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MILITARY SPECIFICATION

PNEUMATIC SYSTEM COMPONENTS, AERONAUTICAL, GENERAL SPECIFICATION FOR

This specification has been approved by the Department of Defense and is mandatory for use by the Departments of the Army, the Navy, and the Air Force.

1. SCOPE

1.1 Scope - This specification covers the general requirements for pneumatic components (see 6.2) used in aircraft systems conforming to Specification MIL-P-5518.

1.2 Classification - Aircraft pneumatic system components covered by this specification shall be of the following types, as specified:

Type I -65° to +160° F temperature range.
Type II -65° to +275° F 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 this 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)

FSC 1650

QQ-S-365	Silver Plating, Electrodeposited, General Requirements for
QQ-Z-325	Zinc Coating, Electrodeposited, Requirements for

Military

MIL-D-1000	Drawings, Engineering and Associated
MIL-G-4343	Grease, Pneumatic System
MIL-C-5015	Connectors, Electric, "AN" Type
MIL-E-5272	Environmental Testing, Aeronautical and Associated Equipment, General Specification for
MIL-G-5514	Gland Design, Packings, Hydraulic, General Requirements for
MIL-P-5517	Plastic Parts in Aircraft Hydraulic Equipment, General Tests for
MIL-P-5518	Pneumatic Systems, Aircraft, Design, Installation, and Data Requirements for
MIL-C-5541	Chemical Films and Chemical Film Materials for Aluminum and Aluminum Alloys
MIL-I-6866	Inspection, Penetrant Method of
MIL-I-6868	Inspection Process, Magnetic Particle
MIL-P-6906	Plate, Identification, Aircraft
MIL-S-7742	Screw Threads, Standard, Optimum Selected Series General Specification for
MIL-M-7969	Motors, Alternating Current, 400-Cycle, 115/200-Volt System, Aircraft, General Specification for
MIL-M-8609	Motors, Direct-Current, 28-Volt System, Aircraft, General Specification for
MIL-A-8625	Anodic Coatings, for Aluminum and Aluminum Alloys

MIL-T-10727	Tin Plating, Electrodeposited or Hot-Dipped, for Ferrous and Nonferrous Metals
MIL-C-26074	Coating, Electroless Nickel, Requirements for
MIL-C-26500	Connectors, General Purpose, Electrical Miniature, Circular, Environment Resisting, 200 Degree C Ambient Temperature

STANDARDS

Military

MIL-STD-129	Marking for Shipment and Storage
MIL-STD-130	Identification Marking of US Military Property
MIL-STD-143	Specifications and Standards, Order of Precedence for the Selection of
MIL-STD-704	Electric Power, Aircraft, Characteristics and Utilization of
MIL-STD-889	Dissimilar Metals
MS9058	Ring-Back-Up, Boss Connection, AMS3651
MS20659	Terminal, Lug, Crimp Style, Copper, Uninsulated, Ring Tongue Type I, Class I
MS20995	Wire, Lock
MS28772	Packing, "D" Ring, Shock Strut
MS28774	Retainer, Packing Back-up, Single Turn, Tetrafluoroethylene
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	Pins, Spring, Functional Limitations of
MS33566	Fittings, Installation of Flareless Tube, Straight-Threaded Connectors
MS33649	Bosses, Fluid Connection-Internal Straight Thread
MS33656	Fitting End, Standard Dimensions for Flared Tube Connection and Gasket Seal
MS33657	Fitting End, Standard Dimension for Bulkhead Flared Tube Connections

Air Force-Navy Aeronautical

AN814	Plug and Bleeder - Screw Thread
AN6230	Gasket, "O" Ring Hydraulic
AN6227	Packing, "O" Ring Hydraulic
AND10064	Fittings - Installation of Flared Tube, Straight Threaded Connectors
AND10074	Boss - Spacing - Hydraulic
AND10476	Washer - Limitations on Usage of Lock

PUBLICATIONS

Air Force-Navy Aeronautical Bulletin

No. 147	Specifications and Standards of Non-Government Organizations Released for Flight Vehicle Construction

(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 documents for a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

American National Standards Institute

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

(Application for copies should be addressed to the ANSI, 10 East 40th Street, New York, N. Y. 10016.)

