MILITARY SPECIFICATION

VALVES: AIRCRAFT, HYDRAULIC PRESSURE RELIEF, TYPE II SYSTEMS

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

1. SCOPE

1.1 Scope.- This specification covers hydraulic pressure relief valves for use in type II aircraft hydraulic systems conforming to, and defined by Specification MIL-H-5440.

1.2 Classification.- Hydraulic pressure relief valves shall be furnished in the sizes and for the rated flows indicated on the applicable MS standard for the class of service as indicated in table I.

TABLE I

Classes and rated flow pressures

Standard	Class 1/	Rated flow pressure setting (psi) 2/		Maximum pressure differential between full flow and reseat pressure (psi)
		min	max	
MS28893	A	500	825	100
	B	825	1,400	160
	C	1,400	2,300	270
	D	2,300	3,850	460

1/ A valve shall be adjustable to deliver rated flow at any pressure within the range of the maximum and minimum rated flow pressure settings listed for its class in table I. Relief valves adjustable to the range of more than one class shall carry in the part number the abbreviated letter designation of the lowest and highest pressure class and shall conform to the applicable envelope, for example: A valve adjustable from 1,400 to 3,850 psi would be Part No. MS28893 CD.

2/ The rated flow pressure setting is the pressure differential which results between the inlet and relief ports of the valve at rated flow.

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:

SPECIFICATIONS

Military

MIL-E-5272	Environmental Testing, Aeronautical and Associated Equipment, General Specification for
MIL-H-5440	Hydraulic Systems: Design, Installation and Tests of Aircraft (General Specification for)
MIL-H-8775	Hydraulic System Components (Type II Systems), Aircraft, General Specification for

STANDARDS

Military

MS28893	Valve, Hydraulic Relief, Cylindrical Type II Systems

Air Force-Navy Aeronautical

AN6246	Pump - Hydraulic Hand, Type 3000

(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.)

3. REQUIREMENTS

3.1 General.- Pressure relief valves furnished under this Specification shall conform to all the requirements of Specification MIL-H-8775. Where the requirements of this specification and the general specification conflict, 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.

3.3 Design and construction.- The configurations, dimensions, and other details of design of standard pressure relief valves shall conform to the requirements of Standard MS28893. The valve shall not permit flow in the reverse direction.

3.3.1 Temperature range.- The valves shall be designed to satisfactorily operate continuously throughout a temperature range of -65° to +275°F.

3.3.2 Hydraulic pressure setting.- All hydraulic pressure relief valves which are furnished under contract, wherein the setting pressure is specified, shall be set by means of a power-driven pump to deliver rated flow at a differential pressure not to exceed the differential pressure required by the specific contract. This pressure differential shall exist with a return port back pressure of 200 ±25 psi. The pressure setting shall be noted on a temporary tag, or equivalent, securely attached to the valve. The tag shall be removed prior to valve installation.

4. QUALITY ASSURANCE PROVISIONS

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

4.2 Classification of tests.- The inspection and testing of the valves shall be classified as follows:

(a) Qualification tests. (See 4.3.)
(b) Acceptance tests. (See 4.4.)

4.3 Qualification tests.-

4.3.1 Sampling instructions.- For valves adjustable to more than one range, two complete sets of Qualification test specimens shall be tested. One set, consisting of a maximum and minimum clearance specimen, shall be adjusted to the applicable low-pressure range and subjected to the complete qualification testing required for that range. The second set shall be adjusted to the applicable high-pressure range and subjected to the complete qualification testing required for that range.

4.3.1.1 Tests.- The Qualification tests described herein shall be performed on the applicable specimens by the manufacturer and the activity responsible for qualification, in the order as indicated in tables II and III. All tests except Examination of product are described in this specification.

4.4 Acceptance tests.- Each relief 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 (see Specification MIL-H-8775).
(b) Proof pressure (4.6.3).
(c) Normal temperature performance (acceptance test) (4.6.5).

4.5 Test conditions.- Except where otherwise specified, the tests of this specification shall be conducted at a room temperature of 70° to 90°F and a fluid temperature of 70° to 110°F, as measured within 12 inches of the test sample. The actual temperature of the fluid during the tests shall be recorded in the test report.

