

MIL-V-19068A (ASG)

30 APRIL 1957

Superseding  
MIL-V-19068(Aer)  
20 August 1955

## MILITARY SPECIFICATION

## VALVES, SHUTTLE, HYDRAULIC, AIRCRAFT, TYPE II SYSTEMS

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

## 1. SCOPE

1.1 Scope. - This specification covers hydraulic shuttle valves for use in type II aircraft hydraulic systems conforming to and as defined in Specification MIL-H-5440. The complete specification for these valves consists of Specification MIL-H-8775, which covers general requirements common to all aircraft hydraulic components, and this specification, which includes additional requirements specifically applicable to shuttle valves.

Classification. Shuttle valves shall be furnished in accordance with the following standards as specified, (see 6.3).

Standard MS28766 Direct mounting.  
Standard MS28767 Internal tube thread.

## 2. APPLICABLE DOCUMENTS

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

SPECIFICATIONSMilitary

MIL-H-5440	Hydraulic Systems Design, Installation and Tests of Aircraft (General Specification for)
MIL-V-5529	Valves, Hydraulic Directional Control
MIL-H-8775	Hydraulic System Components Aircraft, General Specification for

STANDARDSMilitary

MS28766	Valve Hydraulic Shuttle, 3,000 PSI, Direct Mounting (Type II Systems)
MS28767	Valve - Hydraulic Shuttle, 3,000 PSI, Internal Thd. Tube Fitting Outlet: (Type II Systems)

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

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## 3. REQUIRMENTS

3.1 General - Hydraulic shuttle valves furnished under this specification shall conform to requirements of Specification MIL-H-8775, except that in case of conflict between the requirements of Specification MIL-H-8775 and this specification, the requirements of this specification shall govern.

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

## 4. QUALITY ASSURANCE PROVISIONS

4.1 General. - The Qualification and Acceptance test provisions contained in section 4 of Specification MIL-H-8775 are applicable to, and form part of this specification.

4.2 Qualification tests. - The Qualification tests described herein under "Qualification test methods" shall be performed on the applicable specimen by the manufacturer and the activity responsible for qualification, in the order as indicated in tables I and II, respectively. Tests may be supplemented with tests under actual service conditions, at the option of the procuring activity.

4.2.1 Requalification. - Qualification approval based on evaluation of handmade samples or models other than normal production samples will be subject to requalification as directed by the procuring activity. The manufacturer shall furnish the activity responsible for qualification full particulars regarding changes in manufacturing processes product design (including component parts thereof), and of resulting changes in performance. Results of tests conducted to prove the acceptability of such changes shall be furnished. Submission of samples for evaluation shall be as directed by the activity responsible for qualification when such changes are made, or when conformance of the product to requirements of this specification is questionable.

4.3 Qualification test methods. -

4.3.1 Examination of product (qualification). - The maximum and minimum clearance specimens shall each be carefully examined to determine conformance with all the requirements of this specification and for any visible defects. The critical clearance dimensions shall be checked and recorded for comparison of results. The dry weight of the assembled valve shall be recorded.

4.3.2 Fluid immersion. - All shuttle valves shall be immersed continuously in hydraulic fluid for a period of 72 hours at a fluid temperature of 275°, prior to conducting the remainder of the Qualification tests specified herein. All internal parts of the valve shall be in contact with the fluid during this immersion. After the 72-hour soak period, the shuttle valve shall remain in the fluid at normal room temperature until ready for test. It shall not be exposed to air internally for any appreciable length of time during the test.

4.3.3 Proof pressure (qualification). - This test shall be performed at a temperature of 275°F. A proof pressure of 4,500 psi shall be applied twice to each inlet port, with the opposite inlet port open to the atmosphere. Pressure shall be held for 2 minutes each time, and the valve shuttle shall be actuated between applications of pressure. There shall be no measurable external leakage, failure, or permanent set.

TABLE I  
Manufacturer's preliminary tests of Qualification test samples

Tests required on specimens					
Maximum clearance specimen			Minimum clearance specimen		
Order of test	Test	Paragraph	Order of test	Test	Paragraph
1	Examination of product (qualification)	4.3.1	1	Examination of product (qualification)	4.3.1
2	Fluid immersion	4.3.2	2	Leakage and shuttling with fluid (acceptance)	4.4.1.3
3	Proof pressure (qualification)	4.3.3	3	Proof pressure (acceptance)	4.4.1.2
4	Washout	4.3.4	4	Extreme temperature functioning	4.3.7
5	Leakage and shuttling with fluid	4.3.5			
6	Air pressure shuttling and leakage	4.3.6			
7	Extreme temperature functioning	4.3.7			
8	Impulse cycling	4.3.8			
9	Endurance cycling	4.3.9			
10	Shuttling against a closed line	4.3.10			
11	Surge-flow shuttling	4.3.11			
12	Pressure drop	4.3.12			
13	Burst pressure	4.3.13			

TABLE II  
Qualification tests

Tests required on specimens				
Maximum clearance specimen		Minimum clearance specimen		
Order of test	Test	Paragraph	Order of test	Test
1	Examination of product	4.3.1	1	Examination of product (qualification)
2	Inspection and comparison of results with those conducted on minimum clearance specimen		2	Fluid immersion
			3	Proof pressure (qualification)
			4	Washout
			5	Leakage and shuttling with fluid
			6	Air pressure shuttling and leakage
			7	Extreme temperature functioning
			8	Impulse cycling
			9	Endurance cycling
			10	Shuttling against a closed line
			11	Surge-flow shuttling
			12	Pressure drop
			13	Burst pressure

