

3.4.5 Vibration. When required by the acquisition activity, the actuator shall withstand the frequencies and amplitudes of sinusoidal vibrations consistent with the given installation.

3.4.6 Dust. The actuator shall withstand the dust requirements specified in MIL-H-8775.

3.4.7 Salt fog. The actuator shall withstand the salt fog requirements specified in MIL-H-8775.

3.4.8 Burst pressure. The actuator shall withstand the applicable burst pressure specified in MIL-H-8775 and 4.6.12.

3.5 Interchangeability. All parts having the same manufacturer's part number shall be functionally and dimensionally interchangeable. The item identification and part number requirements of DOD-STD-100 shall govern the manufacturer's part numbers and changes thereto.

3.6 Identification of product. In addition to marking in accordance with MIL-H-8775, it is desirable that each actuator also be marked or tagged externally to indicate the standard replacement packing and gasket part numbers and the quantities thereof used in the actuator. Decalcomanias shall not be considered permanent markings.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any 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 the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.2 Classification of inspections. The inspection and testing of actuators shall be classified as:

a. First article inspections (4.4)

b. Quality conformance inspections (4.5)

4.3 Inspection conditions

4.3.1 Test fluid. Unless specified by the acquisition activity, all first article tests shall be performed with hydraulic fluid conforming to MIL-H-5606. Quality conformance tests may be conducted with hydraulic fluid conforming to MIL-H-6083 or fluid of the same type as specified for preproduction tests. For Navy applications, test fluids conforming to MIL-H-83282 and preservative fluid conforming to MIL-H-46170 shall be used.

4.3.2 Temperatures. Except where otherwise specified, the tests of this specification shall be conducted at a room temperature of 10°C (50°F) to 43°C (110°F). Hydraulic fluid temperature may range from 21°C (70°F) to 54°C (130°F). In the first article tests, the approximate temperature shall be recorded in the report except where specified temperatures are required during the tests.

4.4 First article inspections

4.4.1 First article test samples. First article tests shall be conducted on test samples in accordance with MIL-H-8775 and table I.

4.4.2 First article tests. The first article tests of the actuators shall consist of the examinations and tests listed in table I.

4.4.3 Rejection of first article samples. Failure of any actuating mechanism subjected to the first article tests shall be cause for rejection of the design of the actuator represented.

TABLE I. First article tests.

First Article Sample No. 1		First Article Sample No. 2	
Tests	Paragraph	Tests	Paragraph
Examination of product	4.6.1	Examination of product	4.6.1
Extreme temperature performance	4.6.7	Finish of sliding members	4.6.2
Dust	4.6.9	Proof pressure and leakage	4.6.4.1
Salt fog	4.6.10	Nondestructive inspection	4.6.5
Vibration	4.6.11	Immersion	4.6.6
		Endurance	4.6.8
		Burst pressure	4.6.12

4.5 Quality conformance inspections

4.5.1 Sampling. Each actuator submitted for acceptance under contract shall be subjected to the quality conformance tests specified herein. In addition, such actuators up to 1 percent of the contract, may be selected to determine conformance with the other requirements of this specification.

4.5.2 Tests. Quality conformance tests of actuators shall consist of the following examination and tests:

a. Examination of product (4.6.1)

b. Operation and leakage (4.6.3)

c. Proof pressure and leakage (4.6.4.2)

4.5.3 Rejection. Failure of any actuator to conform to any of the quality conformance tests shall be cause for rejection of that actuator assembly and the lot represented.

4.6 Test methods

4.6.1 Examination of product. Examination of product shall be in accordance with MIL-H-8775.

4.6.2 Finish of sliding members. The smoothness of finish on sliding surfaces, such as actuator bores and piston rods, shall be determined with a profilometer, comparator, brush surface analyzer, or other comparison equipment such as surface roughness comparison sample, provided the accuracy of the measuring equipment is within 10 percent of the required value.

4.6.3 Operation and leakage. Each actuator shall be cycled with the piston unrestrained through at least two complete cycles to demonstrate satisfactory operation, stroke adjustment, and leakage characteristics. Pressure shall build up to system pressure at the end of each stroke. Leakage at points where motion through external packing exists shall not exceed the rate of one drop per packing per 25 cycles of actuation. There shall be no other leakage sufficient in value to form a drop.