4.6 Test methods.-

4.6.1 Fluid immersion.- All hydraulic pressure relief 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 balance of the Qualification tests specified herein. All internal parts of the relief valve shall be in contact with the fluid during this immersion. After this 72-hour soak period, the relief valve shall be subjected to the next test immediately or remain in the fluid at normal room temperature until ready for test. It shall not be exposed to air internally for any appreciable time during the testing.

4.6.2 Proof pressure (Qualification test).- This test shall be performed at a temperature of 275°F. With the return port plugged, a proof pressure of 4,500 psi shall be applied to the pressure port, at a rate of approximately 25,000 psi per minute, and held for at least 2 minutes. Pressure shall then be similarly applied and maintained on the return port with the pressure port plugged. There shall be no measurable external leakage, failure, or permanent set.

TABLE II

Manufacturers' Qualification tests

Maximum clearance specimen			Minimum clearance specimen		
Order of tests	Titles of tests	Paragraph reference	Order of tests	Titles of tests	Paragraph reference
1	Examination of product, see specification MIL-H-8775	-----	1	Examination of product see specification MIL-H-8775	-----
2	Fluid immersion	4.6.1	2	Proof pressure	4.6.2
3	Proof pressure (Qualification test)	4.6.2	3	Normal temperature performance	4.6.4
				(a) Maximum setting	4.6.4.2
4	Normal temperature performance (Qualification test)	4.6.4	4	Extreme temperature performance	4.6.6
	(a) Minimum setting	4.6.4.1		(a) Low temperature performance	4.6.6.1
	(b) Maximum setting	4.6.4.2		(b) Rapid warmup	4.6.6.2
				(c) High temperature performance	4.6.6.3
5	Extreme temperature performance	4.6.6			
	(a) Low temperature performance	4.6.6.1			
	(b) Rapid warmup	4.6.6.2			
	(c) High temperature performance	4.6.6.3			
6	Vibration	4.6.6.4			
7	Endurance cycling	4.6.7			
8	Burst pressure	4.6.9			

TABLE III

Services' Qualification tests

Maximum clearance specimen			Minimum clearance specimen		
Order of test	Title of tests	Paragraph reference	Order of tests	Titles of tests	Paragraph reference
1	Examination of product see specification MIL-H-8775	----	1	Examination of product see specification MIL-H-8775	----
			2	Fluid immersion	4.6.1
	INSPECTION AND		3	Proof pressure	4.6.2
	COMPARISON		4	Normal temperature performance	4.6.4
	OF			(a) Minimum setting	4.6.4.1
	RESULTS			(b) Maximum setting	4.6.4.2
			5	Extreme temperature performance	4.6.6
				(a) Low temperature performance	4.6.6.1
				(b) Rapid warmup	4.6.6.2
				(c) High temperature performance	4.6.6.3
			6	Vibration	4.6.6.4
			7	Endurance cycling	4.6.7
			8	Burst pressure	4.6.9

4.6.3 Proof pressure (acceptance test).- With the return port plugged, a proof pressure of 4,500 psi shall be applied to the pressure port at a rate of approximately 25,000 psi per minute, and held for at least 2 minutes. Pressure shall then be similarly applied and maintained on the return port with the pressure port plugged. There shall be no measurable external leakage, failure, or permanent set.

4.6.4 Normal temperature performance (Qualification test).- Normal temperature performance shall consist of the following tests: Minimum setting and maximum setting.

4.6.4.1 Minimum setting.- These tests shall be performed with a test setup similar to figure I. The valve shall be installed four tube diameters downstream from a piezometer pressure pickup and 15 tube diameters upstream from a piezometer pickup. Using the power-driven pump for pressure application, the valve shall be adjusted to deliver rated flow, as specified on the applicable drawing, at a pressure differential equivalent to the minimum pressure setting specified for its class in table I. This pressure differential shall exist with a pressure at the outlet port of 200 psi ±25 psi. For these tests, in all instances leakage shall be observed at the outlet port during the third minute following a 2-minute waiting period.

4.6.4.1.1 Reseat pressure.- The inlet pressure shall then be decreased gradually until leakage not greater than the reseat leakage shown in table IV can be determined. The minimum pressure at which this leakage rate occurs shall be recorded as the reseat pressure, and its value shall be not less than that specified by table I.

4.6.4.1.2 Decreasing pressure leakage.- The reduction of pressure shall be continued slowly, and the leakage rate similarly observed at pressure values equivalent to approximately 3/4, 1/2, and 1/4 of the rated flow pressure setting of the valve. Leakage at these pressures shall not exceed the values shown in table V.