4.3.4 Washout.- This test shall be performed within a temperature range of 70° to 120°F, using setup similar to figure 1. A high-surge flow from an accumulator shall be directed twice alternately to one inlet port in the normal flow direction, and then to the outlet port in the reverse flow direction. Sufficient time shall elapse between reversals of flow direction to allow the accumulator pressure to rise to rated pressure. The accumulator shall have a volumetric capacity equal to 400 cubic inches and shall have a preload charge of 1,000 psi. The pump source shall deliver rated flow at rated pressure. The pressure line between the accumulator and the shuttle valve shall be not greater than 4 feet in length, and the return line from the directional control valve to the reservoir shall be not greater than 3 feet in length. The line and fitting sizes shall be not smaller than the corresponding size of the test valve, and pressure drop at rated flow through the directional control valve shall not exceed the maximum allowable value for the corresponding size valve specified in the paragraph titled "Pressure Drop at Rated Flow" of Specification MIL-V-5529. The valve shall be subjected to 109 cycles of flow reversals. The shuttle valve shall also be subjected to this test with the Inlet ports interchanged. The leakage from the open inlet port shall not exceed 1/2 cs per cycle, nor shall there be any washing out of packings or malfunctioning of any part of the valve.

4.3.5 Leakage and shuttling with fluid.- This test shall be performed with a test setup similar to figure 2. Unless otherwise specified, this test shall be conducted with a fluid temperature of 100°F. The outlet port shall be plugged, and the valve so positioned that the unconnected inlet port is down and open to the atmosphere. With the system bled of air, the pump and needle valve shall be operated until the valve shuttles at a flow rate not exceeding 10 cubic inches per minute. Leakage through a single shuttling operation shall not exceed 3 cc. The pressure for shuttling shall be observed and shall be not less than 25 psi, nor greater than 100 psi. A pressure of 5 Psi shall then be applied to the valve for a period of 32 minutes. Leakage in a 30-minute period, following a 2-minute seating period, shall not exceed 1/4 cc. The pressure shall then be raised to rated pressure, and there shall be no leakage in a 30-minute period following a 2-minute seating time. The valves shall also meet the above test requirements with the inlet ports interchanged.

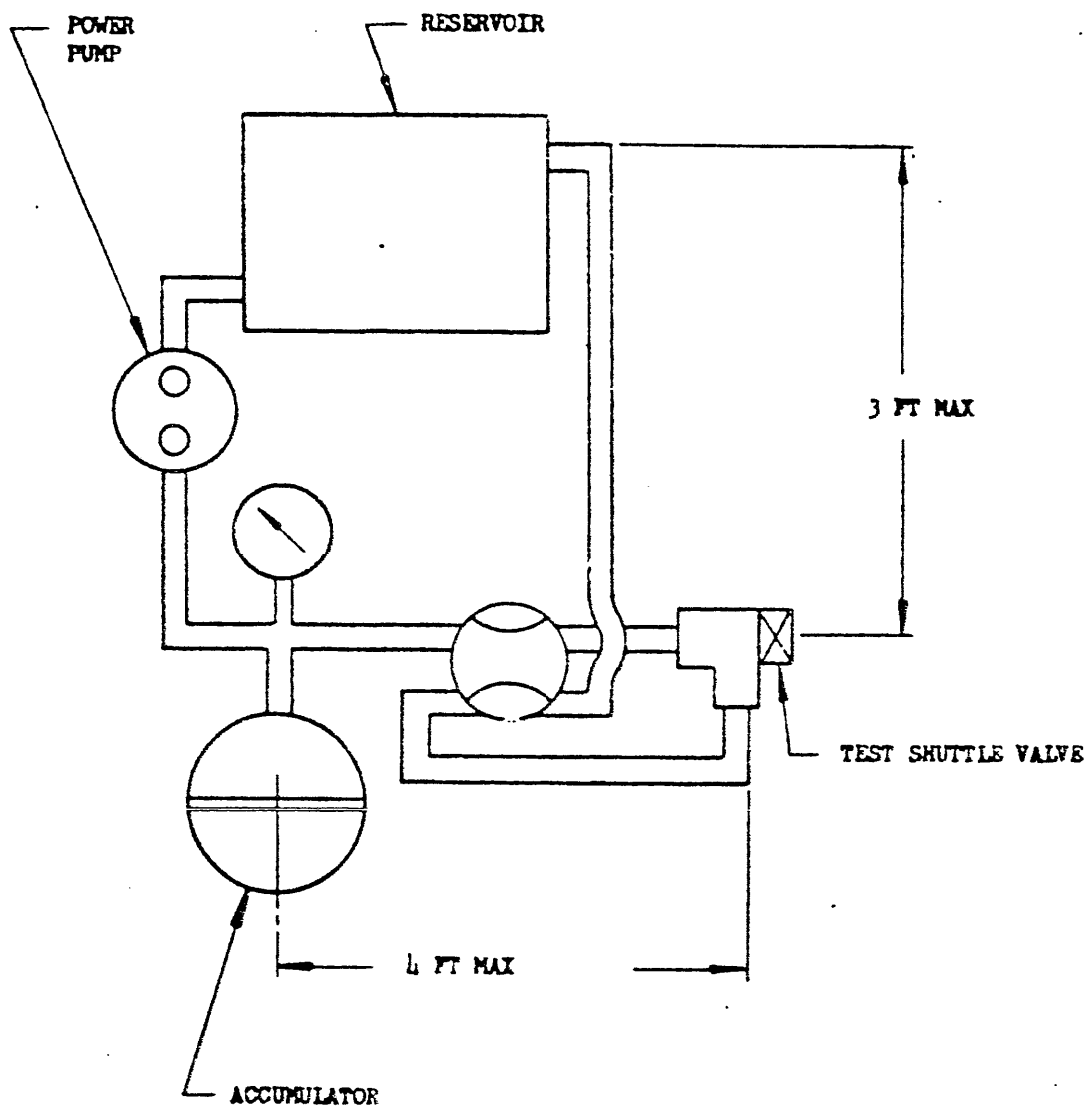
4.3.6 Air pressure shuttling and leakage.- This test shall be performed within a temperature range of 70° to 120°F. The valve shall be set up substantially the same as shown in figure 3. The shuttle valve shall be wet internally, but not filled with hydraulic fluid. With the air pressure reducing valve set at 100 psi, and shutoff valve "A" Closed, the quick-opening type valve "B" shall be opened, and the valve shall shuttle satisfactorily. Leakage of air past the shuttle valve pistons as collected in the graduate, shall not exceed 10 cubic inches of free air per shuttling cycle. The air pressure shall then be adjusted to 15 psi, and the leakage shall not exceed 5 cubic inches of free air per minute. Pressure shall then be raised to 3,000 psi, and the leakage shall not exceed 5 cubic inches of free air per minute.