4.6.4 Proof pressure and leakage

4.6.4.1 For first article. The actuator shall be installed in a harness fixture and shall be restrained in a tension position and in one or more of its critical positions as a column (piston not bottomed). In each of these positions, a pressure of five pounds per square inch (psi) shall be applied for 5 minutes with the opposite port open to atmosphere. Then a pressure equal to 1.5 times the actual differential pressure to be encountered (that corresponding to the maximum external piston load, including externally induced loads which may be in excess of those resulting from application of actuating pressure) shall be applied for 5 minutes with the opposite port open to atmosphere. There shall be no external or internal leakage (from the open

port) sufficient in volume to form a drop unless specifically permitted by the design. There shall be no evidence of loosening, permanent deformation, or rupture of parts of the assembly.

4.6.4.2 For quality conformance. Each actuator shall be subjected to a pressure of 5 psi and a proof pressure of 150 ±5 percent of the operating pressure (see MIL-H-5440) for a period of 3 minutes for each pressure application. These pressures shall be applied first to one port and then to the other, with the opposite port open to atmosphere and the piston bottomed at the opposite end. There shall be no open evidence of external leakage nor internal leakage sufficient in volume to form a drop unless permitted by the contractor's drawing approved by the acquisition activity. There shall be no evidence of loosening, permanent deformation, or rupture of parts of the assembly.

4.6.5 Nondestructive inspection. Highly stressed parts such as end caps, piston heads and rods, locks, and other parts as specified on the manufacturing drawings manufactured from magnetic materials shall be subject to magnetic inspection in accordance with MIL-I-6868. Harmful discontinuities revealed by the penetrant method of inspection (see 3.2.1.3) shall be cause for rejection. Cracks or other injurious defects revealed by magnetic inspection shall be cause for rejection. Fusion weldments inspected by x-ray in accordance with MIL-STD-453 showing lack of penetration or fusion, cracks in parent metal or weld, underbead crater, burn-through, sharp weld edge, elongated metallic or nonmetallic inclusions, shall be rejected. Linear porosity and undercut in high-stress areas shall be cause for rejection. Diameters of scattered porosity and round inclusions in high-stress areas shall not exceed one-fifth of the metal thickness to a maximum defect image of 0.060 inch, with a distance between defects of at least eight defect diameters, or a minimum of 0.12 inch, and not exceeding three defects per inch of weld. In low-stress areas, the distance between gas pores or inclusions shall be at least six defect diameters or a minimum of 0.090 inch and not exceeding five defects per inch of weld. Film density shall be 2.5 ±0.2. The maximum defect allowable in ultrasonic testing shall be a flat bottom 1/32 inch in diameter, using 5 megacycles.

4.6.6 Immersion. Type I actuators containing nonmetallic parts other than standard seals and backup rings in glands conforming to MIL-G-5514 shall be immersed in hydraulic fluid for a period of 7 days at a temperature of 71°C ±1°C (160°F ±2°F) prior to conducting any of the other first article tests specified herein. Type II actuators containing nonmetallic parts shall be immersed in hydraulic fluid for a period of 72 hours at a temperature of 135°C ±3°C (275°F ±5°F) prior to conducting any of the other preproduction tests specified herein.

4.6.7 Extreme temperature performance

4.6.7.1 Low temperature. The actuator shall be connected to a static head of 1 to 3 feet of fluid in a manner to fill the entire actuator and subjected to -54°C (-65°F) maximum temperature for a period of 3 hours for type I and type II actuators following stabilization of the temperature of the test actuator. The actuator, still at a temperature of -54°C (-65°F) maximum, shall be

slowly cycled through five complete cycles with pressure buildup to operating pressure at the end of each stroke. At least the first full cycle shall be made with fluid at the specified temperature. Leakage shall not exceed two drops at each external packing gland during this cycling, and there shall be no evidence of binding of mating parts. Binding may be checked by comparing the pressure required to cycle under no load at room temperature, and at -54°C (-65°F). These values shall be approximately the same if cycling is conducted at velocities that permit viscous shear forces to remain approximately equal.

4.6.7.2 Intermediate temperatures. Immediately following the low temperature test specified in 4.6.7.1, the actuator shall be rapidly warmed up from the -54°C (-65°F) temperature to 71°C (160°F) or 135°C (275°F), as applicable, while being cycled through complete strokes at maximum increments of 20°C (36°F) to determine satisfactory operation throughout the temperature range. These cycles shall be performed without waiting for the temperature to stabilize.