4.6.4.1.3 Increasing pressure leakage.- The pressure shall then be increased gradually, and leakage observed at values of approximately 1/2, and 3/4 of the rated flow pressure setting of the valve. Leakage shall not exceed the values shown in table V. Pressure shall then be increased to the reseat pressure as determined by the test of 4.6.4.1.1. Leakage at the reseat pressure shall not exceed the value shown in table IV.

TABLE IV

Reseat leakage

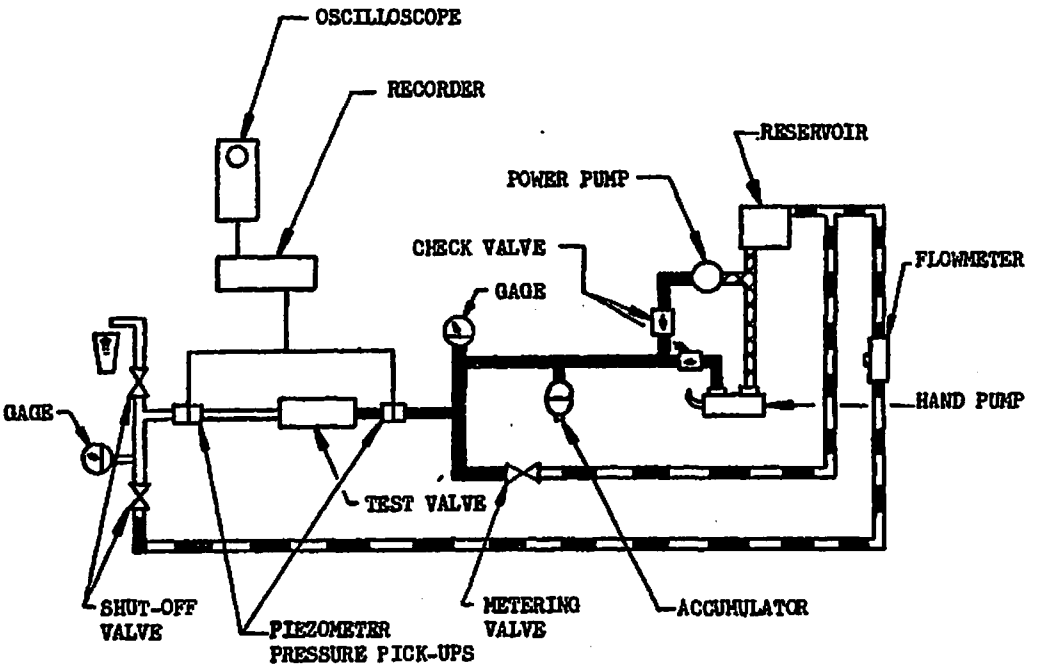
Tube size	Maximum leakage at reseat pressure (cc per minute)
-4	4.5
-6	4.5
-8	6.
-12	9.

TABLE V

Decreasing pressure leakage

Tube size	Maximum leakage at or below 3/4 of rated flow differential pressure setting (cc per minute)
-4	1.5
-6	1.5
-8	2.
-12	3.

4.6.4.1.4 Rated flow.- The pressure increase shall be continued until rated flow is produced at the outlet. Vary the back pressure from 0 to 200 psi at several flows between zero and rated flow. The differential pressure shall at no time exceed the specified value in table I. The differential pressure at which rated flow occurs with 200 ±25 psi back pressure shall be within ±25 psi of the original differential pressure setting.



GAGES SHALL BE PLACED AS CLOSE TO VALVE PORTS AS PRACTICABLE.

FIGURE 1. Diagram for normal temperature performance tests

4.6.4.2 Maximum setting.- The tests specified for "Minimum setting" (4.6.4.1) shall be repeated with the valve adjusted to deliver rated flow at a differential pressure equivalent to the maximum pressure setting specified for its class in table I.

4.6.4.3 Reverse flow leakage.- With rated relief flow pressure applied to the outlet port, leakage from the inlet port shall not exceed the values specified in table V during the third minute of a 3-minute waiting period.