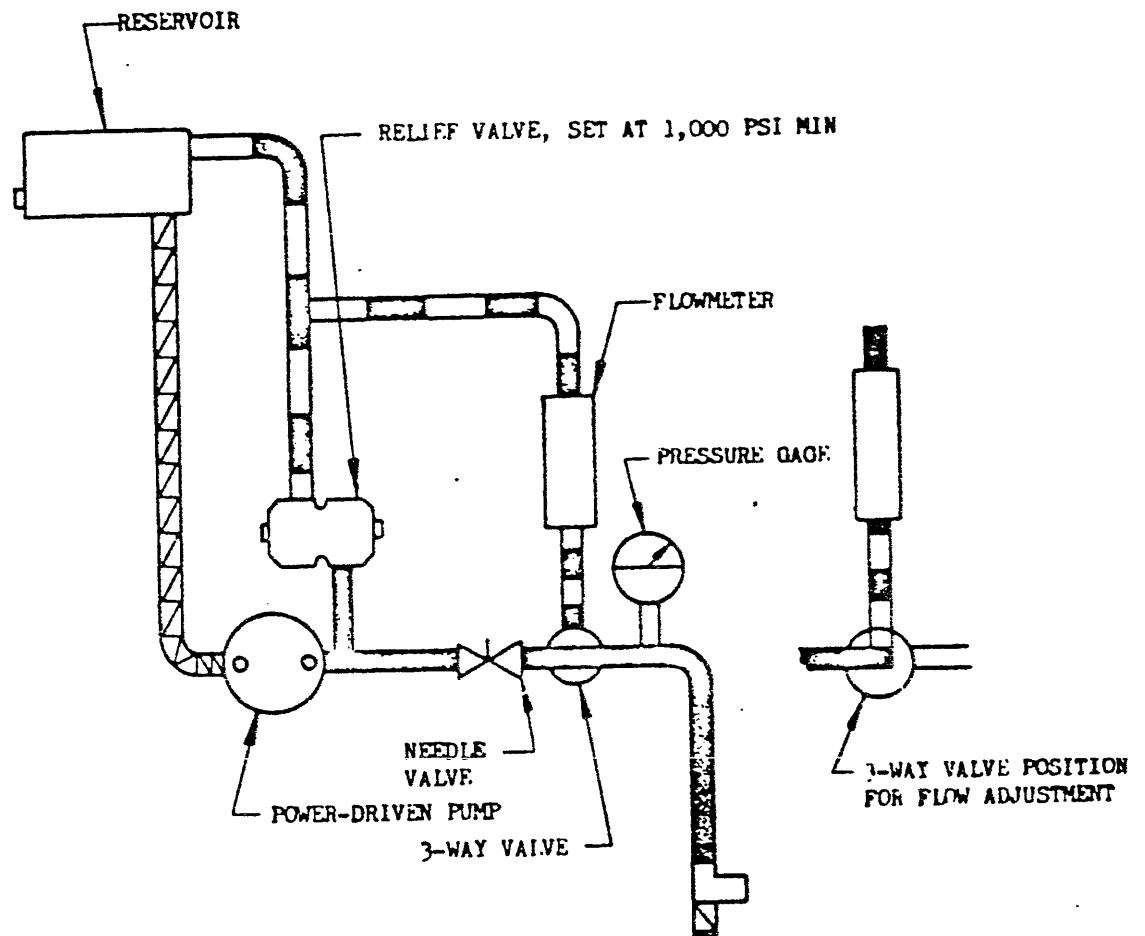
#### 4.3.7 Extreme temperature functioning.-

4.3.7.1 Low-temperature functioning.- With a test setup similar to figure 4, the temperature shall be maintained at not warmer than -65°F for a period of 4 hours. After this period, the valve shall be shuttled at least five times by means of the hand prep. After the fifth actuation, the shuttling pressure and leakage shall then be observed and shall be as specified in 4.3.5 titled Leakage and shuttling with fluid.

4.3.7.2 Rapid warm up.- The low-temperature test setup shall be allowed to warm up rapidly to a temperature of 275°F. While the temperature is being raised and without waiting for the temperature to stabilize throughout the setup, the valve shall be shuttled at approximately 70°-F differentials in ambient temperature and the shuttling pressure shall be observed and shall be as specified in 4.3.5 titled Leakage and shuttling with fluid.

