INCH-POUND

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DETAIL SPECIFICATION

VALVES, SHUTTLE, HYDRAULIC, AIRCRAFT, TYPE II SYSTEMS

INACTIVE FOR NEW DESIGN AFTER 25 AUGUST 1998

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

1. SCOPE

1.1 Scope. This specification covers shuttle valves for use in aircraft hydraulic systems operating at 3000 psi pressure and temperature range from -65 to +275 ^{o}F.

1.2 Classification. Shuttle valves are furnished of the following types (see 6.2).

Type I - Direct Mounting (MS28766-Valve)

Type II - Internal-Thread, Tube Fitting Outlet (MS28767-Valve)

Comments, suggestions, or questions on this document should be addressed to the Commander, Naval Air Warfare Center Aircraft Division, Code 491000B120-3, Highway 547, Lakehurst, NJ 08733-5100 or emailed to 4Hthomas.omara@navy.mil. Since contact information can change, you may want to verify the currency of this address information using the Assist Online database at http://assist.daps.dla.mil.

2 APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements of documents cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications and standards. The following specifications and standards form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-PRF-5606	-	Hydraulic Fluid, Petroleum Base, Aircraft, Missile and Ordnance (Inactive for new design)
MIL-S-7742	-	Screw Threads, Standard, Optimum Selected Series: General Specification For (Inactive for new design)
MIL-A-8625	-	Anodic Coatings For Aluminum and Aluminum Alloys
MIL-PRF-83282	-	Hydraulic Fluid, Fire Resistant, Synthetic Hydrocarbon Base, Metric NATO Code Number H537
MIL-PRF-87257	-	Hydraulic, Fluid, Fire Resistant, Low Temperature Synthetic Hydrocarbon Base, Aircraft and Missile

DEPARTMENT OF DEFENSE STANDARDS

AND10050	-	Bosses, Standard Dimensions for Gasket Seal Straight Thread
AND10387	-	Drill Sizes and Drilled Hole Tolerances-Twist (Inactive for new design)
MS28766	-	Valve, Shuttle, Hydraulic, Direct Mounting, 3,000 PSI, Type II Systems (Inactive for new design)
MS28767	-	Valve, Shuttle, Hydraulic, Internal Thread, Tube Fitting Outlet, 3,000 PSI, Type II Systems (Inactive for new design)

(Copies of these documents are available online at http://assist.daps.dla.mil/quicksearch/ or http://assist.daps.dla.mil or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.2.2 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME) INTERNATIONAL

ASME-B46.1	-	Surface Texture (Surface Roughness, Waviness and Lay). (DoD adopted)

(Copies of this document are available from http://www.asme.org or the American Society of Mechanical Engineers, 3 Park Avenue, New York, NY 10016-5990).

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE)

SAE-AMS-2700	-	Passivation Of Corrosion Resistant Steels
SAE-AS4395	-	Tube Connection, Fitting End; Flared Design Standard (DoD adopted)
SAE-AS5440	-	Hydraulic Systems, Aircraft, Design and Installation Requirements for (DoD adopted)
SAE-AS8775	-	Hydraulic Systems Components, Aircraft and Missiles, General Specification for (DoD adopted)
SAE-AS28775	-	Packing, Preformed, Hydraulic, + 275 ^{o}F (O-ring) (DoD adopted)

(Copies of these documents are available online at http://www.sae.org or the Society of Automotive Engineers World Headquarters, 400 Commonwealth Drive, Warrendale, PA 15096-0001.)

2.3 Order of precedence. In the event of a conflict between the text of this document and the references cited herein (except for related specification sheets), the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3 REQUIREMENTS

3.1 General. Hydraulic shuttle valves furnished under this specification shall conform to the requirements of this specification and SAE-AS8775.

In case of conflict between the requirements of this specification and SAE-AS8775, the requirements of this specification shall govern.

3.2 Specification sheets. The individual item requirements shall be as specified herein and in accordance with the applicable specification sheets. In the event of conflict between the requirements of this specification and the specification sheet, the latter shall govern.

3.3 First article test. When specified (see 6.2), a sample valve shall be subjected to first article inspection in accordance with 4.4, table I.

3.4 Design and construction. The design and construction of the shuttle valves shall be in accordance with MS28766 for direct mounting and MS28767 for internal threaded tube fitting mounting. The dimensions shall be as shown in the applicable specification sheets.

3.5 O-rings. If O-rings are used, they shall conform to SAE-AS28775 and shall be compatible with hydraulic fluid, fuel, and oil. They shall operate with type II hydraulic systems and shall meet the age requirements specified in that standard. The O-rings shall be installed as specified in SAE-AS28775.

3.6 Materials. Materials shall be as specified on the applicable specification sheets. If no specific material is specified on the specification sheets, the materials shall be selected in accordance with SAE-AS8775. The material selected shall be compatible with hydraulic fluid, light weight, corrosion resistant, and shall meet the performance requirements of this specification.

3.7 Aluminum alloy forging. If aluminum alloy forging is used, it shall be of corrosion resistant type or treated with stress corrosion.

3.8 Nonmetallic parts. All nonmetallic parts used shall be compatible with hydraulic fluids, oil, and fuel.

3.9 Finish. The finish requirements shall be in accordance with the applicable specification sheets. Cadmium plating shall not be used. The finished parts shall have corrosion protection and shall operate in the highly corrosive environment.

3.10 Recycled, recovered, or environmentally preferable materials. Recycled, recovered, or environmentally preferable materials should be used to the maximum extent possible, provided that the material meets or exceeds the operational and maintenance requirements, and promotes economically advantageous life cycle costs.

3.11 Hazardous substances and ozone depleting chemicals. If the tests contain hazardous chemicals, it shall be handled in accordance with Federal regulations and guidelines to perform those tests. For further information about toxic chemicals and hazardous materials list, consult the Environmental Protection Agency at http://www.epa.gov/ebtpages/pollutants.html.