4.6.5 Normal temperature performance (acceptance test).-

4.6.5.1 Pressure setting and reseat pressure.- Except where the contract or order specifies the applicable setting pressure, each valve shall be set by means of a power-driven pump to deliver rated flow at a pressure setting equivalent to the maximum pressure differential setting specified for its class in table I. The pressure shall then be reduced to the minimum allowable reseat pressure specified for its class in table I. Leakage at this pressure shall be observed in the third minute of a 3-minute waiting period, and shall not exceed the value shown in table IV.

4.6.5.2 Decreasing pressure leakage.- After checking the reseat pressure, the pressure shall be gradually decreased and leakage observed at pressure values of 3/4 and 1/2 of the rated flow pressure setting. Leakage at these pressure values shall be observed in the third minute of a 3-minute waiting period, and shall not exceed the values shown in table V.

4.6.5.3 Increasing pressure leakage.- After checking decreasing pressure leakage, the pressure shall be gradually increased and leakage observed at a pressure of 3/4 of the rated flow pressure setting and at the minimum allowable reseat pressure. Leakage observed, during the third minute of a 3-minute waiting period at 3/4 of the rated flow pressure setting, shall not exceed the values shown in table V. Leakage similarly observed at the minimum reseat pressure shall not exceed the values shown in table IV.

4.6.6 Extreme temperature performance.-

4.6.6.1 Low temperature performance.- With a test setup similar to figure 1, the valve shall be adjusted at room temperature to deliver rated flow at a differential pressure equivalent to the maximum pressure setting specified for its class in table I. The valve shall then be installed in a test setup similar to figure 2. Cycling the hand pump at the rate of one full stroke per second, note the highest pressure which can be developed at room temperature. The test setup shall then be maintained at a temperature of not warmer than -65°F for a period of 2 hours with the valve unpressurized. The valve shall then be pressurized to approximately 90 percent of the minimum allowable reseat pressure specified in table I, and held for a minimum of 2 additional hours. The hand pump test outlined above shall then be repeated. The pressure value so obtained at -65°F shall not vary more than -10 percent or -5 percent from that obtained during the room temperature test.

4.6.6.2 Rapid warmup.- The low temperature arrangement shall then be allowed to warm 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 hand pump shall be cycled as described above (4.6.6.1) at approximately 50°F differentials in ambient temperature. The pressure values so obtained at these temperature increments shall not vary more than -10 percent or +5 percent from those obtained during the room temperature test.

4.6.6.3 High temperature performance.- Unless otherwise indicated, this test shall be conducted at a temperature of 275°F, with a test setup similar to figure 1, and with the valve adjusted at room temperature to deliver rated flow at a differential pressure equivalent to the maximum pressure setting specified in table I. The test outlined under "Maximum setting" (4.6.4.2) shall then be repeated at 275°F and the requirements therein shall be satisfied.