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**FIGURE 1. Setup for packing Washout test**



ADJUST FLOW TO SPECIFIED VALUE, USING NEEDLE VALVE AND FLOWMETER.

FIGURE 2. Setup for Leakage and shuttling with fluid test

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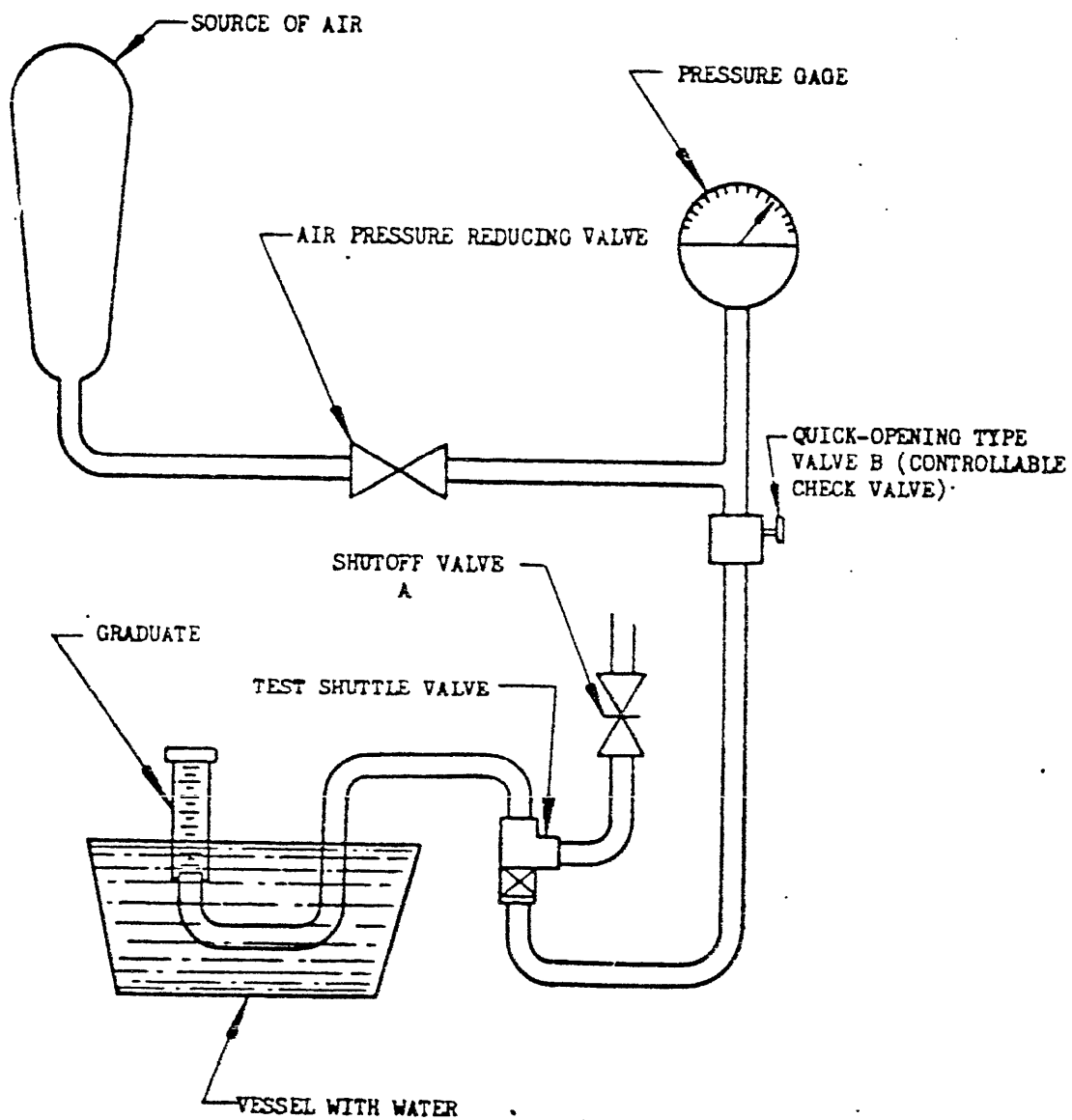