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 pneumatic system, or the number of deviations necessary would make this specification impracticable, the contractor shall prepare a general component specification, similar to this specification, and submit this specification to the procuring activity for approval. This document shall specify the performance, design, and testing requirements for all the components in the pneumatic system and also shall be the controlling document for components not otherwise covered by an applicable detail component specification.

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

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

3.2.1.1 All copper alloys shall be suitably protected with a coating selected from Table I, except that cadmium and zinc plating shall not be used in applications subject to abrasion. Other metallic coatings, which shall have been demonstrated to be satisfactory to the Government, such as electroless nickel and electrodeposited 85 percent tin, 15 percent cadmium alloy, may be used. All aluminum alloys shall be anodized in accordance with Specification 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 Specification 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 - 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. Magnesium shall not be used for Type I components.

3.2.1.3 Type II components - 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. 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.

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.

3.2.3 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 Standard MIL-STD-143 and ANA Bulletin No. 147, except as provided in the following paragraph.

3.2.3.1 Standard parts - Standard parts (MS or AN) 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, and cotter pins, may be used, provided they possess suitable properties, and are replaceable by the standard parts (MS or AN) 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.

3.2.4 Storage life - Every effort shall be made to select materials which will assure satisfactory service after normal storage.

3.3 Design and construction.

3.3.1 General - The configuration, dimensions, and other details of design shall conform to the applicable AN or MS standards. Nonstandard components shall conform to the applicable manufacturer's drawings as governed by Specification MIL-P-5518. Every effort shall be made during design to insure that methods and equipment for functional tests are of standard design (see 3.9).

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

3.3.3 Threads - Only straight threads conforming to Specification MIL-S-7742, Unified Fine Thread Series, classes UNF-3A or UNF-3B shall be used. Pipe threads shall not be used.

3.3.4 Pneumatic media - Components shall be designed to operate with air, nitrogen, or other applicable gas approved by the procuring activity.

3.3.5 Orifices - All orifices smaller than 0.070 inch in diameter, the clogging of which could cause malfunctions of the systems, shall be protected by a filter element having a screened opening of 0.008

inch to 0.012 inch. Orifices and filter elements shall be strong enough to absorb system design flow and pressure without rupture or excessive deformation.

3.3.6 Seals - Components shall be so designed that , in assembly of parts, sufficient clearance exists to permit assembly of the components without damage to O-ring or backup rings where they pass threaded parts or sharp corners. Specification MIL-G-5514 and Standards AND10064 and MS33566 shall be used for Type I system packing installation and as a guide for Type II system packing installation.

3.3.6.1 Type I system Components - All packing and gaskets shall be in accordance with Standard MS28778, AN6227, AN6230, or MS28772. Backup rings shall be in accordance with Standard MS28774, MS28782, MS28783, or MS9058.

3.3.6.2 Type II system components - Backup rings shall be in accordance with Standard MS28774 or MS9058.

3.3.7 Safetying - All threaded parts, except standard parts without lock-wire holes, shall be securely locked or safetied by safety wiring, self-locking nuts, or other approved methods. Safety wire shall be applied in accordance with Standard MS33540 and shall conform to Standard MS20995. Star washers and jam nuts shall not be used as locking devices. Use of lock washers shall be governed by limitations set forth in Standard AND10476.

3.3.8 Retainer rings - Except where they are positively retained from being dislodged from their grooves, retainer or snap rings shall not be used in pneumatic system components in any location where failure of the ring will allow "blow-apart" of the unit caused by internal pneumatic 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 pneumatic pressurized components is involved, such as locking in place of nonpressurized end caps, etc., the rings shall be capable of being installed and removed with standard pin-type pliers or other standard tools developed for use with the specified rings.

3.3.9 Spring pins - The use of spring pins is undesirable. Unless specifically approved by the procuring activity, spring pins shall be governed by limitations as set forth in Standard MS33547.

