

MIL-V-19593 (Aer)  
31 July 1956

MILITARY SPECIFICATION

VALVE-CONTROL, AIRCRAFT PNEUMATIC  
28 VOLT D-C SOLENOID OPERATED

This specification has been approved  
by the Bureau of Aeronautics, Department of the Navy

1. SCOPE

1.1 Scope.- The complete specification for solenoid operated pneumatic control valves consists of this specification which covers details pertinent to solenoid operated pneumatic control valves to be actuated by 28 volt d-c aircraft electrical systems, the Pneumatic Components, Aeronautical-General Specification for, MIL-P-8564A(ASG) which covers general requirements common to all components for use in high pressure aircraft pneumatic systems, and the Solenoid, Electrical, General Specification for, MIL-S-4040 which covers general requirements common to electrical solenoids. A solenoid operated valve, within the meaning of this specification, is an electrically operated pneumatic valve, for controlling the direction of flow of air.

1.2 Classification.- Solenoid valves shall be furnished in the following classes and sizes:

Class I - This class shall be normally closed (with zero voltage on the solenoid) so that pressure on the inlet port is blocked and the flow of air is from the outlet port to the vent port when the outlet port is pressurized.

Class II- This class shall be normally open (with zero voltage on the solenoid) so that the flow of air is from the inlet port to the outlet port with no flow from the outlet port to the vent port, when the inlet port is pressurized.

Sizes:

Size -4- The inlet, outlet, and vent ports shall be threaded for - 4 tube connections.

Size -6- The inlet, outlet, and vent ports shall be threaded for - 6 tube connections.

Size -8- The inlet, outlet, and vent ports shall be threaded for - 8 tube connections.

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:

SPECIFICATIONS

MILITARY

MIL-P-8564A(ASG)	Pneumatic Components, Aeronautical-General Specification for Pneumatic Systems; Design, Installation and tests in Aircraft
MIL-S-4040	Solenoid, Electrical, General Specification for

(When requesting specifications, standards, drawings, and publications refer to both title and number. Copies of this specification and applicable specifications may be obtained upon application to the Commanding Officer, Naval Aviation Supply Depot, Philadelphia 11, Pennsylvania, Attention Code ODPT)

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3. **REQUIREMENTS.-** The requirements listed in Section 3 of specifications MIL-P-8564A (ASG) and MIL-S-4040 are applicable to this specification.

3.1 **Voltage.-** The solenoid valve shall be designed for continuous duty on 28 volt d-c aircraft electrical systems. When any voltage between 18 and 30 volts d-c is used to energize the solenoid, the solenoid shall develop sufficient force to actuate the valve, as specified herein, for any operating pressure from 25 to 3000 psig.

3.2 **Manual Override.-** The solenoid valve shall have incorporated in it a push-button manual override feature such that, under all conditions of operation, mechanical energy may be substituted for electrical energy to actuate the valve.

3.3. **Performance.-** The solenoid valve shall satisfy the requirements of the performance tests specified in Section 4.

#### 4. QUALITY ASSURANCE PROVISIONS

4.1 The provisions contained in Section 4 of specification MIL-P-8564A(ASG) are applicable to this specification. Pending the issuance of a military standard envelope drawing, however, approval by the procuring activity, for the use of solenoid valves in military aircraft, will be based on the acceptability of drawings and reports of preproduction tests conducted by the manufacturer in conformance with the requirements of paragraph 4.2.1.3 of specification MIL-P-8564A(ASG) except that the manufacturer shall conduct all tests on both specimens.

Preproduction tests shall be performed in the following order:

1. Examination of Product (MIL-P-8564A(ASG))
2. Plastic Parts (MIL-P-8564A(ASG))
3. Proof Pressure Test
4. Capacity Test
5. Leakage Test
6. Functional Test
7. Force Test
8. Response Time Test
9. Electrical Resistance Test
10. Temperature Rise Test
11. Extreme Temperature Tests
12. Endurance Test
13. Dielectric Strength Test
14. Burst Test

Acceptance tests shall be performed in the following order:

1. Examination of Product (MIL-P-8564A(ASG))
2. Proof Pressure Test for Acceptance
3. Leakage Test for Acceptance
4. Functional Test for Acceptance
5. Electrical Resistance Test
6. Dielectric Strength Test for Acceptance

4.2 **Proof Pressure Test.-** Apply a pneumatic pressure of 4,500 psi to the inlet and vent ports of the solenoid valve with the outlet port plugged and hold for five minutes. There shall be no evidence of failure or permanent set.