4.6.7.3 High temperature. The actuator assembly, filled with fluid at a static head of 1 to 3 feet, shall be subjected to a temperature of 71°C (160°F) or 135°C (275°F), as applicable, for a period of 2 hours following stabilization of the temperature of the test actuator. The actuator shall be slowly cycled through five complete cycles with pressure buildup to operating pressure at the end of each stroke. At least the first full cycle shall be made with fluid at the specified temperature. There shall be no evidence of binding and leakage shall not exceed a trace. A trace of leakage is considered as that indicated by a slightly wetted surface.

4.6.7.4 Extreme temperature test waiver. At the option of the acquisition activity, the extreme temperature test specified in 4.6.7 need not be performed, provided the following are furnished to and approved by the acquisition activity prior to start of preproduction testing.

a. Assembly drawing with a cutaway section showing all detail parts in their normal assembled positions and all detail drawings of subassemblies pertaining to the assembled part, except for drawings of military standard parts (see 6.2.1).

b. Full details and dimensions of packing glands, piston heads, piston rod, and actuator.

c. A mathematical analysis covering the effects of differential thermal expansion or contraction between room temperature and the highest and lowest temperature the actuator will be exposed to in its application. The analysis shall include consideration of minimum clearances and maximum eccentricities allowed by drawing dimensions.

d. Tests or other data showing satisfactory function throughout the entire temperature range of operation (particularly for actuators with design features critical to satisfactory function, which may be adversely affected by temperature).

4.6.8 Endurance. The actuator assembly shall be subjected to cyclic operation at a temperature of 71°C (160°F) or 135°C (275°F), as applicable, in a set-up which simulates the loading and duplicates swiveling and bending loads, if any, which would occur in operation of the unit in its installation in the aircraft. Pressures within the actuator shall be typical of those expected under service conditions . This may be accomplished by use of the same or an equivalent control valve as used in the actual installation. Actuators shall be cycled against full design external loading (load-stroke curve, including pressure buildup at end of stroke to system design operating pressure) for the number of cycles specified. At the completion of this test, leakage at each external packing gland shall not exceed the rate of one drop per 25 cycles of actuation. Interport leakage in the proof pressure and leakage test specified in 4.6.4 shall not exceed one drop per minute unless specifically permitted by the design, and there shall be no evidence of excessive wear or failure.

a. Emergency actuators: 2,000 full-stroke cycles (operating in emergency only)

b. Normal service actuators: 20,000 full-stroke cycles.

4.6.8.1 Pressure impulse cycles. The actuating cylinder shall be subjected to pressure impulses conforming to figure 2. Each cylinder shall withstand 50,000 cycles of rated impulse pressure in both the extended and retracted positions. The test shall be conducted with the piston bottomed. It is mandatory that pressure peaks rise to 150 percent of rated operating pressure at some point prior to leveling off at operating pressure. There shall be no external leakage nor internal leakage (from the open port) unless specifically permitted by the design. There shall be no evidence of loosening, permanent deformation, or rupture of parts of the assembly. Maximum cycling rate shall be 300 cycles per minute. The pressure rise shall be 200,000 to 300,000 psi per second. The cycles shall be evenly distributed throughout the endurance cycling tests of 4.6.8.

4.6.8.2 Simplified endurance. In cases where eyebolt and piston rod strength and piston and piston rod bearing wear characteristics are acceptable without life test on basis of similarity to a previous life-tested unit, the endurance strength of such other parts of the unit, such as piston diaphragms, piston-to-rod attachments, and actuator heads and barrels can be verified by a simplified life test as follows: The actuator shall be installed in a harness fixture which shall retain the piston in a nonbottomed position. Pressure shall be applied to the actuator ports alternately, with the number of cycles and applied pressures conforming to the cycles and loads specified for the various types of actuators in 4.6.8. There shall be no evidence of failure at the conclusion of the test.