3.12 Performance requirements.

3.12.1 Fluid immersion. The shuttle valve shall not leak, malfunction, or be damaged after immersion continuously for 72 hours in fluid conforming to MIL-PRF-83282, MIL-PRF-5606, or MIL-PRF-87257 as specified in 4.6.2.

3.12.2 Proof pressure. The valve shall not leak, fail, or be permanently damaged after being tested with the proof pressure test as specified in 4.6.3.

3.12.3 Washout. The valve shall not leak more than 10 drops [0.5 cubic centimeter (cc)] per cycle from the open inlet port when tested as specified in 4.6.4. No washout of packing or malfunctioning of any part of the valve during and after the test.

3.12.4 Leakage and shuttling with fluid. The valve shall be designed not to leak more than 0.132 ounce (3 cc) with a single shuttling operation when tested as specified in 4.6.5. The valve shall shuttle between 25 and 100 psi. The valve shall also meet the leakage requirements when tested with the pressures specified in 4.6.5.

3.12.5 Air pressure shuttling and leakage. The free air leakage shall be not greater than 5 cubic inches per minute when tested with air pressure specified in 4.6.6. The valve shall not be damaged or malfunction after the test.

3.12.6 Extreme temperature functioning.

3.12.6.1 Low temperature functioning. The valve shall not leak or malfunction when tested with the fluid at –65 ^{o}F temperature as specified in 4.6.7.1. The shuttling pressure shall be between 25 and 100 psi.

3.12.6.2 Rapid warm up. The valve shall operate without leakage after warming up from –65 to +275 ^{o}F and shall shuttle satisfactorily between 25 and 100 psi when tested as specified in 4.6.7.2.

3.12.6.3. High temperature functioning. The valve shall function with the hydraulic oil at +275 ^{o}F and shall shuttle without leakage when tested as specified in 4.6.7.3.

3.12.7 Impulse cycling. The valve shall not leak internally more than 20 drops (1 cc) per 100 cycles when tested as specified in 4.6.8. There shall be no external leakage. The valve shall not be damaged or malfunction during or after the test.

3.12.7.1 Impulse cycling at high temperature. The internal leakage of the valve shall not be greater than 20 drops (1 cc) per 100 cycles when tested as specified in 4.6.8.1 with the temperature at +275 ^{o}F. The external leakage shall be zero. The valve shall not be damaged and shall shuttle satisfactorily at that temperature.

3.12.7.2 Impulse cycling at intermediate temperature. The internal leakage of the valve shall not be greater than 20 drops (1 cc) per 100 cycles when tested as specified in 4.6.8.2 with a

temperature at +225 ^{o}F and no external leakage. The valve shall not be damaged and shall shuttle satisfactorily at that temperature.

3.12.8 Endurance cycling. The requirements of 3.12.4 shall be met when tested as specified in 4.6.9.

3.12.9 Shuttling against a closed line. When tested in accordance with 4.6.10, the pressure drop of the valve from emergency inlet through outlet shall be not greater than 10 times the maximum allowable pressure drop at rated flow as specified in table II.

3.12.10 Surge flow shuttling. The valve shall not be damaged or malfunction when tested in accordance with 4.6.11.

3.12.11 Pressure drop. The pressure drop of the test shuttle valve shall be as specified in table II when tested in accordance with 4.6.12.

3.12.12 Burst pressure. The valve shall withstand a burst pressure at 7,500 psi for 2 minutes without rupture of internal or external parts when tested in accordance with 4.6.13. There shall be no damage and the valve shall shuttle satisfactorily after the test.

4. VERIFICATION

4.1 Classification of inspections. The inspection requirements specified herein are classified as follows:

a. First article inspection (see 4.4)
b. Conformance inspection (see 4.5)

4.2. Inspection conditions. Unless otherwise specified, all inspections shall be performed in accordance with the conditions specified herein and SAE-AS8775. If the requirements conflict between SAE-AS8775 and this specification, the latter shall govern.

4.3 General. The first article and the conformance tests provisions contained in section 4 of SAE-AS8775 are applicable to and form a part of this specification.

4.4 First article inspection. When specified (see 6.2), the first article tests shall be performed on the applicable specimen by the manufacturer and the activity responsible for the tests in the order specified in table I. Tests may be supplemented with tests under actual service conditions at the option of the acquiring activity. In addition to the first article tests, the manufacturer shall complete an engineering analysis on their valve design showing the valve shall function at the extreme temperature conditions under all maximum and minimum clearance. Include the engineering analysis report with the first article test report submitted for examination and approval.

4.4.1 Test samples. Unless otherwise specified in the contract, the first article test shall be conducted on two samples.

TABLE I. First article tests.

Order of test	Tests	Requirement paragraphs	Test paragraphs
1	Examination of product	-----	4.6.1
2	Fluid immersion	3.12.1	4.6.2
3	Proof pressure	3.12.2	4.6.3
4	Washout	3.12.3	4.6.4
5	Fluid shuttling and leakage	3.12.4	4.6.5
6	Air pressure shuttling and leakage	3.12.5	4.6.6
7	Extreme temperature functioning (a) Low temperature functioning (b) Rapid warm up (c) High temperature functioning	3.12.6 3.12.6.1 3.12.6.2 3.12.6.3	4.6.7 4.6.7.1 4.6.7.2 4.6.7.3
8	Impulse cycling a. Impulse cycling at high temperature b. Impulse cycling at intermediate temperature	3.12.7 3.12.7.1 3.12.7.2	4.6.8 4.6.8.1 4.6.8.2
9	Endurance cycling	3.12.8	4.6.9
10	Shuttling against a closed line	3.12.9	4.6.10
11	Surge flow shuttling	3.12.10	4.6.11
12	Pressure drop	3.12.11	4.6.12
13	Burst pressure	3.12.12	4.6.13

4.4.2 Minimum and maximum clearance analysis. The analysis shall be conducted on two different designs, one to the minimum clearances and the other to the maximum clearances. Conduct the analysis with temperature excursions from room temperature to -65 ^{o}F and from the room temperature to the highest temperature. The analysis shall show forces on all internal components due to thermal expansion and contraction, material property changes and any other factors caused by temperature changes. The analysis report shall include details of any friction or possible binding which might inhibit the valve from functioning over the extremes of temperature. The analysis shall clearly show detail of the design and manufacturing tolerances that are being analyzed.