4.2.1 **Proof Pressure Test for Acceptance.-** This test shall be conducted in a manner similar to the Proof Pressure Test except that the pressure shall be held for only one minute.

4.3 **Capacity Test.-** The capacity from inlet to outlet and also from outlet to vent, for each size solenoid valve shall be denoted by the flow factor F and shall be at least that noted below:

Size	Flow Factor
-4	0.25
-6	0.70
-8	1.20

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The flow factor  $F$  is the value of  $Q_u$  when the downstream absolute pressure is one-half the upstream absolute pressure.  $Q_u$  is defined as the flow in SCFM (Cubic feet per minute of standard air) divided by the upstream pressure in psia. Standard air is dry air at 69°F temperature, 14.7 psia, pressure, and weighing 0.075 lbs./cu. ft. (density).

A typical setup for this test is shown in figure 1. A more detailed drawing of the entrance and exit measuring sections is shown in figure 2. This test is to be performed with standard AN flared tube fittings in the inlet, outlet, and vent ports of the solenoid valve. Determine the flow in  $Q_u$  from the inlet to the outlet of the solenoid valve when the downstream absolute pressure is one-half of the upstream absolute pressure. This test shall also be performed with the flow from the outlet to the vent of the solenoid valve.

4.4 Leakage Test.- Apply a pneumatic pressure of between 2800 and 3000 psig to the inlet port of the solenoid valve in its normal position (with zero voltage on the solenoid) and the outlet port plugged. After allowing one (1) minute for stabilization, determine the internal leakage and external leakage during a five minute period. Repeat the above procedure with the solenoid valve in its actuated position (with 28 volts across the solenoid). Reduce the applied pressure to zero gage before deenergizing the solenoid. Deenergize the solenoid and apply a pneumatic pressure of 5 psig to the inlet port of the solenoid valve with the outlet port plugged. After allowing one (1) minute for stabilization, determine the internal leakage and external leakage during a five minute period. The internal leakage shall not exceed 3 cc. per minute (standard air) and the external leakage shall not exceed 3 cc. per hour (standard air).

4.4.1 Leakage Test for Acceptance.- This test shall be performed similar to the Leakage Test except that the only applied pressure shall be between 2800 and 3000 psig, the time allowed for stabilization may be reduced to 30 seconds and the period during which the leakage is measured may be reduced to one (1) minute.

4.5 Functional Test.- Apply a pneumatic pressure of 25 psig to the inlet port of the solenoid valve with a closed volume at the outlet port. Operate the solenoid valve electrically with applied voltages of 18, 24, and 30 volts for 3 cycles at each voltage, and operate the solenoid valve manually for 3 cycles for a total of 12 cycles. Repeat the above procedure with applied pneumatic pressures of 1500 psig and between 2800 and 3000 psig. There shall be no apparent malfunction of the solenoid valve during this test.

4.5.1 Functional Test for Acceptance.- This test shall be performed similar to the Functional Test except that the only applied pressure shall be between 2800 and 3000 psig.

4.6 Force Test.- Apply a pneumatic pressure of between 2800 and 3000 psig to the inlet port of the solenoid valve with a closed volume at the outlet port. Apply a steadily increasing measured mechanical force to the manual override of the solenoid valve until it actuates. Record the force necessary to actuate the solenoid valve. The force shall not exceed 15 pounds and there shall be no apparent malfunction of the solenoid valve.

4.7 Response Time Test.- This test shall be performed using 28 volts D.C. to energize the solenoid. Apply a pneumatic pressure of between 2800 and 3000 psig to the inlet port of the solenoid valve in the normal position with a pressure pickup attached to the outlet port by less than one (1) foot of tubing. The line shall be plugged beyond the pressure pickups. Actuate the solenoid valve electrically and determine the time between the initial voltage change and the start of flow. Then deenergize the solenoid and determine the time between the initial voltage change and the start of flow. The response time in either case shall not exceed 0.05 seconds.

4.8 Electrical Resistance Test.- Determine the electrical resistance of the solenoid with the solenoid armature in its normal position and with the armature in its actuated position. The resistance shall be no less than 10 ohms in either position.