FIGURE 3. Air pressure shuttling and leakage test

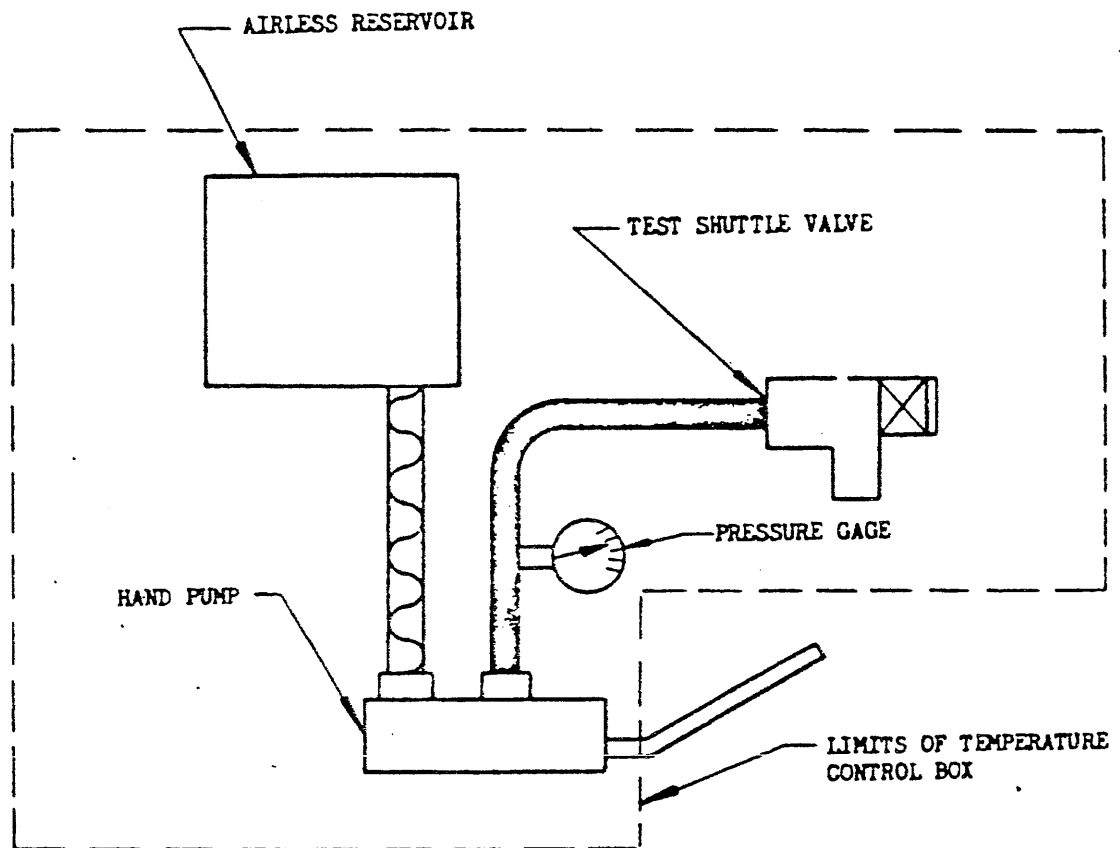


FIGURE 4. Setup for Extreme temperature functioning test

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4.3.7.3 High temperature functioning.- Unless otherwise specified, this test shall be conducted at a temperature of 275°F. The valve shall then be shuttled at least five times by means of the hand pump. After the fifth actuation, the shuttling pressure and leakage shall then be observed and shall be as specified in 4.3.5 titled Leakage and shuttling with fluid.

4.3.8 Impuls cycling. - With a setup similar to figure 5, the shuttle valve shall be subjected to a total of 20,000 cycles or operation at a rate of 35 ± cpm. For each cycle the directional control valve shall alternately apply rated pressure and then a back pressure of 75 psi maximum to one inlet port of the shuttle valve. Of the total number of cycles, 5,000 shall be performed in accordance with the procedure outlined in 4.3.8.1 titled Impulse at high temperature. The balance of 15,000 cycles shall be performed in accordance with the procedure outlined in 4.3.8.2 titled Impulse at intermediate temperature. Surge pressure during the pressure buildup portion of each cycle shall be 150 percent ± 5 percent of rated pressure. During his impulse cycling internal leakage shall be collected at the unconnected inlet port and shall not exceed 1 cc per 100 cycles, and there shall be no measurable external leakage.

4.3.8.1 Impulse at high temperature.. The valve shall be subjected to 5,000 cycles of impulse at a temperature of 275°F. Upon completion of these 5,000 cycles, the valve shall be soaked at a temperature of 275°F for a period of 1 hour with rated pressure applied to the valve. The pressure shall then be relieved to approximately 0, and the valve soaked for a period of 1 hour at a temperature of 275°F. The temperature of the valve shall then be reduced to a range of 70° to 120°F and the test specified in 4.4.1.3 titled Leakage and shuttling with fluid shall be conducted, and the requirements therein shall be satisfied. The temperature of the test setup shall then be lowered to not warmer than -65°F and the test specified in 4.4.1.3 titled leakage and shuttling with fluid shall be conducted, and the requirements therein shall be satisfied.

4.3.8.2 Impulse at intermediate temperatures.- The valve shall then be subjected to 15,000 cycles of impulse at a temperature of 225°F. Upon completion of these 15,000 cycles, the test specified in 4.3.7.3 titled High-temperature functioning shall be conducted at a temperature of 225°F, and the requirements therein shall be satisfied. The temperature of the test setup shall then be reduced to a range of 70° to 120°F and the fluid temperature stabilized at 100°F. The test specified in 4.4.1.3 titled Leakage and shuttling with fluid shall then be conducted, and the requirements therein shall be satisfied.

4.3.9 Endurance cycling.- With a test setup similar to figure 6, the shuttle valve shall be subjected to a total of 2,000 cycles of shuttling at a rate of 35 25 cpm. Shuttling shall be accomplished by operating the directional control valve in such manner as to alternately apply rated pressure to the inlet ports. Surge pressures during the pressure application portion of each cycle shall be 150 percent ± percent of rated pressure. The valve shall be subjected to the first 500 cycles of shuttling at a temperature of 275°F. Upon completion of these cycles, the valve shall be soaked for 1 hour at a temperature of 275°F with rated pressure applied to either inlet. The pressure shall then be relieved, and the valve soaked an additional hour at this temperature. The temperature of the test setup shall then be reduced to a range of 70° to 120°F and the fluid temperature stabilized at 100°F at which the requirements for leakage and shuttling with fluid (4.4.1.3) shall be checked and satisfied. The temperature shall then be reduced to -65°F and the test Leakage and shuttling with fluid (4.4.1.3) again checked and satisfied. The shuttle valve shall then be subjected to 1,500 cycles at a temperature of 225°F. Upon completion of these cycles, the test Leakage and shuttling with fluid (4.4.1.3) shall be conducted at a temperature of 225°F, and the requirements therein shall be satisfied.