3.3.10 Symmetrical components - Components shall be designed, by mounting provisions or port location or similar means, so that reverse installation is impossible.

3.3.11 Structural strength - The components shall have sufficient strength to withstand all loads or combinations of loads resulting from pneumatic pressure, temperature variations, actuation or operations, and torque loads for connection of tube fittings. MS or AN standard Type II components shall be designed to withstand proof pressure and burst pressure tests, 4.5.3.1 and 4.5.3.2 respectively, after loss of strength of the material caused by aging at 275° F for 1,000 hours. Nonstandard Type II components shall be designed to withstand proof pressure and burst pressure tests, 4.5.3.1 and 4.5.3.2, respectively, after loss of strength of the material caused by aging at 275° F for a time period as designated in the detail specification.

3.3.12 Ruggedness - Where a manually operated 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.

3.3.13 Rated flow capacity - The rated flow capacity and capacity to withstand pressure differential with flow shall be as specified in the applicable detail drawing or specification.

3.3.14 Pressure drop at rated flow - The components 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 in the applicable detail drawing or specification.

3.3.15 Scavenging - The configuration of components shall favor scavenging of entrapped foreign material, such as water or excess lubricant.

3.3.16 Function-adjustment screws - Function-adjustment screws, if used, shall be so designed and constructed as to maintain adjustment under all the required conditions of vibration and operation. Friction type locking devices shall be kept to a minimum and shall be subject to the approval of the procuring activity. If friction type is used, the adjustment screws shall maintain their setting after adjusting through the full range the number of times specified in the detail specification and then vibration tested. It shall be possible to adjust and lock the adjustable screws with a standard wrench or screwdriver. Where practicable, it shall be possible to make adjustment under full system pressure with negligible loss of the pneumatic medium. The adjustment screws shall be sealed (lock wired) and permanently marked with the pressure setting. It shall be necessary to destroy this seal and pressure setting marking before a change of

adjustment can be made. The means of adjustment shall either be internal or protected from tampering by a cover or similar device.

3.3.17 Plumbing connections.

3.3.17.1 Bosses - All internally threaded bosses for connecting fittings and AN814 plugs shall conform to Standard MS33649. Spacing of ports for connecting fittings shall conform to Standard AND10074. Bosses shall be made deep enough or shall incorporate fitting stops to prevent damage to internal mechanism or restriction of pneumatic medium flow when universal fittings are screwed into the bosses to excessive depths.

3.3.17.2 External tube connections - External male threaded tube connections, when used, shall conform to Standards MS33656 and MS33657 or MS33514 and MS33515. Male threaded flared fitting ends on 3,000 pounds per square inch (psi) components shall be steel in sizes below 1/2-inch tube sizes. These may be aluminum alloy or steel for tube sizes 1/2 inch and above. Caution should be used in the use of aluminum alloy where repeated assembly could damage the fitting which is an integral part of the component and thus render it unserviceable.

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

3.3.18 Plugs - All plugs, except permanently installed plugs that will not have to be removed during the life of the component, shall conform to Standard AN814 for Types I and II systems. Pipe threaded plugs shall not be used.

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

3.3.20 Electrically controlled components.

3.3.20.1 Voltage range - Electrically operated components shall be designed to operate on 28 volts (V) direct current (dc) or 115V single phase or 200V 3 phase, 400 cycles per second (cps) alternating current (ac) in aircraft electrical systems having characteristics as specified in Standard MIL-STD-704. The components shall be designed to operate

under simultaneous extremes of temperature, pneumatic pressure, and voltage for their classes as specified in Table II.

TABLE II

TEMPERATURE, PRESSURE, AND VOLTAGE

Class	Temperature	System pressure	Voltage	
			DC	AC
A,B,C,D	(min) (4-hour soak)	(max), (min)	18 (max)	92 (max)
A,B,C,D	Room (70° F to 90°F)	(max), (min)	18 (max)	92 (max)
A,B,C,D	Room (70° F to 90°F)	1.5 times	24 (max)	110 (max)
A	(max) plus temp. rise	(max), (min)	18 (max)	92 (max)
B	(max) plus temp. rise	(max), (min)	24 (max)	110 (max)
C	(max) plus temp. rise	(max), (min)	29 (max)	122 (max)
D	(max)	(max), (min)	18 (max)	92 (max)

3.3.20.1.1 Class A and B components - Class A and B components are normally energized continuous-duty type. These components shall be capable of operation at the specified voltages after being energized at 29V dc or 122V ac, as applicable, while exposed to the maximum ambient temperature and altitude conditions specified in the detail specification until coil temperature stabilization is reached. If any form of temperature control of the coil is to be used in the actual system it shall be employed in the test setup.