4.6.8.2.1 Endurance test waiver. At the option of the acquisition activity, the simplified endurance test need not be performed, provided the following complete drawings and data are furnished to and approved by the acquisition activity prior to the start of preproduction testing:

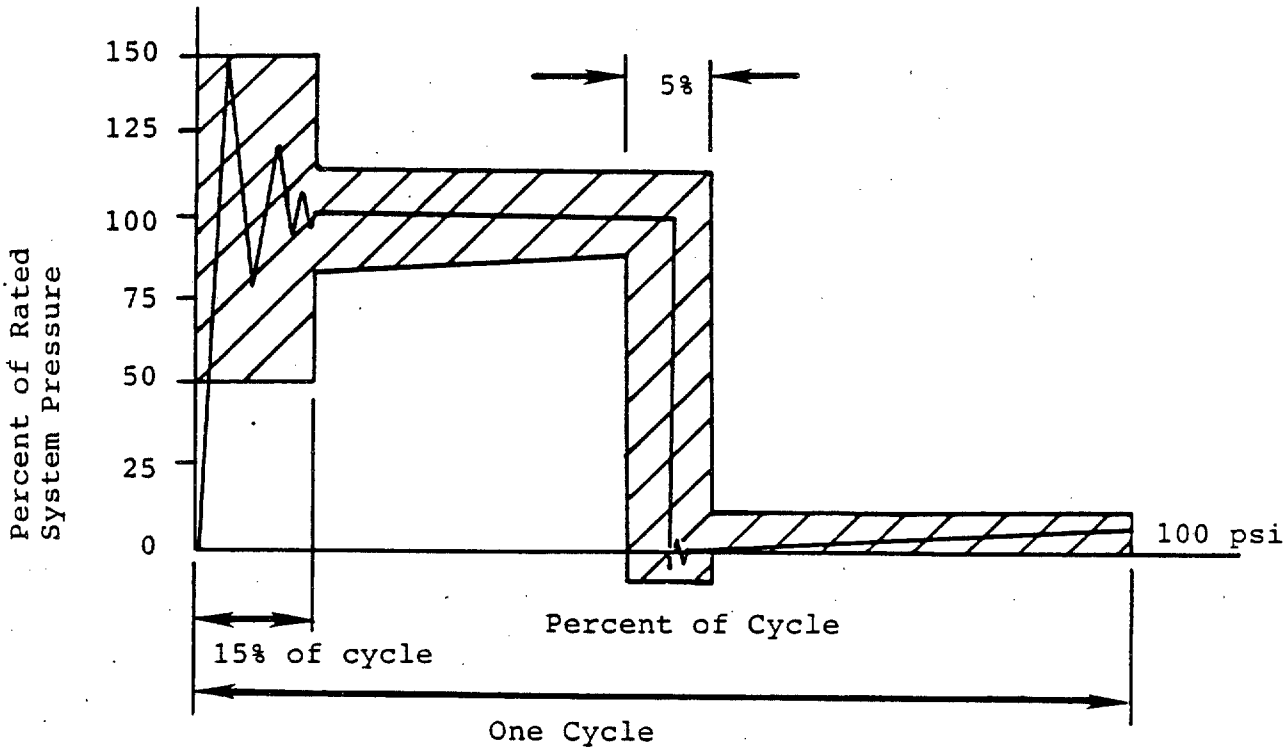


FIGURE 2. Pressure impulse.

a. Assembly drawing with a cutaway section showing all detail parts in their normal assembled positions and all detail drawings of subassemblies pertaining to the assembled part, except for drawings of military standard parts (see 6.2.1)

b. Full details and dimensions of packing glands, piston head, piston rod, and cylinder

c. Material used in construction of bearing, piston head and piston rod

d. Finish of piston head, piston rod, inner surface of cylinder, and packing glands. The roughness of the surface shall be designated in accordance with ANSI B46.1.

e. Packing part number, dimensions, packing compound, and packing manufacturer

f. Method of locking end caps and piston rod to the piston head and rod end connections

g. Bearing overlap in extended position

h. Length of stroke and method for limiting travel

i. Analysis of loads on cylinder as shown by load-stroke curve for intended use.

4.6.9 Dust. The dust test shall be conducted in accordance with MIL-H-8775.

4.6.10 Salt fog. The salt fog test shall be conducted in accordance with MIL-H-8775.

4.6.11 Vibration. The actuator shall be subjected to vibration tests in accordance with MIL-H-8775. The applicable test procedure from the vibration test selection chart shall be specified by the airframe contractor.

4.6.12 Burst pressure. The actuator shall be subjected to increasing pressure until the applicable burst pressure, as specified in MIL-H-8775, is reached. Rupture shall not occur at any pressure below the specified burst pressure. The rate of applying pressure shall not exceed 25,000 psi per minute. This pressure may be applied simultaneously to each end of the actuator, if desired by the contractor.