4.4.3 Test fluid. Unless specified by the acquiring activity (see 6.2), test fluid shall be hydraulic oil in accordance with MIL-PRF-5606, MIL-PRF-83282, or MIL-PRF-87257.

4.5 Conformance inspection. Conformance inspection shall include the acceptance tests as specified in 4.7 and extreme temperature functioning tests as specified in 4.6.7.

4.6 First article method of inspections.

4.6.1 Examination of product. The specimens submitted for the first article tests shall be carefully examined for any visible defects, and to determine conformance with all the requirements of this specification and specification sheets. The dry weight of the assembled valve shall be recorded.

4.6.2 Fluid immersion. Test shuttle valves shall be immersed continuously in hydraulic fluid for a period of 72 hours at a fluid temperature of 275 °F prior to conducting the remainder of the first article tests specified herein. All internal parts and external surfaces 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 room temperature until ready for test. It shall not be exposed to air internally for any appreciable length of time during the test. The valve shall meet the requirements specified in 3.12.1.

4.6.3 Proof pressure. The proof pressure test shall be performed at a fluid 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. The valve shall meet the requirements specified in 3.12.2.

4.6.4 Washout. This washout test shall be performed within a fluid temperature range of 70 to 120 °F using test 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 a 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 shall deliver the test fluid at rated flow at rated pressure as specified in table II. 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. Pressure drop at rated flow through the directional control valve shall be not greater than the maximum allowable value for the corresponding size specified in table II. The valve shall be subjected to 109 cycles of flow reversals. The shuttle valve shall also be subjected to this washout test with the inlet ports interchanged. The leakage shall meet the requirements as specified in 3.12.3.

4.6.5 Leakage and shuttling with fluid. Set up the test similar to figure 2. Unless otherwise specified, conduct the test with a fluid at a temperature of 100 °F. Plug the outlet port and position the 3-way-valve so that the unconnected inlet port is down and open to the atmosphere. With the system bled of air, the power driven pump and needle valve shall be adjusted until the valve shuttles at a flow rate not exceeding 10 cubic inches per minute. Observe the leakage and the leakage shall meet the requirements specified in 3.12.4. The pressure for shuttling shall be observed. It shall be between 25 and 100 psi. A pressure of 5 psi shall then be applied to the valve for 32 minutes. The leakage in a 30-minute period following a 2-minute seating period shall be not greater than 5 drops (.25 cc). The pressure shall then be raised to a rated pressure of 3,000 psi and there shall be no leakage in a 30-minute period following a 2-minute seating time. The valves shall also meet this test requirement with the inlet ports interchanged.

4.6.6 Air pressure shuttling and leakage. Perform the test with air within a temperature range of 70 to 120 ^{o}F. Set up the test valve similar to figure 3. Wet the test shuttle valve internally, but do not fill with hydraulic fluid. With the air pressure reducing valve set at 100 psi, and shutoff valve "A" closed, the quick-opening type valve "B" opened, the valve shall shuttle satisfactorily. Leakage of air past the shuttle valve piston as collected in the graduate shall be not greater than 10 cubic inches of free air per shuttling cycle. Adjust the air pressure to 15 psi, and observe the leakage. Raise the pressure to 3,000 psi rated pressure and check the leakage. The leakage shall meet the requirement specified in 3.12.5.

4.6.7 Extreme temperature functioning.

4.6.7.1 Low temperature functioning. Set up the test similar to figure 4. The temperature shall be maintained at -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 pump. After the fifth actuation, the shuttling pressure and leakage shall be observed and shall meet the requirements specified in 3.12.4.

4.6.7.2 Rapid warm up. The low-temperature test setup shall allow the test fluid 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 meet the requirements specified in 3.12.4.

4.6.7.3 High temperature functioning. Unless otherwise specified, this test shall be conducted at a fluid temperature of 275 ^{o}F. The test 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 meet the requirements specified in 3.12.4.

4.6.8 Impulse cycling. With a test setup similar to figure 5, the shuttle valve shall be subjected to a total of 20,000 cycles of operation at a rate of 35 ± 5 cpm. For each cycle, the directional control valve shall alternately apply a rated pressure of 3,000 psi and then a backpressure of 75 psi maximum to one inlet port of the shuttle valve. Of the total number of 20,000 cycles, 5,000 shall be performed at high temperature in accordance with the procedure specified in 4.6.8.1. The remainder of 15,000 cycles shall be performed at intermediate temperature in accordance with the procedure specified in 4.6.8.2. Surge pressure during the pressure buildup portion of each cycle shall be 150 ± 5 percent of rated pressure. During this impulse cycling, internal leakage shall be collected at the unconnected inlet port. The leakage requirements shall be as specified in 3.12.7.

4.6.8.1 Impulse cycling 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 in hydraulic fluid 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 re-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 conduct the acceptance test leakage and fluid shuttling as specified in 4.7.1.3. The temperature of the test setup shall then be lowered to -65 °F and repeat the test as specified in 4.7.1.3. Both tests shall meet the requirements specified in 3.12.6.1 and 3.12.7.1 respectively.