3.3.20.1.2 Class C components - Class C components are normally energized continuous-duty type. These components shall be capable of recycling at the voltage, temperature, and altitude specified in the detail specification, after being energized at the same voltage while exposed to the maximum ambient temperature and altitude conditions specified in the detail specification until coil temperature stabilization is reached. If any form of temperature control of the coil is to be used in the actual system, it shall be employed in the test setup.

3.3.20.1.3 Class D components - Class D components are normally deenergized intermittent-duty type, and shall be tested at the specified voltage while at the maximum temperature and altitude conditions after temperature stabilization is reached while in the deenergized condition. The time of energization and time between cycles shall be as specified in the detail specification.

3.3.20.1.4 The class of the component shall be specified in the detail specification.

3.3.20.2 Solenoid operated components - The solenoids shall be compact design and of sufficiently rugged construction to withstand the mechanical shocks and stresses incident to their use in aircraft. Solenoids shall be designed for continuous or intermittent duty, as applicable, and shall be provided with single-coil windings. Solenoids shall be totally enclosed, in order to prevent moisture from coming in contact with the electrical windings. The coil shall be firmly fixed in the frame to prevent ultimate failure of leads caused by vibration.

3.3.20.2.1 Coils - Coils shall be evenly wound and insulated to meet the performance requirements specified (see 3.3.20.2.7). Coils shall be completely insulated from the frame or other component parts. Coils shall be suitably taped, impregnated, and secured to the frame as required to prevent damage under humidity, salt fog, vibration, and other test conditions specified for the component (see section 4).

3.3.20.2.2 Terminals - Solenoid coils shall be terminated with an electrical connector conforming to Specification MIL-C-5015 or MIL-C-26500, or terminals of the screw-stud type as designated on the applicable detail specification or drawing. Terminals shall be constructed of corrosion-resistant material or suitably plated material and equipped with washer, lockwasher, and screw or nut, for use with cable terminals conforming to Standard MS20659.

3.3.20.2.3 Dielectric strength - All solenoids shall be capable of withstanding a test voltage of not less than 1,500V root mean square (rms), at commercial frequency 60 cps for 1 minute between terminals and case at maximum operating temperature of the solenoid (see 4.5.14).

3.3.20.2.4 Temperature rise - When tested at maximum temperature and altitude conditions, the temperature attained at equilibrium calculated by the rise of resistance method shall not exceed the continuous rating of the electrical insulation or other materials used in construction of the solenoid (see 4.5.7).

3.3.20.2.5 Endurance - The solenoid valve shall withstand endurance test specified in the detail specification for the component (see 4.5.8 and 4.6.1).

3.3.20.2.6 Attitude - The solenoid valve shall conform to all requirements of this specification while mounted in any position.

3.3.20.2.7 Performance - The solenois shall be capable of operating the component under the following environmental conditions or natural combinations thereof:

(a) Atmospheric pressure range:
Equivalent to the range from sea level to the maximum altitude specified in the detail specification.

(b) Temperature limits:
Same as specified for the pneumatic media and ambient limits for the component. Test as specified in 4.5.6.4.

(c) Humidity:
Conditions encountered when tested as specified in 4.5.10.

(d) Sand and dust:
Conditions encountered when tested as specified in 4.5.12.

(e) Vibration:
Conditions encountered when tested as specified in 4.5.9.

(f) Fungus resistance: (See 4.5.11)

(g) Salt fog: (See 4.5.13)

3.3.20.3 Electric motor operated components - The characteristics of electric motors for operating pneumatic components shall conform generally to Specification MIL-M-8609 for dc operated units, Specification MIL-M-7069 for ac operated units, and to the detail specification, including the oil-proof and explosion-proof requirements.