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4.9 Temperature Rise Test.- This test shall be conducted in still air and at an ambient temperature between 68°F(20°C) and 95°F(35°C). The resistance of the solenoid with the armature in the actuated position shall be determined at the ambient temperature. Apply a test voltage of 30 volts dc continuously to the solenoid for 3 minutes. At the end of the three minute period measure the resistance of the solenoid with the armature in the actuated position and determine the resistance change. This change in resistance due to temperature rise of the solenoid shall not exceed 25 percent of the original value. This corresponds to a temperature rise of 117°F(65°C).

4.10 Extreme Temperature Tests.- Air supplied to the solenoid valve during these tests shall be at approximately the same temperature as the ambient.

4.10.1 Low Temperature Operation.- The solenoid valve shall be maintained in an ambient temperature of less than -65°F(-54°C) for a period of at least 6 hours after the temperature has stabilized. After this period and at this temperature the Leakage Test and the Functional Test shall be performed. The external leakage shall not exceed 6 cc. per hour (standard air) and the internal leakage shall not exceed 6 cc. per minute (standard air). There shall be no apparent malfunction of the solenoid valve.

4.10.2 High Temperature Operation.- The solenoid valve shall be maintained in an ambient temperature of more than 160°F(71°C) for a period of at least 6 hours after the temperature has stabilized. After this period and at this temperature the Leakage Test and Functional Test shall be performed. The external leakage shall not exceed 4 cc. per hour (standard air) and the internal leakage shall not exceed 4 cc. per minute (standard air). There shall be no apparent malfunction of the solenoid valve.

4.11 Endurance Test.- The solenoid valve shall withstand 50,000 cycles of actuation and flow and shall remain within the performance requirements prescribed herein. A typical setup for this test is shown in figure 3. A 15½ cubic inch closed volume is connected to the outlet port and a 10 foot length of tubing is connected to the vent port. Maintain the pressure to the inlet port of the solenoid valve at between 2500 and 3000 psig. Actuate the solenoid valve mechanically every 5th cycle and electrically on the remaining cycles with an applied voltage of 28 volts D.C.

The cycling shall be at a rate of 5 to 20 cycles per minute. The solenoid valve shall be in the open position approximately half of each cycle and in the closed position approximately half of each cycle. The Leakage Test shall be performed at normal temperatures after 25,000, and 40,000 cycles. After 50,000 cycles the Leakage Test, Functional Test, Force Test and Capacity Test shall be performed at normal temperatures. The internal leakage shall not exceed 6 cc. per minute, and the external leakage shall not exceed 3 cc. per hour. The valve shall meet the same performance requirements for the Functional Test, Force Test and Capacity Tests as specified herein for normal temperature operation.

4.12 Dielectric Strength Test.- Apply a test voltage of 1,000 volts, rms, at commercial frequency (60 cps) between the terminals of the solenoid and ground for one (1) minute. (If one lead of the coil is grounded, this connection must be broken before applying the test voltage). Any flashover, or current flow in excess of the normal capacitive reactive current, or noticeable decrease in insulation resistance during or as a result of this test shall constitute a failure.

4.12.1 Dielectric Strength Test for Acceptance.- This test shall be performed similar to the Dielectric Strength Test except that the test voltage shall be applied for one second only.

4.13 Burst Pressure Test.- Apply a hydrostatic pressure of 7500 psig to the inlet and vent ports of the solenoid valve, with the outlet port plugged, at a rate not exceeding 25,000 psi per minute. Hold this pressure for at least 5 minutes. The solenoid valve shall not rupture under this pressure. If desired, the pressure may then be increased until rupture occurs to obtain the actual burst pressure.