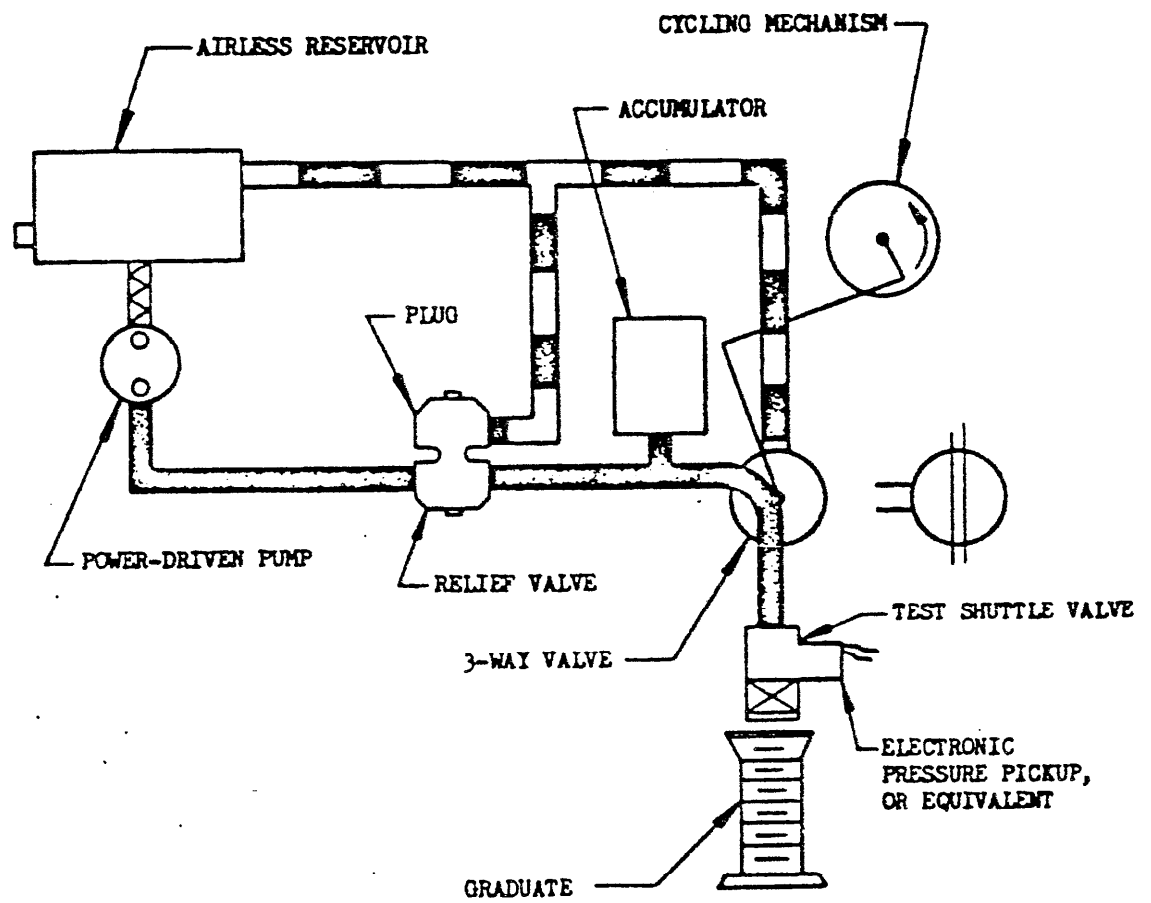
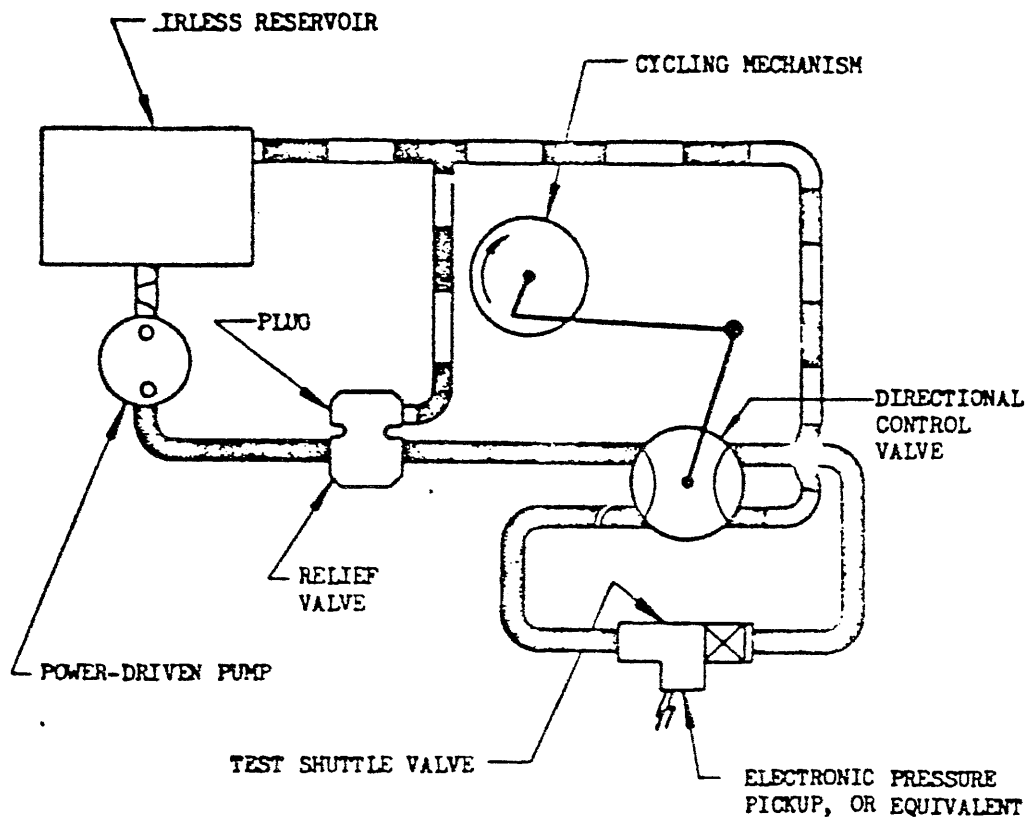