3.3.20.4 Clutches or brakes - On assemblies using clutches or brakes to limit over-travel, the design shall be such as to prevent over-travel 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.

3.3.21 Reliability - Each component shall be designed and constructed to meet a specified quantative reliability requirement in terms of mean time between failures (MTBF), or its equivalent. Component detail specifications shall specify the necessary reliability requirements, including confidence factors, or their equivalent.

3.4 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-1000. Subassemblies composed of selected mating components must be interchangeable as assembled units, and shall be so indicated on the manufacturer's drawings. The individual components of such assembled units need not be interchangeable.

3.5 Lubricants - Unless otherwise authorized by the procuring activity, only lubricants conforming to Specification MIL-G-4343 shall be used as a lubricant between rubber and metal in Type I components. For Type II components, lubricants shall be adequate to meet the requirements of the detail specification. 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.

3.6 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.

3.7 Finish (surface roughness) - Surface roughness finishes, where required shall be established, and shall be specified on the manufacturer's assembly drawings as specified in ANSI B46.1-1962. The determination of surface finishes shall be made with a profilometer, comparator brush analyzer, or other suitable comparison equipment with an accuracy of ±15 percent at the level being measured. If surface defects are unacceptable, it shall be a specifically designated control that all imperfections shall be within the stated limits or that prescribed special inspection procedures shall be followed. At least where a surface of 16 microinch RHR or finer is designated, the essential process description or its generation shall, in addition to surface measurements, constitute part of the requirements for compliance. When necessary, waviness and lay shall be specified.

3.8 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 shall 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 touchup on parts which have been anodized, the above inspection process will not be required.

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

3.10 Identification of product - The components shall be marked for identification in accordance with Standard MIL-STD-130.

3.10.1 Nameplate - Each component shall be identified by means of a durable nameplate conforming to Specification MIL-P-6906. The nameplate shall be securely attached to each component by use of screws, rivets, welding, or other approved method. Nameplates which are attached by use of adhesives will require prior approval of the procuring activity. Nameplates shall not be impression-stamped after installation.

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

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection - Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified, the supplier may utilize his own facilities or any commercial laboratory acceptable to 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 tests - The classification of tests shall be as specified in the detail specification.

4.3 Test samples - Tests shall be conducted on two or more samples of every component. Any component failing to pass any of the tests specified shall be rejected. Unless waived by the procuring activity, the two samples shall be prepared to adverse tolerance dimensions as follows.

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

adverse O-ring cross section tolerances and high-swell pneumatic lubricant. This specimen shall be marked "MIN".

4.3.2 Maximum clearance specimen - The second specimen shall be assembled of parts which have been selected to provide that the clearance with regard to linear and diametrical tolerances between moving members, conducive to malfunctioning as a result of wear associated with prolonged operation, will be not less than 90 percent of the maximum designed clearance permitted by the manufacturer's drawings. This specimen shall be marked "MAX".

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

4.3.4 Test conditions - The following test conditions apply, unless otherwise modified by, or added to in the detail specification

4.3.4.1 Test media - Tests shall be performed with air or nitrogen except that burst pressure tests may be performed with a liquid. For the purpose of this specification, standard air is defined as air containing less than 0.12 gram of moisture per pound of dry gas, and weighing approximately 0.075 lb./cu. ft. at 69° F temperature and 14.7 psi absolute pressure.

4.3.4.2 Temperatures - All room temperature (as contrasted to extreme temperature) tests, shall be conducted with the ambient and inlet test media temperatures between 70° F and 120° F. The actual temperatures of the test media and the ambient shall be recorded.

4.3.4.3 Filtration - The test media shall be continuously filtered through a filter element which is equivalent to a 10-micron nominal standard filter element. The filter and element used shall be satisfactory for the temperature range encountered, and cleaned or changed regularly to avoid clogging. When finer filtration is required, it will be specified in the detail specification.