5. PACKAGING

5.1 Preservation. Each actuator shall be preserved and packaged in accordance with Level A or Level B, as specified.

5.2 Level A. Unless otherwise specified, each actuator shall be protected from corrosion and packaged in accordance with MIL-P-116, Submethod 1A-8.

5.2.1 Actuator cavities. All cavities of the actuator shall be flushed with corrosion-preventive oil conforming to MIL-H-6083 or MIL-H-46170 for systems

using MIL-H-83282 fluid. The excess oil shall be drained, taking care that enough oil remains in the cavities to completely cover all surfaces. All parts shall be sealed with closures conforming to MIL-C-5501; except for Navy application where only metal closures shall be used.

5.2.2 Piston rod bearing. The piston rod bearing shall be protected with a preservative conforming to MIL-C-11796 or packed with the operating grease and wrapped in Grade A paper conforming to MIL-B-121.

5.2.3 Piston rod. The piston rod shall be retracted and securely fastened to prevent extension. Any exposed surface of the piston rod shall be coated with peservative conforming to MIL-H-6803, and wrapped in Grade A paper conforming to MIL-B-121.

5.2.4 Actuator. Each actuator shall be adequately cushioned with cellulose wadding conforming to PPP-C-843, sealed in a bag constructed of material conforming to MIL-B-131, and packaged in a unit container conforming to PPP-B-636, class weather resistant.

5.2.4.1 Level B. Level B actuators shall be perserved and packaged as for Level A, except that MIL-P-116, Submethod 1C-1 may be used, and PPP-B-636 class domestic may be used as a unit container.

5.3 Packing

5.3.1 Level A. Overseas exterior shipping containers shall conform to PPP-B-601, Grade A.

5.3.2 Level B. Domestic exterior shipping containers shall conform to PPP-B-636, class weather resistant. When fiberboard exterior shipping containers are used, such containers shall be fabricated from fiberboard having a Mullen test of 275 pounds or more.

5.4 Marking of shipments. Interior packages and exterior shipping containers shall be marked in accordance with MIL-STD-129.

6. NOTES

6.1 Intended use. The actuators covered by this specification are intended for use in aeronautical hydraulic systems covered by MIL-H-5440 to actuate such individual units as landing gears and bomb bay doors. The actuators should not be used with any hydraulic fluid other than that conforming to MIL-H-5606, unless otherwise specified by the acquisition activity.

6.2 Ordering data. Acquisition documents should specify:

a. Title, number and date of this specification.

b. Type of actuator required (see 1.2).

c. Applicable level of packaging and packing required (see 5.2 and 5.3).

d. Where the preproduction test samples should be sent and instructions concerning the submittal of the test reports (see 4.4.1).

e. Whether the extreme temperature test (see 4.6.7.4) or the endurance test (see 4.6.8.2.1) will be waived.

6.2.1 Assembly drawings. The assembly drawings referenced in 4.6.4.2, 4.6.7.4, and 4.6.8.2.1 are not required to be in accordance with DOD-STD-100. The intended purpose of the drawings is to show the changes, in the actuators being procured, that have been incorporated over previously procured actuators.

6.3 Changes from previous issue. Asterisks are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

Custodians:
Army - AV
Navy - AS
Air Force - 11

Review activities:
Air Force - 99

Preparing activity:
Air Force - 11

Project 1650-0396

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions – Reverse Side)

1. DOCUMENT NUMBER	2. DOCUMENT TITLE

3a. NAME OF SUBMITTING ORGANIZATION	4. TYPE OF ORGANIZATION *(Mark one)*
	☐ VENDOR ☐ USER ☐ MANUFACTURER ☐ OTHER *(Specify)*: _____
b. ADDRESS *(Street, City, State, ZIP Code)*	

5. PROBLEM AREAS

a. Paragraph Number and Wording:

b. Recommended Wording:

c. Reason/Rationale for Recommendation:

6. REMARKS

7a. NAME OF SUBMITTER *(Last, First, MI)* – Optional	b. WORK TELEPHONE NUMBER *(Include Area Code)* – Optional
c. MAILING ADDRESS *(Street, City, State, ZIP Code)* – Optional	8. DATE OF SUBMISSION *(YYMMDD)*

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