FIGURE 5. Setup for Impulse cycling test

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**FIGURE 6. Setup for Endurance cycling test**

6.3.10 Shuttling against a closed line.- This test shall be performed within a temperature range of 70° to 120°F. The valve shall be set up as shown in figure 7. With shutoff valve "B" and "C" closed, and shutoff valve "A" opens flow shall be directed through the flowmeter until the air is thoroughly bled from the system. Shutoff valve "A" shall be then positively closed, after which the valve shall be reversed from the position shown in order to direct flow to the emergency inlet port on the shuttle valve. The pressure drop from emergency inlet through outlet shall not exceed 10 times the maximum allowable pressure drop at rated flow as indicated in table III. Five seconds shall be allowed before pressure drop reading is taken. This test shall be repeated 20 times.

4.3.11 Surge-flow shuttling. - The surge flow test shall be performed within a temperature range of 70° to 120°F. The shuttle valve shall be set up essentially as shown in figure 7 with shutoff valves "A," "B" and "C" open. The 4-way valve, however, shall be put in a neutral position to permit the buildup of 3,000 hydraulic pressure in the accumulator. The 4-way valve shall then be cycled 20 times. At the end of each shuttling operation or half cycle, the 4-way valve shall be returned to the neutral position to again permit the buildup of 3,000 psi hydraulic pressure in the accumulator. There shall be no malfunctioning of or damage to the valve during this test.

4.3.12 Pressure drop.- This test shall be performed at a fluid temperature of 100°F. Hydraulic pressure sufficient to produce rated flow shall be applied to either of the two inlets, first in the normal flow direction (from inlet to outlet) and then in the reverse direction, from outlet to the same inlet port. This procedure shall then be repeated starting with the opposite inlet. Pressure and rate of flow shall be accurately maintained. A manometer, or suitable pressure gages, connected across the shuttle valve shall be used for accurate measurement of the pressure drop. Pressure drop in both directions shall be measured and shall not exceed the values specified in table III.

TABLE III

## Maximum pressure drop

Valve size	Tube size (in.)	Rated flow capacity (min) gpm	Pressure drop (max) psi
-4	1/4	1.2	10
-6	3/8	3.5	10
-8	1/2	6.0	10
-10	5/8	10.5	10

4.3.13 Burst pressure.- This test shall be performed at a temperature of 275°F. Any suitable fluid may be used for this test. Hydraulic pressure shall be applied to either inlet, with the outlet port plugged, at a rate of approximately 25,000 psi per minute until a pressure of 7,500 psi is obtained. The valve shall withstand this minimum burst pressure for a period of 2 minutes without rupture of internal or external parts.

4.4 Acceptance tests.- Each valve to be furnished under contract shall be examined to determine conformance with the material and design requirements of this specification and shall be subjected to the following tests:

- (a) Examination of product - acceptance (4.4.1.1)
- b Roof pressure - acceptance 4.4.1.2
- c Leakage and shuttling with fluid - acceptance (4.4.1.3)
- d Reverse-flow unseating - acceptance (4.4.1.4)