4.6.8.2 Impulse cycling at intermediate temperatures. The valve shall then be subjected to 15,000 cycles of impulse at a temperature of 225 °F. Upon completion of the 15,000 cycles, conduct the high temperature functioning test as specified in 4.6.7.3 at a temperature of 225 °F. Reduce the test setup temperature to a range of 70 to 120 °F and stabilize the fluid temperature at 100 °F. Reconduct the test as specified in 4.7.1.3. Both tests shall meet the requirements specified in 3.12.7.1 and 3.12.7.2 respectively.

TABLE II. Maximum pressure drop.

Valve size (Dash No)	Tube size (inch)	Rated flow GPM (min)	Pressure drop PSI (max)
-4	.250	1.20	10
-6	.375	3.50	10
-8	.500	6.00	10
-10	.625	10.50	10

4.6.9 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 ± 5 cpm. Shuttling shall be accomplished by operating the directional control valve in such manner that it alternately applies rated pressure to the inlet ports. Surge pressure during the pressure application portion of each cycle shall be 150 ± 10 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 in hydraulic fluid 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 one 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 tests for leakage and shuttling with fluid (conformance) as specified in 4.7.1.3 shall be met and satisfied. Reduce the temperature of the fluid to -65°F and repeat the test leakage and shuttling with fluid (conformance) and satisfy the tests as specified in 4.7.1.3. The shuttle valve shall then be subjected to 1,500 cycles at a temperature of 225 °F. Upon completion of these cycles, conduct the test as specified in 4.7.1.3 and meet the leakage specified therein.

4.6.10 Shuttling against a closed line. This test shall be performed within a temperature range of 70 to 120 °F. The test valve shall be set up as shown on figure 7. With shutoff valves "B" and "C" closed, and shutoff valve "A" open, flow shall be directed through the flow meter until the air is thoroughly bled from the system. The shutoff valve "A" shall then be closed, after which it shall be reversed from the position shown in order to direct flow to the emergency inlet port on the shuttle valve. Allow five seconds before pressure drop reading is taken. Repeat this test 20 times. It shall meet the requirements specified in 3.12.9.

4.6.11 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 for test as shown on 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 psi 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. The valve shall meet the requirements specified in 3.12.10.

4.6.12 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. Repeat this procedure with the opposite inlet. Maintain and observe the pressure and rate of flow very closely. 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 meet the requirements specified in 3.12.11.

4.6.13 Burst pressure. This test shall be performed at a fluid temperature of 275 °F. Any test fluids can be used for this test. With the inlet port plugged, the hydraulic pressure shall be applied 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. The valve shall meet the requirements specified in 3.12.12.

4.7 Conformance inspections. 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 - conformance (4.7.1.1)

b. Proof pressure - conformance (4.7.1.2)

c. Leakage and shuttling with fluid - conformance (4.7.1.3)

d. Reverse flow unseating - conformance (4.7.1.4)

4.7.1 Conformance inspection methods.

4.7.1.1 Examination of product (conformance). Repeat the test as specified in 4.6.1. In addition, the acquiring activity shall use as necessary the manufacturer's drawings and the manufacturer's applicable specifications, which were submitted when first article approval was granted to determine that the product submitted for acceptance under contract is identical to the item as previously inspected and accepted.

4.7.1.2 Proof pressure (conformance). Repeat the test as specified in 4.6.3 and meet the requirements specified in 3.12.2. The valve shall not have external leakage.

4.7.1.3 Leakage and shuttling with fluid (conformance). Repeat the test as specified in 4.6.5 except reduce the period from 32 minutes to 8 minutes, and observe the leakage. The leakage during the final 6 minutes after a 2-minute seating period shall be not greater than one drop (0.05 cc).

4.7.1.4 Reverse flow unseating (conformance). 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 valve shall not unseat, and the leakage out of the opposite inlet port shall be not greater than 10 drops (0.5 cc) per minute.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When packaging of materiel is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point’s packaging activities within the Military Service or Defense Agency, or within the military service’s system commands. Packaging data retrieval is available from the managing Military Department’s or Defense Agency’s automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. The valves covered by this specification are intended for use in aircraft type II hydraulic systems conforming to SAE-AS5440. The complete requirements for these valves consist of SAE-AS8775 which covers general requirements common to all aircraft hydraulic components and this specification which includes additional requirements specifically applicable to shuttle valves. These valves are designed for emergency hydraulic systems for military aircraft only and not available for commercial aircraft. The type I valve is intended to mount directly in the aircraft and the type II valve has threaded ports intended to be mounted in the hydraulic line.

6.2 Acquisition requirements. Acquisition documents should specify the following:

a. Title, number, and date of this specification.
b. Type I or type II (see 1.2).
c. Valve part number with dash size.
d. When first article inspection is required (see 3.3, 4.4) and test fluid to be used (see 4.4.3).
e. Packaging requirements (see 5.1).

6.3 Subject term (key word) listing.

Emergency control systems
Flow control
Fluid regulator
Pressure regulator
3000 psi operating pressure

6.4 Leakage. As defined in SAE-AS5440 and SAE-AS8775, slight wetting insufficient to form a drop is considered not a leakage.

6.5 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extent of the changes.