4.4 Quality conformance tests - Unless otherwise specified in the detail specification, the quality conformance tests for a Type I or a Type II component shall consist of:

(a) Examination of product (4.5.1)

(b) Proof pressure (4.5.3.1)

(c) Leakage tests (4.5.4)

(d) Pressure drop (4.5.5)

4.4.1 Quality conformance test conditions - Unless otherwise specified in the detail specification, the following test conditions shall apply.

4.4.1.1 Quality conformance test media - Tests shall be performed with air or nitrogen.

4.4.1.2 Quality conformance test temperature - Unless otherwise specified, test media and ambient temperatures shall be between 70° F and 120° F.

4.4.1.3 Quality conformance test filtration - Unless otherwise specified, the test media shall be continuously filtered through a filter element which is equivalent to a 10-micron nominal standard element. The filter and element shall be cleaned or changed regularly to avoid clogging.

4.5 Test methods - Type I components.

4.5.1 Examination of product - Each component shall be carefully examined to determine conformance to the requirements of this specification for design, weight, workmanship, marking, conformance to applicable AN or MS standard, and manufacturer's drawings, and for any visible defects.

4.5.2 Immersion of plastic parts - In addition to the tests specified herein, components containing plastic parts, other than AN or MS standard parts, shall be tested for conformance to Specification MIL-P-5517, except that all tests shall be accomplished using water in lieu of hydraulic fluid as the immersion medium. Backup rings conforming to Standards MS9058, MS28782, and MS28783 are not considered "plastic parts" for the purpose of this specification.

4.5.3 Pressure tests.

4.5.3.1 Proof pressure - A proof pressure, as specified in Specification MIL-P-5518 or the detail specification, shall be applied at the

temperature specified in the detail specification for 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 pressure. There shall be no evidence of excessive external leakage, excessive distortion, or permanent set as specified in the detail specification. This test shall be conducted at room temperature.

4.5.3.2 Burst pressure - A hydrostatic burst pressure, as specified in Specification MIL-P-5518 or the detail specification, shall be applied to the component at a maximum pressure rise rate of 25,000 psi per minute, at room temperature after all other tests have been completed. The component shall not rupture under this pressure. The pressure may be increased above that specified in order to secure data on actual burst pressure. After this test, the component shall be painted red, or otherwise be conspicuously marked to warn against and prevent any additional testing or further use.

4.5.4 Leakage tests.

4.5.4.1 External leakage - It may not be necessary to run a special test for external leakage, but during the course of all the tests listed in this specification, external leakage, through seals at any other point, shall be no greater than specified in the detail specification. Leakage exceeding the maximum allowable shall be cause for rejection.

4.5.4.2 Internal leakage - These tests 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, and working pressure for a period of 30 minutes each unless otherwise specified in the detail specification. The leakage measurement shall begin 2 minutes after the application of the required pressure. The component shall be actuated between pressure applications. The rates of leakage shall not exceed those specified in the detail specification. During the first 2 minutes of each test, the leakage shall rapidly decrease from the flow condition to the rate in the fully seated condition. The setup used for leakage testing and the means of accumulating leakage shall be fully described in the test report.

4.5.4.2.1 Quality conformance leakage tests - These tests shall be performed with the component held in the position most conducive to leakage. Pressure of 5 psi and working pressure shall be held for a period of 5 minutes each unless otherwise specified in the detail specification. In each case the leakage measurement shall consist of the last 3 minutes of the 5-minute period. The rate of leakage shall not exceed that specified in the detail specification. The setup used for leakage testing and the means of accumulating leakage shall be fully described in the test report.

4.5.5 Pressure drop - Pressure drop characteristics for a flow range of 0 to 150 percent of rated flow, as specified in the detail specification, shall be determined for the component. The pressure drop shall not exceed the value permitted by the applicable specification. The setup used for pressure drop testing shall be fully described in the test report.

4.5.6 Extreme temperature functioning tests.

4.5.6.1 Low temperature - The component shall be connected to a low pressure, or rated working pressure, 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 two times. Variation of actuating forces or regulation, as applicable, shall not exceed that permitted by the detail specification. The quality conformance tests for leakage shall be performed after each actuation, and the requirements of the detail specification satisfied.