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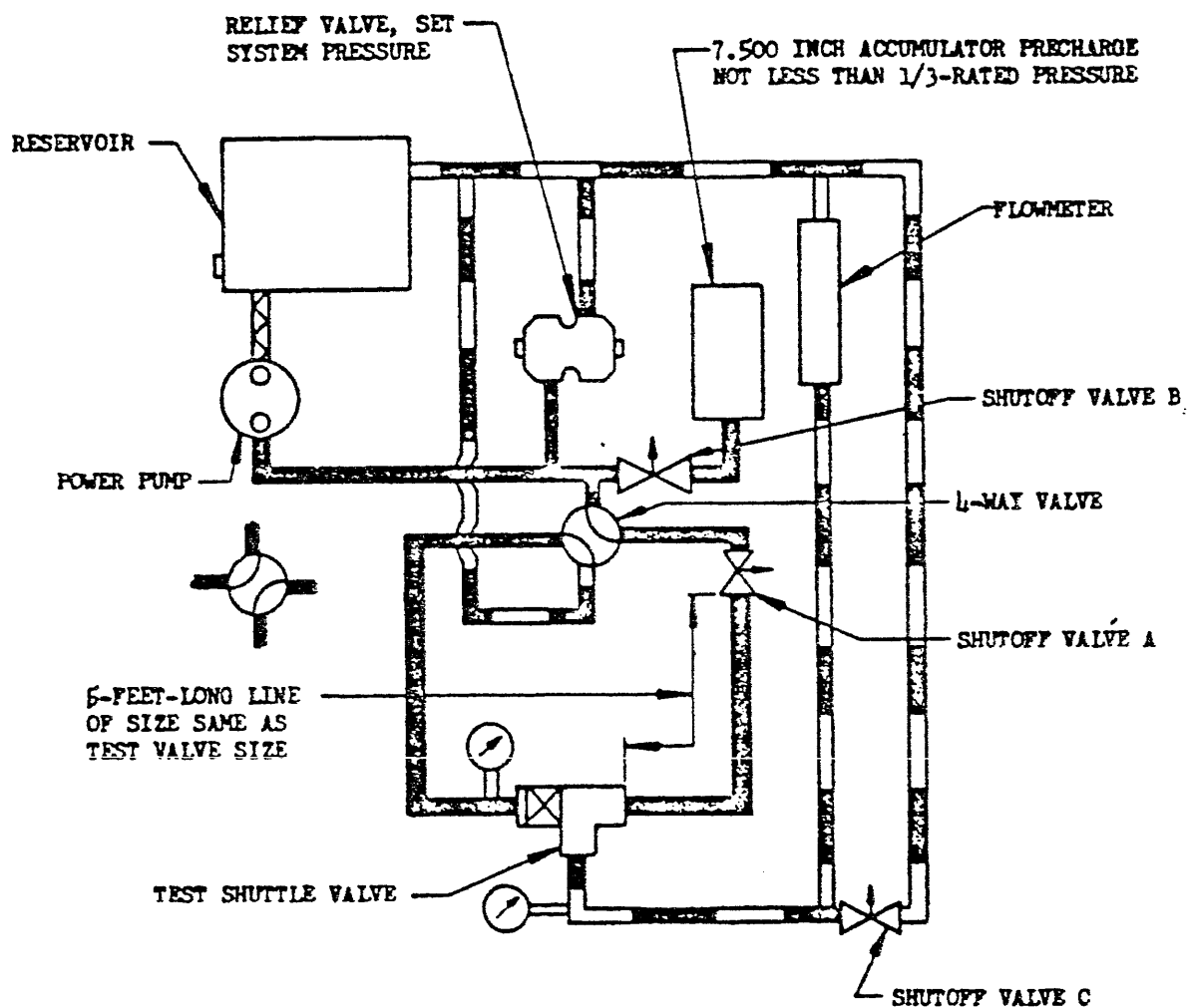


FIGURE 7. Setup for Shuttling against a closed line and Surge-flow shuttling tests

#### 4.4.1 Acceptance test methods.-

4.4.1.1 Examination of product (acceptance).- Each valve shall be carefully examined to determine conformance with the requirements of this specifications design, construction, weight, workmanship, identification of product, conformance to applicable drawings, and for any visible defects. The manufacturer's drawings and the manufacturer's applicable specifications which were submitted when qualification approval was granted, will be used by the Inspector, as necessary, to determine that the product submitted for acceptance under contract is identical to the item as qualified.

4.4.1.2 Proof pressure (acceptance).- A proof pressure of 4,500 psi shall be applied twice to each inlet port, with the opposite inlet port open to the atmosphere. pressure shall be held for 2 minutes each time, and the valve shall be shuttled between applications of pressure. There shall be no measurable external leakage, failure, or permanent set.

4.4.1.3 Leakage and shuttling with fluid (acceptance).- This test, for acceptance shall be conducted with a test setup similar to figure 2. The valve shall be so positioned, with the outlet port plugged that the, unconnected inlet port is down and open to the atmospheres Then with the system bled of air, the pump and needle valve shall be operated until the valve shuttles at a flow rate not exceeding 10 cubic inches per minute. Leakage through a single shuttling operation shall not exceed 3 cc. The shuttling pressure shall be observed and shall be not less than 25 psi, nor greater than 100 psi. A pressure of 5 psi shall then be applied to the valve for a period of 8 minutes, and the leakage observed during the final 6 minutes after a 2-minute seating period shall not exceed one drop. The pressure shall be raised to rated pressure, and there shall be no leakage when measured over a period of not less than 5 minutes. The leakage measurement period shall begin 3 minutes after application of the pressure, to allow the valve to seat. The valves shall also meet the 1 bov test requirements with the inlet ports interchanged.

4.4.1.4 Reverse-flow unseating (acceptance).- Three times the rated flow of the valve shall be applied in a reverse direction discharging through the open inlet port. During the test, the shuttle shall not unseat, and the leakage out of the opposite inlet port shall not exceed 1/2 cc (10 drops) Per minute.

#### 5. PREPARATION FOR DELIVERY

5.1 General.- The provisions contained in section 5 of Specification MIL-H-8775, as applicable, form a part of this specification.

5.2 Marking of shipments.- In addition to the marking of shipments identification specified in Specification MIL-H-8775, the following shall be added:

MS Part No.  
Manufacturer's Part No.

#### 6. NOTES

6.1 General.- The notes contained in section 6 of Specification a part of this Specification.

6.2 Intended use.- The valves covered by this specification are intended for use in aircraft type II hydraulic systems conforming to and as defined in Specification MIL-H-5440

6.3 Ordering data. - Procurement documents should specify the MS Part No. of the valve required. (See 1.2.)

6.4 Provisions for qualification.- With respect to products requiring qualification, awards will be only for such products as have, prior to the bid opening date, been tested and approved for inclusion in the applicable Qualified Products List whether or not such products have actually been so listed by that date.

6.4.1 The attention of suppliers is called to this requirement, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government, tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. Request for information pertaining to qualification of products covered by this specification should be addressed to the Bureau of Aeronautics Navy Department, Washington 25, D. C., the activity responsible for qualification, with a copy to the Commander, Wright Air Development Center, Wright-Patterson Air Force Base, Ohio.

NOTICE: When Government drawings, specification, 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.

Custodians:

Navy - Bureau of Aeronautics  
Air Force

Preparing activity:

Navy - Bureau of Aeronautics