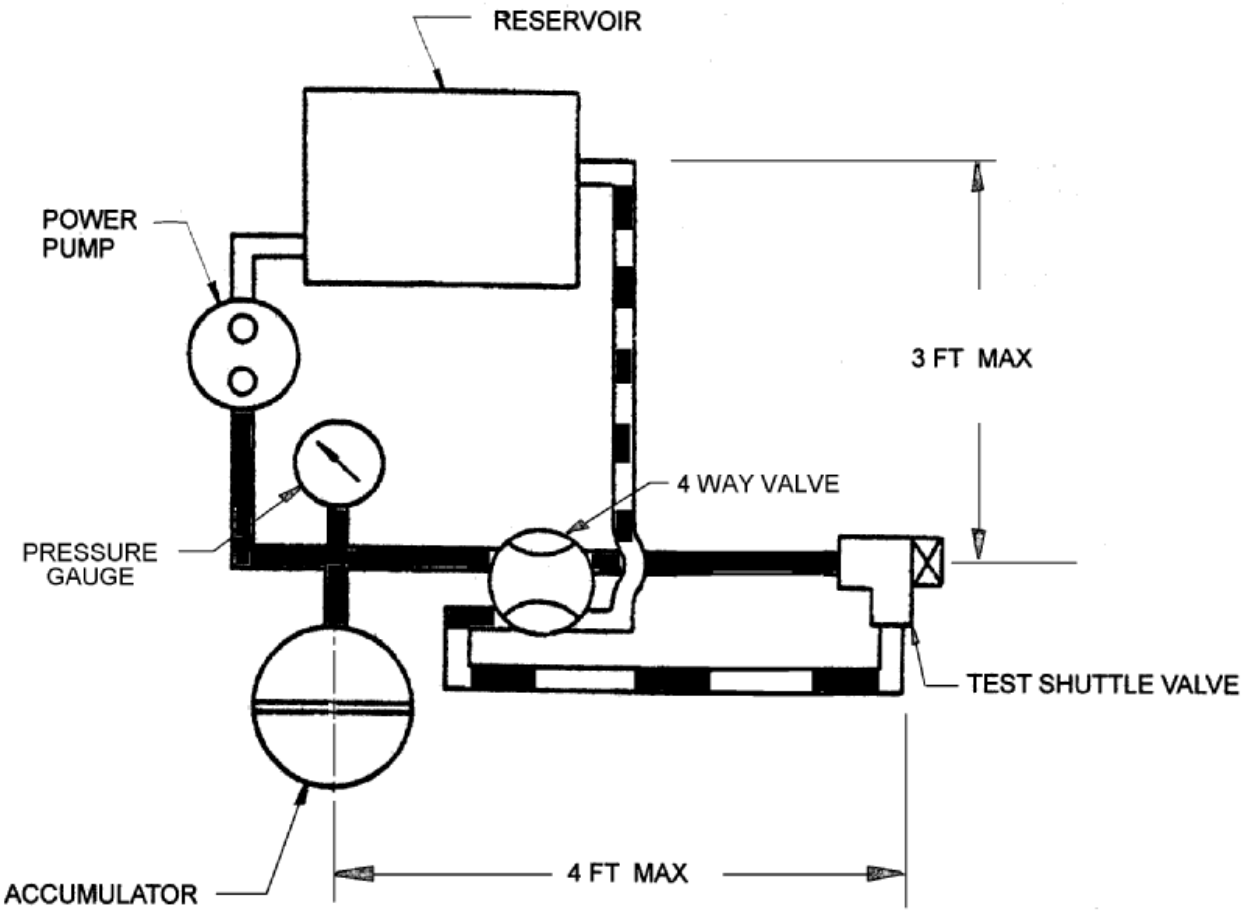

FIGURE 1. Setup for packing washout test.

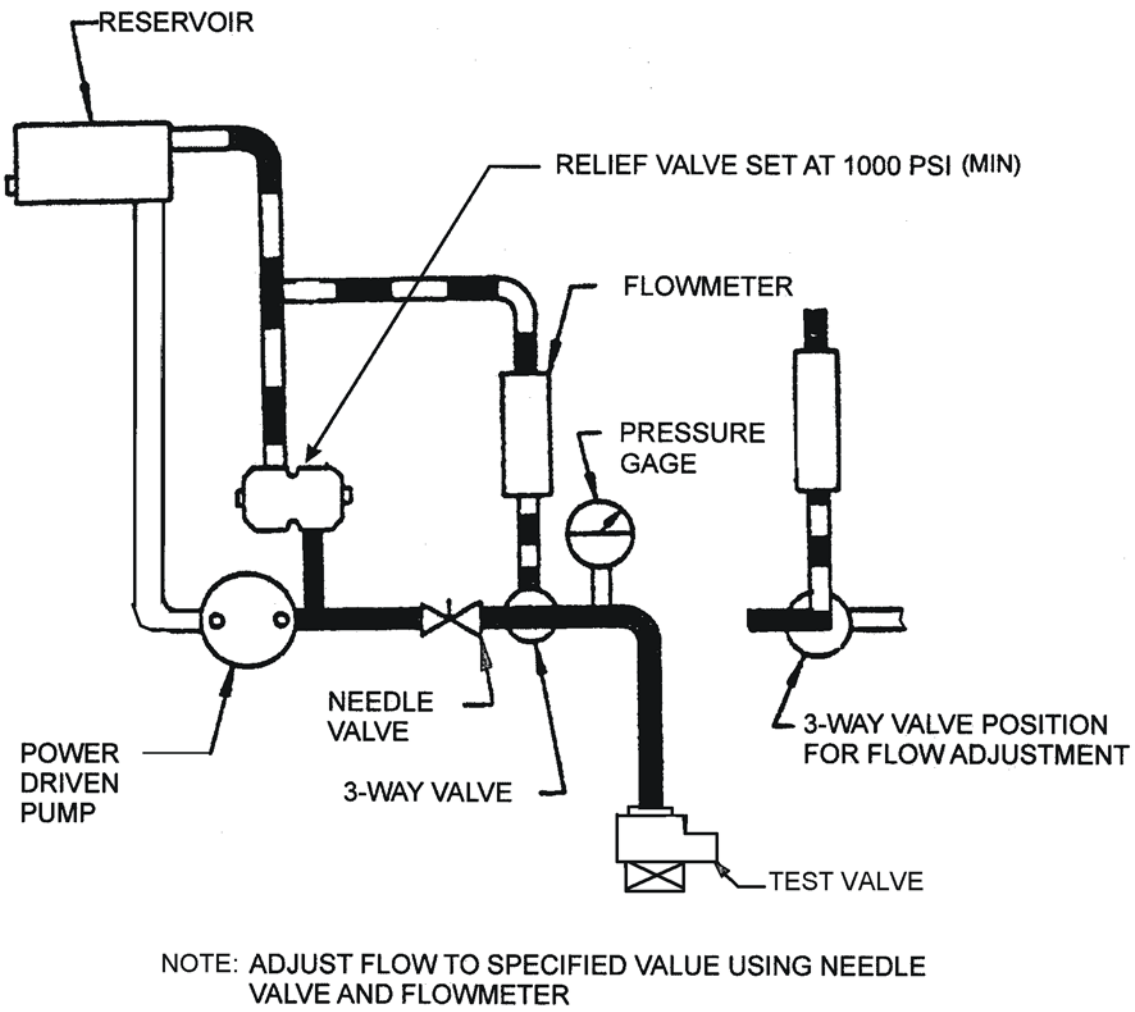

FIGURE 2. Setup for leakage and shuttling with fluid test.