## 5. PREPARATION FOR DELIVERY

5.1 General.- The provisions contained in Section 5 of Specification MIL-P-8564A(ASG) form a part of this specification.

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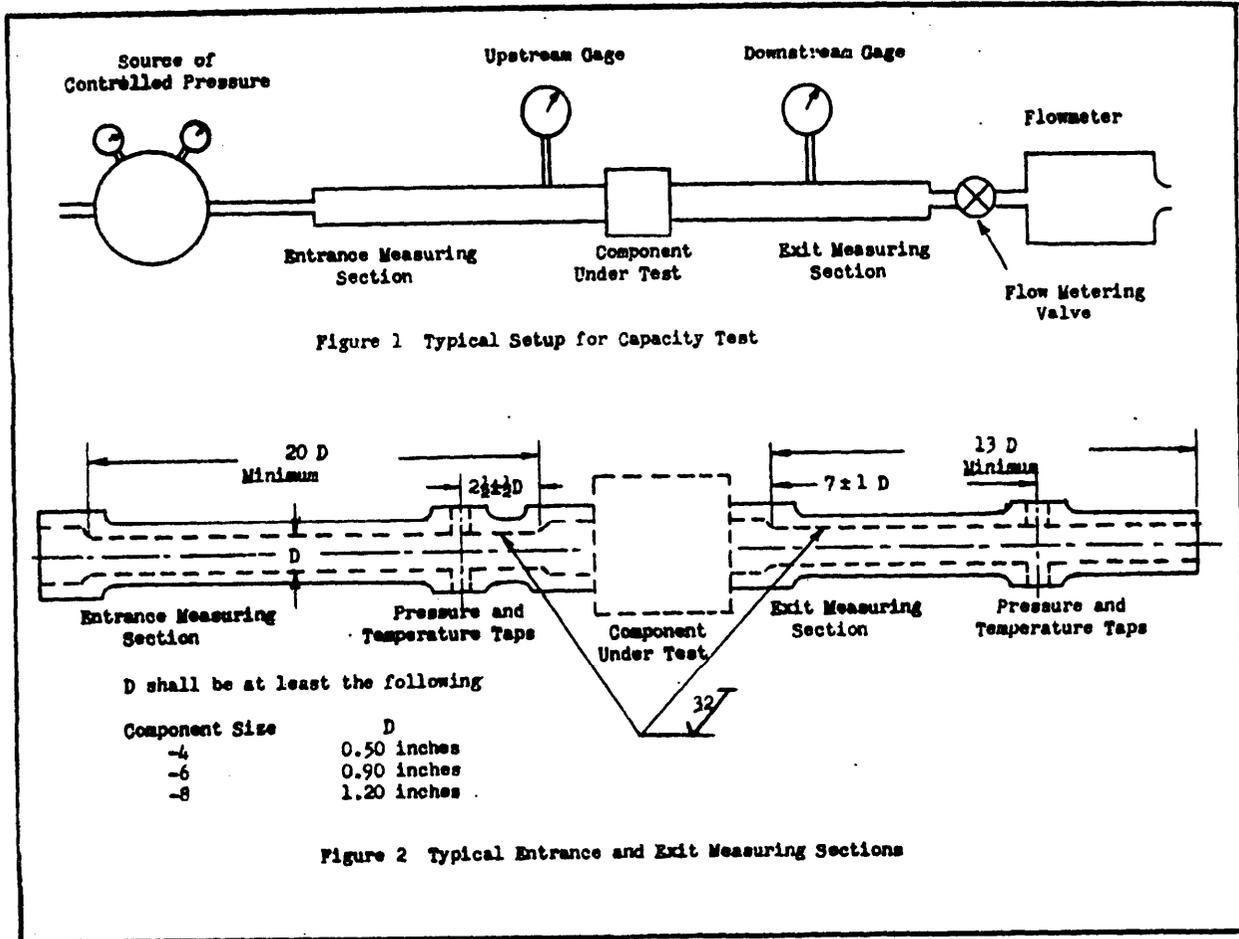
5.1.1 Positive precautions shall be taken to insure that all internal surfaces are clean, dry, and oil free at the time of packaging so as to eliminate the possibility of corrosion.