4.5.6.2 Intermediate temperatures - Immediately following the low temperature test (4.5.6.1), 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.

4.5.6.3 High temperature - The temperature shall be maintained at 160° F for a length of time sufficient to allow all parts of the component to attain the temperature. The component shall then be actuated at least two times at 160° F. In the case of pressure actuation or regulation, the variation from room temperature actuation or regulation shall not exceed that permitted by the detail specification. The quality conformance tests for leakage (4.5.4) shall be performed after each actuation, and the requirements of the detail specification satisfied.

4.5.6.4 Temperature limits - The solenoids shall be subjected to high and low temperature tests Procedure II of Specification MIL-E-5272.

4.5.7 Temperature rise - Twenty-eight V, dc solenoids shall be tested at 29V, dc, and 115V ac solenoids shall be tested at 122V, as specified in the detail specification. The dc test source shall be used to measure coil resistance prior to and immediately after operation at 122V ac. The dc resistance measurements shall be used to determine temperature rise.

4.5.8 Endurance - The component shall be subjected to

cyclic operation and, where applicable, other fatigue tests, such as pneumatic impulse, in accordance with the detail specification, which shall indicate number of cycles, schedule of cycling, cycle rate, stroke, rate of flow, loads, temperature, impulse peaks, etc. When applicable, leakage and function 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.

4.5.8.1 Aircraft applications - The number of cycles selected shall be applicable to the duty cycle over the anticipated life of the particular aircraft, but shall be not less than the values specified in Table III, which is presented as a general guide.

4.5.9 Vibration - Components that are adversely affected by vibration shall be subjected to vibration test Procedure XII of Specification MIL-E-5272, or as specified in the detail specification. Any functional adjusting device, unless provided with a positive mechanical method of securing, which is acceptable to the procuring activity, shall be completely loosened and retightened 15 times, or as specified in the detail specification, and adjusted to the most critical pressure setting prior to conducting the vibration test.

TABLE III

ENDURANCE TEST

Type of usage of component	Cycles
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, steering, antiskid, etc.	(See detail specification)

4.5.10 Humidity - Moisture resistance shall be established by humidity test Procedure I of Specification MIL-E-5272. At the conclusion of this test, the component shall operate normally through 25 cycles at rated voltage. The solenoids shall be subjected to the dielectric strength test specified in 4.5.14.

4.5.11 Fungus - Components with electrical elements shall be subjected to fungus resistance test in accordance with Procedure I of Specification MIL-E-5272.

4.5.12 Sand and dust - The components shall be subjected to sand and dust test Procedure I of Specification MIL-E-5272. This test may be omitted if all moving parts of the component are exposed only to internal pneumatic media.

4.5.13 Salt fog - The components shall be subjected to salt fog test Procedure II of Specification MIL-E-5272, only if required by the detail specification covering the component. The dielectric strength test (4.5.14) shall be performed if required after the salt fog test.

4.5.14 Dielectric strength - If the dielectric test follows the humidity test or the salt fog test, the solenoids shall be baked for 6 hours at a maximum ambient temperature as specified in the detail specification prior to being subjected to the dielectric test. All solenoids shall be subjected to a test voltage of not less than 1,500V rms at a commercial frequency of 60 cps for 1 minute between terminals and case at maximum operating temperature of the solenoid.

4.5.14.1 Subsequent dielectric tests on assembled pneumatic component or dielectric test after environment test on the solenoid shall be performed at 75 percent of the above voltages for 1 minute. Flashover or failure of leakage current to stabilize shall constitute a failure. There shall be no distinction between test voltage on prototype and production units.

4.5.15 Reliability - Tests shall be conducted to demonstrate compliance with reliability requirements, including MTBF, as specified in the detail specification.

4.6 Test methods - Type II components - In general, the test methods described for Type I components specified in 4.5.1, 4.5.4, and 4.5.5 shall also apply to Type II components. Extreme temperature functioning tests specified in 4.5.6, shall also apply for Type II components, except that the test specified in 4.5.6.3 shall be conducted at 275° F instead of 160° F. Proof pressure and burst pressure tests shall be conducted as specified in 4.5.3.1 and 4.5.3.2, except that the component temperature shall be maintained at 275° F.