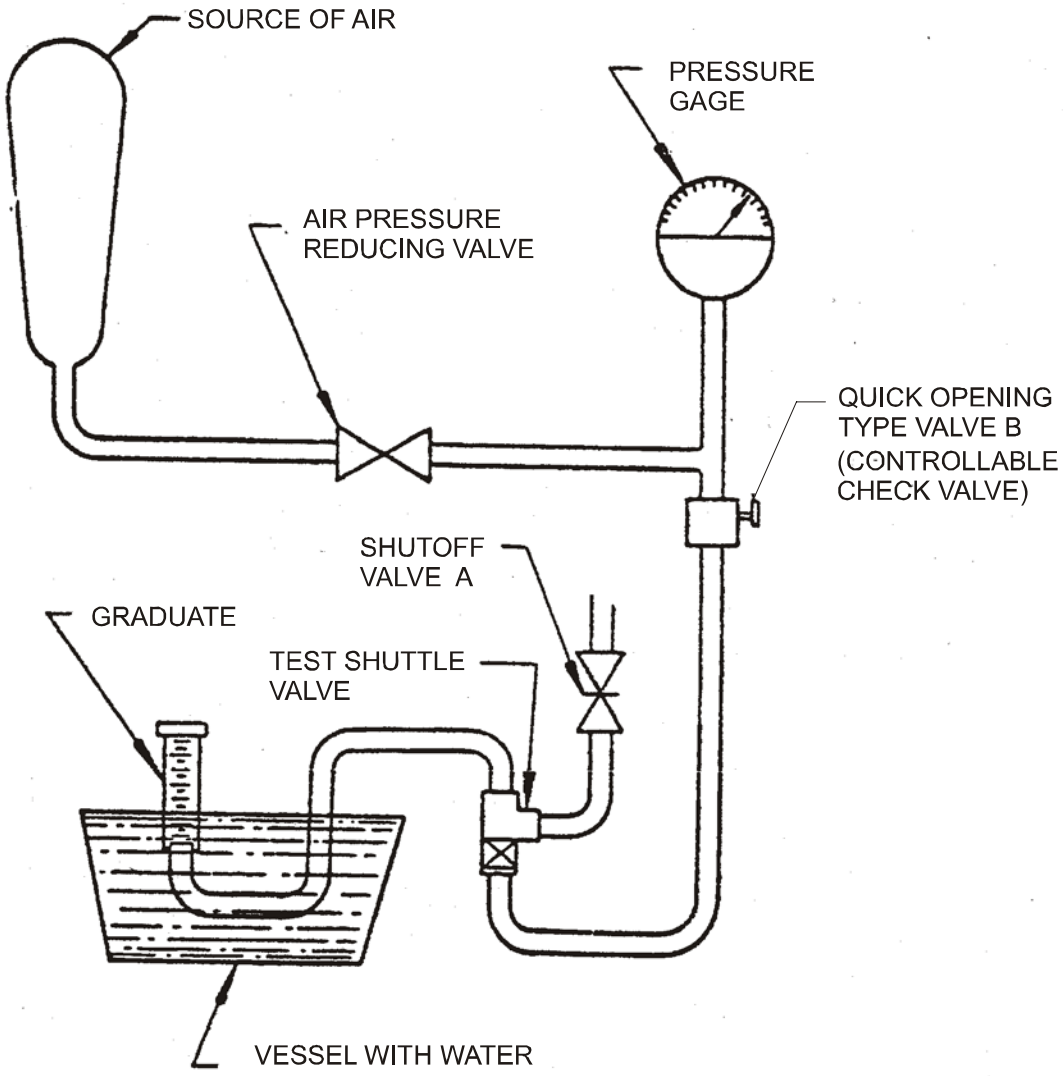

FIGURE 3. Air pressure shuttling and leakage test.