6. NOTES

6.1 Intended Use.- The valves covered by this specification are intended for use in aircraft pneumatic systems.

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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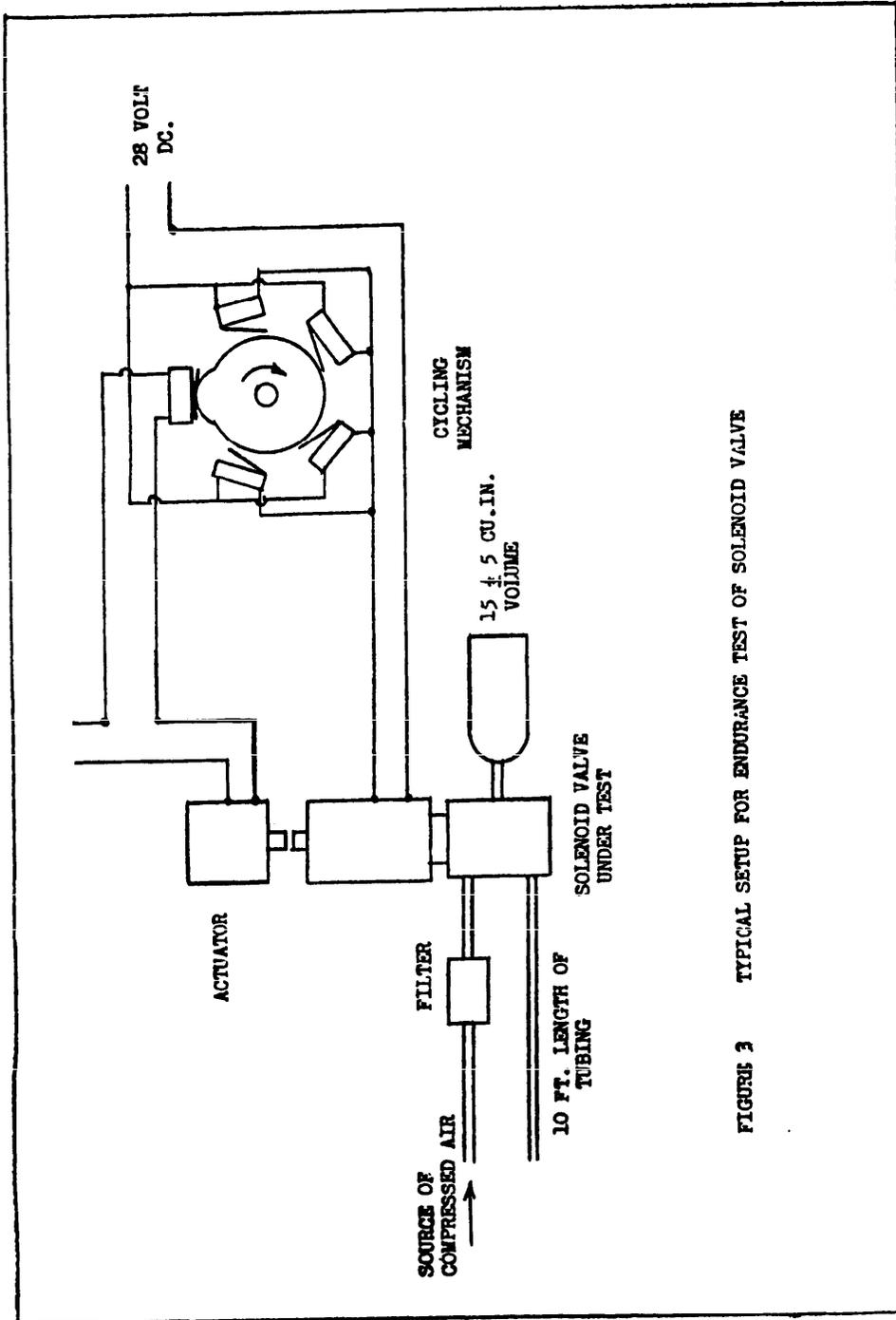


FIGURE 3 TYPICAL SETUP FOR ENDURANCE TEST OF SOLENOID VALVE



SPECIFICATION ANALYSIS SHEET		Form Approved Budget Bureau No. 119-R004	
<b>INSTRUCTIONS</b>			
This sheet is to be filled out by personnel either Government or contractor, involved in the use of the specification in procurement of products for ultimate use by the Department of Defense. This sheet is provided for obtaining information on the use of this specification which will insure that suitable products can be procured with a minimum amount of delay and at the least cost. Comments and the return of this form will be appreciated. Fold on lines on reverse side, staple in corner, and send to preparing activity (as indicated on reverse hereof).			
SPECIFICATION			
ORGANIZATION (Of submitter)		CITY AND STATE	
CONTRACT NO.	QUANTITY OF ITEMS PROCURED	DOLLAR AMOUNT	
		\$	
MATERIAL PROCURED UNDER A			
<input type="checkbox"/> DIRECT GOVERNMENT CONTRACT <input type="checkbox"/> 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?			
<input type="checkbox"/> YES <input type="checkbox"/> 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)			
SUBMITTED BY (Printed or typed name and activity)		DATE	

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