4.6.1 The endurance tests of Type II components shall be governed by the following general test cycle, as well as the test methods for Type I components specified in 4.5.8. The following tests shall be performed in the sequence indicated:

General test cycle - Type II components:

(a) Soak for a period of 72 hours at a temperature of 275° F and atmospheric pressure.

(b) Conduct the test specified in 4.5.3.1 at 275° F.

(c) Conduct the test specified in 4.5.6.1 at -65° F for a minimum of 10 cycles. Test specimen to remain at -65° F for at least 4 hours prior to conducting test. Increase in temperature during the test owing to operation is permitted.

(d) Immediately following the test specified in 4.5.6.1 at -65° F, warm test arrangement rapidly to 275° F and actuate component at increments of approximately 70° F to determine satisfactory operation. (Test same as 4.5.6.2, except for temperature.)

(e) Conduct the test specified in 4.5.6.3 at 275° F for a minimum of 10 cycles.

(f) Conduct 25 percent or more of the cycles of the test specified in 4.5.8 at 275° F.

(g) Soak component at 275° F for 2 hours. Pressure is to be maintained during the first hour and reduced to approximately zero psi for the second hour.

(h) Repeat the low temperature test specified in 4.5.6.1, at -65° F and the intermediate and high temperature tests specified in 4.5.6.2 and 4.5.6.3, at 70° F to 120° F.

(i) Conduct 75 percent of the cycles of the test specified in 4.5.8 at 225° F.

(j) Repeat the low temperature test (4.5.6.1). At the conclusion of this test, the component shall operate satisfactorily and leakage shall not be excessive. The component shall be disassembled and carefully inspected; there shall be no evidence of excessive wear in any part.

4.7 Packaging, packing, and marking - Preparation for delivery shall be inspected for conformance to section 5.

5. PREPARATION FOR DELIVERY

5.1 Preservation, packaging, and packing - Preservation, packaging and packing requirements shall be as specified in the detail specification or by the procuring activity.

5.2 Marking - In addition to any special marking required by the contract or order, or the detail specification, interior packages and exterior shipping containers shall be marked in accordance with Standard MIL-STD-129.

5.2.1 Reinspection marking - Reinspection marking shall be as specified by the procuring activity.

6. NOTES

6.1 Intended use - Aircraft pneumatic components are intended for use in aircraft pneumatic systems conforming to Specification MIL-P-5518.

6.2 Definition - For the purpose of this specification, the term "component" is used to mean a valve, actuating cylinder, or similar device of a pneumatic system. A standard component is one that is assigned an MS or AN part number upon meeting all the requirements for the component in the applicable Government document.

Custodians:
Navy - AS
Air Force - 11

Preparing activity:
Navy - AS

Reviewer activity:
Navy - AS
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User activity:

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SPECIFICATION MIL-P-8564D PNEUMATIC SYSTEM COMPONENTS, AERONAUTICAL, GENERAL SPECIFICATION FOR

ORGANIZATION

CITY AND STATE

CONTRACT NUMBER

MATERIAL PROCURED UNDER A

☐ DIRECT GOVERNMENT CONTRACT ☐ SUBCONTRACT

1. HAS ANY PART OF THE SPECIFICATION CREATED PROBLEMS OR REQUIRED INTERPRETATION IN PROCUREMENT USE?

A. GIVE PARAGRAPH NUMBER AND WORDING.

B. RECOMMENDATIONS FOR CORRECTING THE DEFICIENCIES

2. COMMENTS ON ANY SPECIFICATION REQUIREMENT CONSIDERED TOO RIGID

3. IS THE SPECIFICATION RESTRICTIVE?

☐ YES ☐ NO *(If "yes", in what way?)*

4. REMARKS *(Attach any pertinent data which may be of use in improving this specification. If there are additional papers, attach to form and place both in an envelope addressed to preparing activity)*

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