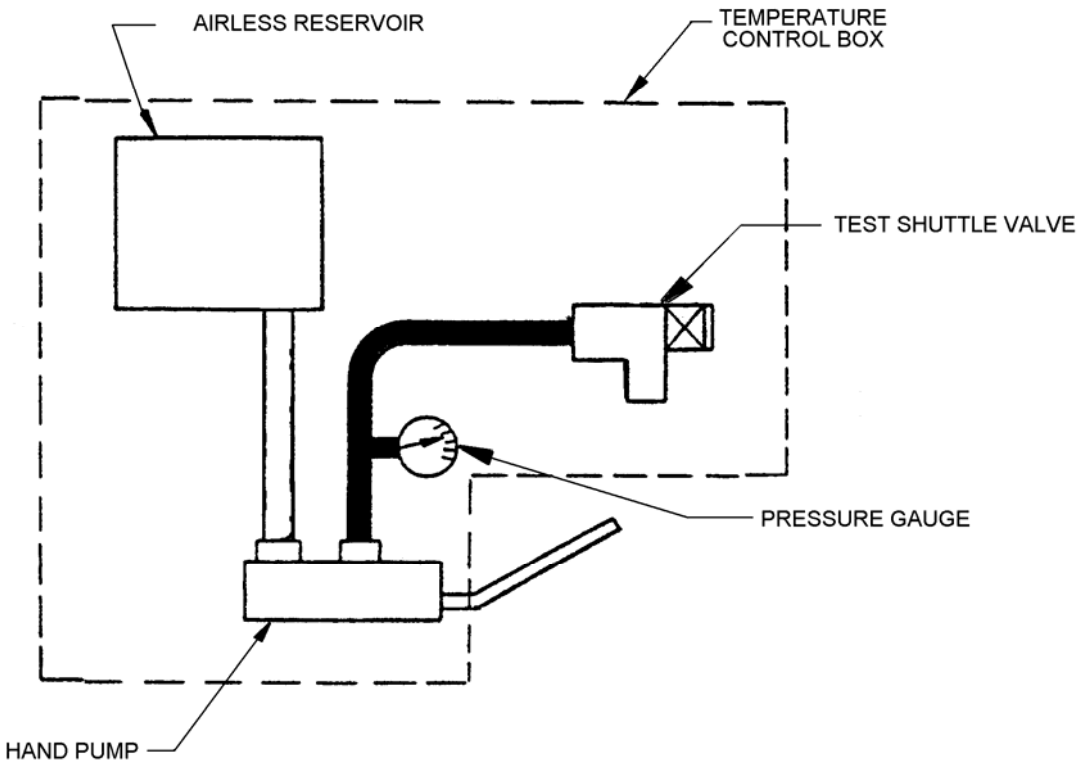

FIGURE 4. Setup for extreme temperature functioning test.

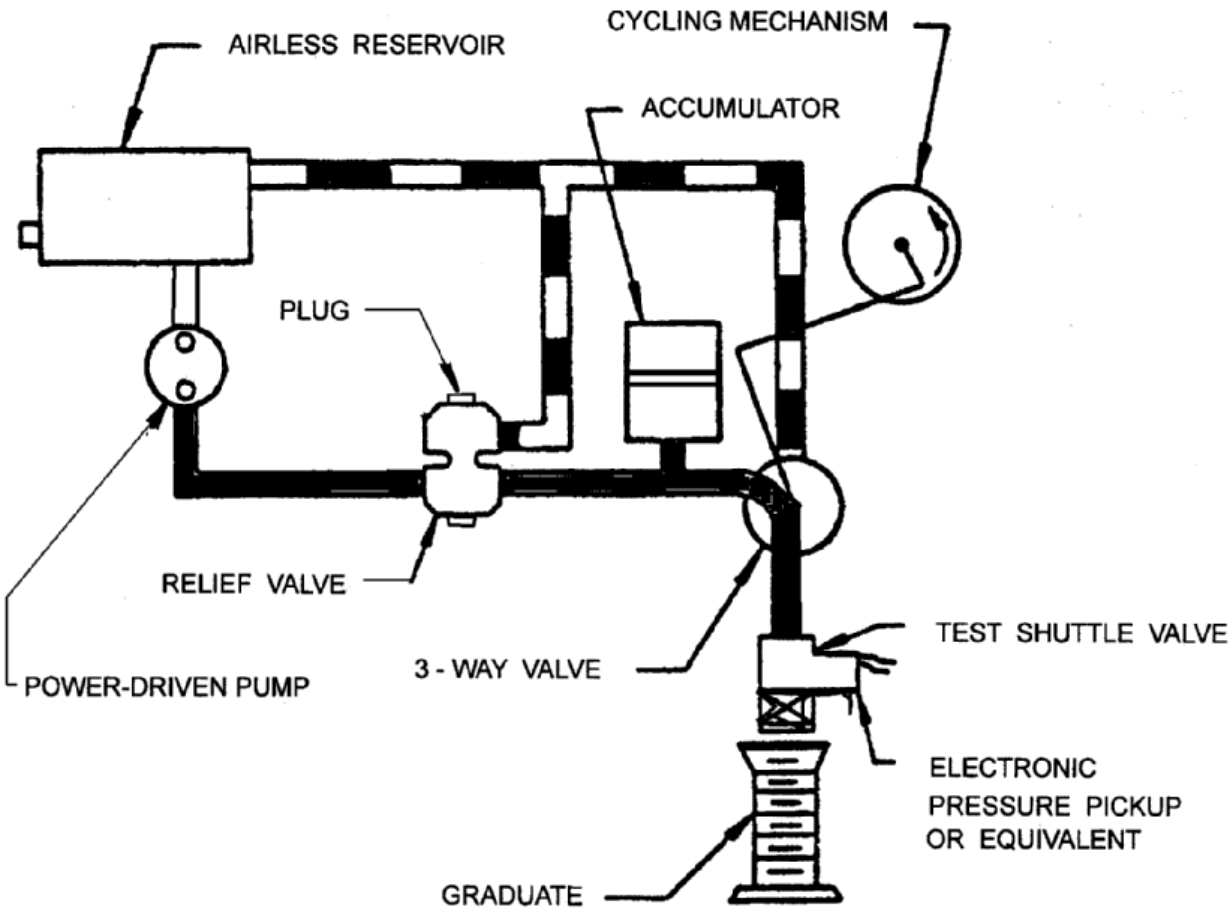

FIGURE 5. Setup for impulse cycling test.

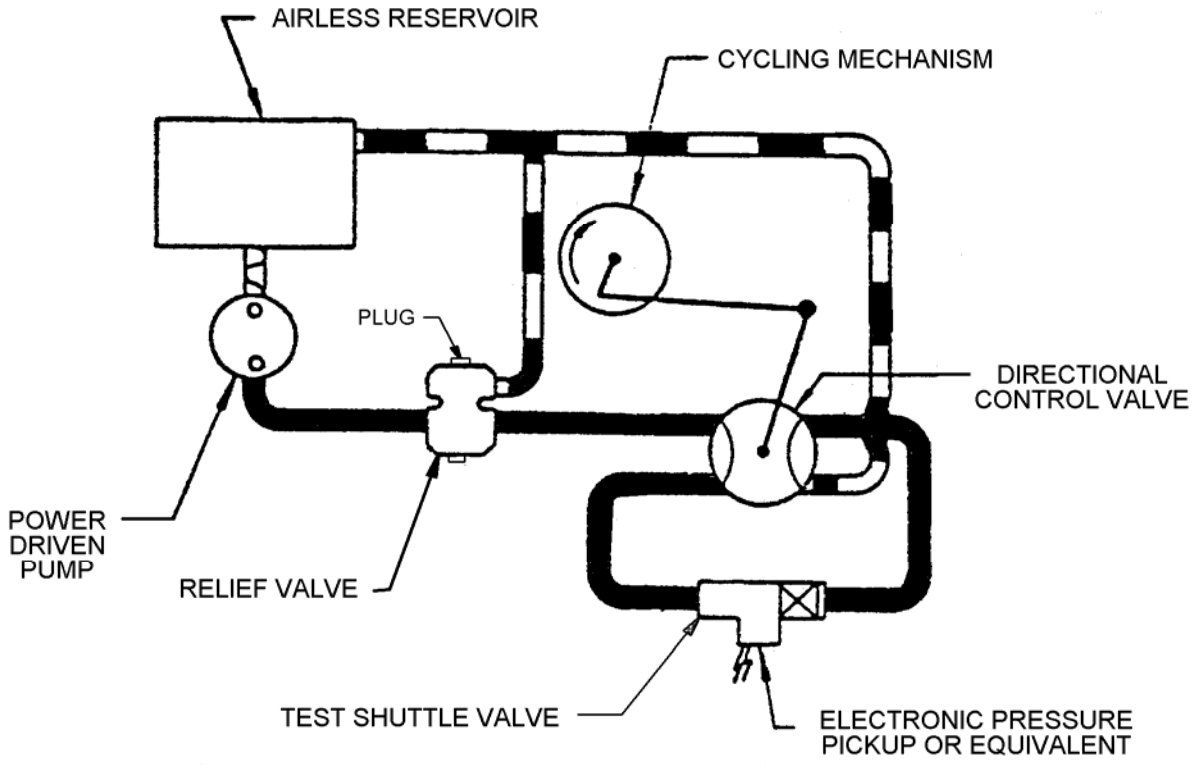

FIGURE 6. Setup for endurance cycling test.

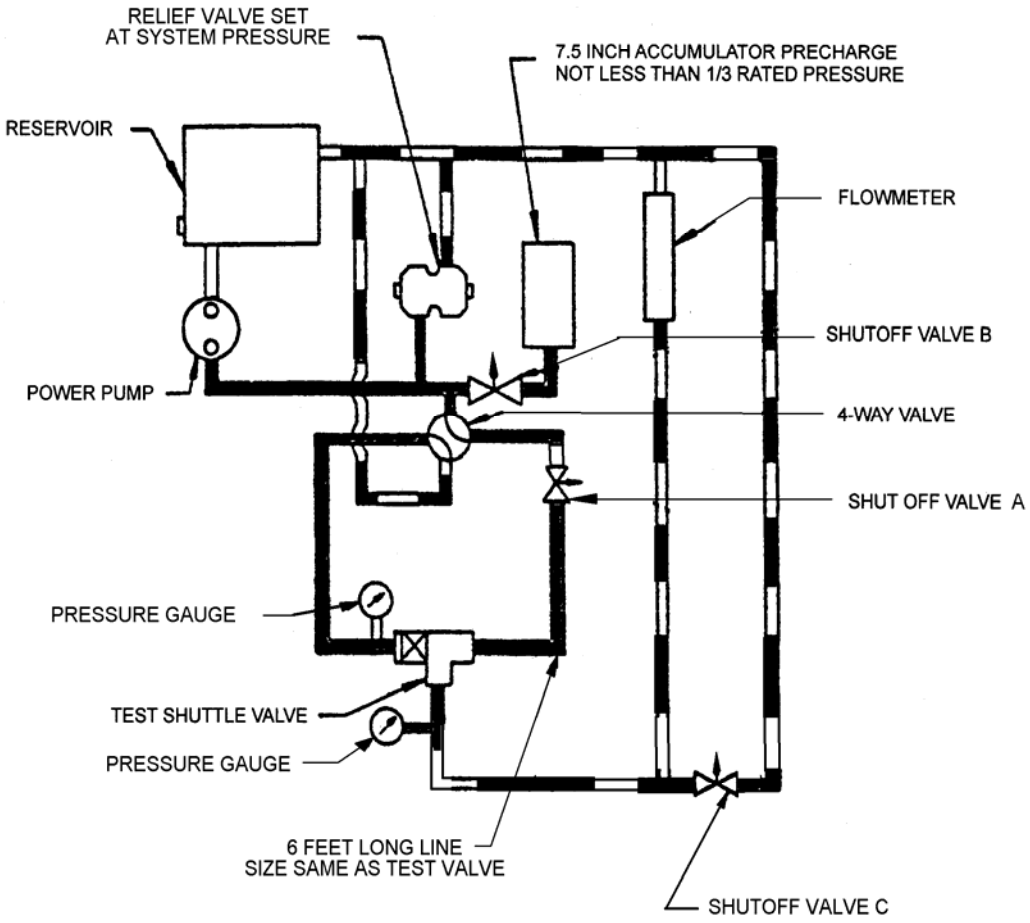

FIGURE 7. Setup for shuttling against a closed line and surge flow shuttling test.

Custodians:
Army-AV
Navy-AS
Air Force-99

Review activities:
Army - AT
Navy- SA
Air Force- 71
DLA- CC

Industry Association:
SAE-A6C

Preparing activity:
Navy-AS
(Project No. 4820-2005-002)

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at http://assist.daps.dla.mil.