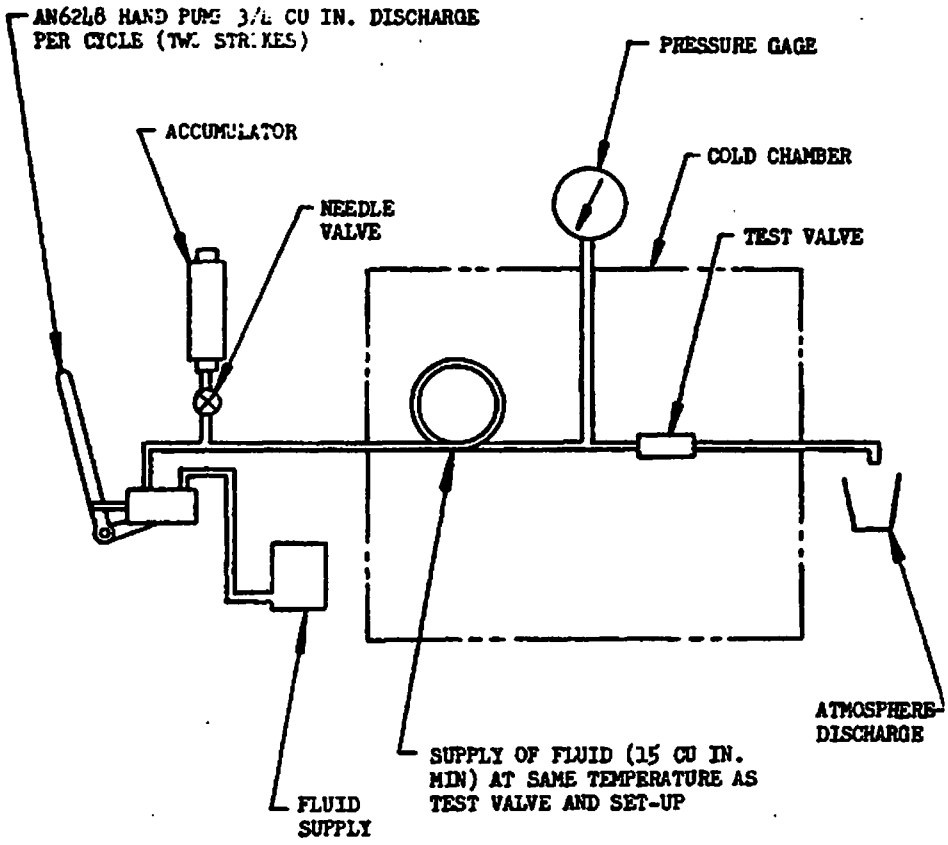


FIGURE 2. Typical schematic diagram for Low temperature performance test

4.6.6.4 Vibration.- The Vibration test, Procedure I, of Specification MIL-E-5272 shall be conducted except that the high temperature test shall be conducted at 275°F in lieu of 160°F. Unless a positive mechanical method of securing the pressure adjusting device, acceptable to the procuring activity, is provided, the device shall be completely loosened and retightened 15 times prior to conducting the vibration test. The valve shall then be adjusted to the applicable rated pressure flow setting. During the vibration tests the valve shall be tested in accordance with 4.6.4 and shall meet the requirements specified therein.

4.6.7 Endurance cycling.- The valve shall be subjected to a total of 50,000 cycles with a test setup similar to figure 3. The valve shall be adjusted at room temperature to deliver rated flow, as specified on the applicable drawings, at a differential pressure equivalent to the maximum pressure setting specified for its class in table I. Each cycle shall consist of imposing rated flow through the valve, and then reducing pressure to substantially zero. Cycling shall be accomplished at the rate of 5 to 35 cpm. Of the total number of cycles, 12,500 shall be performed in accordance with the procedure outlined below for High temperature endurance cycling. The balance of 37,500 cycles shall be performed in accordance with the procedure outlined below for Intermediate temperature endurance cycling.

4.6.7.1 High temperature endurance cycling.- The valve shall be subjected to 12,500 cycles at a temperature of 275°F. Upon completion of these 12,500 cycles, the valve shall be soaked at a temperature of 275°F for a period of 1 hour with pressure equivalent to 90 percent of the reseat pressure applied to the valve. The pressure shall then be relieved to approximately zero, and the valve soaked for an additional period of 1 hour at a temperature of 275°F. The temperature of the test setup shall then be lowered to a range of 70°F to 120°F and the fluid temperature stabilized at 100°F. Internal leakage shall then be measured in the manner indicated herein for maximum setting at the previously recorded reseat pressure and at 1/2, and 3/4 of the maximum rated flow differential pressure setting. The leakage values obtained here shall be a maximum of two times the corresponding values permitted during the original normal temperature performance "Maximum setting" test (4.6.4.2). Following this, the Low temperature performance test (4.6.6.1) shall then be repeated and the requirements therein shall be satisfied.

4.6.7.2 Intermediate temperature endurance cycling.- The valve shall then be subjected to the balance of 37,500 cycles at a temperature of 225°F, internal leakage shall be measured in the manner indicated herein for "Maximum setting" (4.6.4.2) at the previously recorded reseat pressure and at 1/2, and 3/4 of the maximum rated flow differential pressure setting. The leakage values obtained here shall be a maximum of two times the corresponding values permitted during the original normal temperature performance "Maximum setting" test (4.6.4.2). 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 leakage shall then be similarly measured as outlined above for 225°F, and the leakage values so obtained here shall be a maximum of two times the corresponding values permitted during the original normal temperature performance "Maximum setting" test of 4.6.4.2.

4.6.8 External leakage.- There shall be no evidence of leakage through external seals, other than a slightly wetted surface, which does not form a drop, nor shall there be any other evidence of external leakage, during performance of the above tests.

4.6.9 Burst pressure.- This test shall be performed at a temperature of 275°F. Any suitable fluid may be used for this test. With all ports except the pressure port plugged, 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 burst pressure for a period of 2 minutes without rupture of internal or external parts.

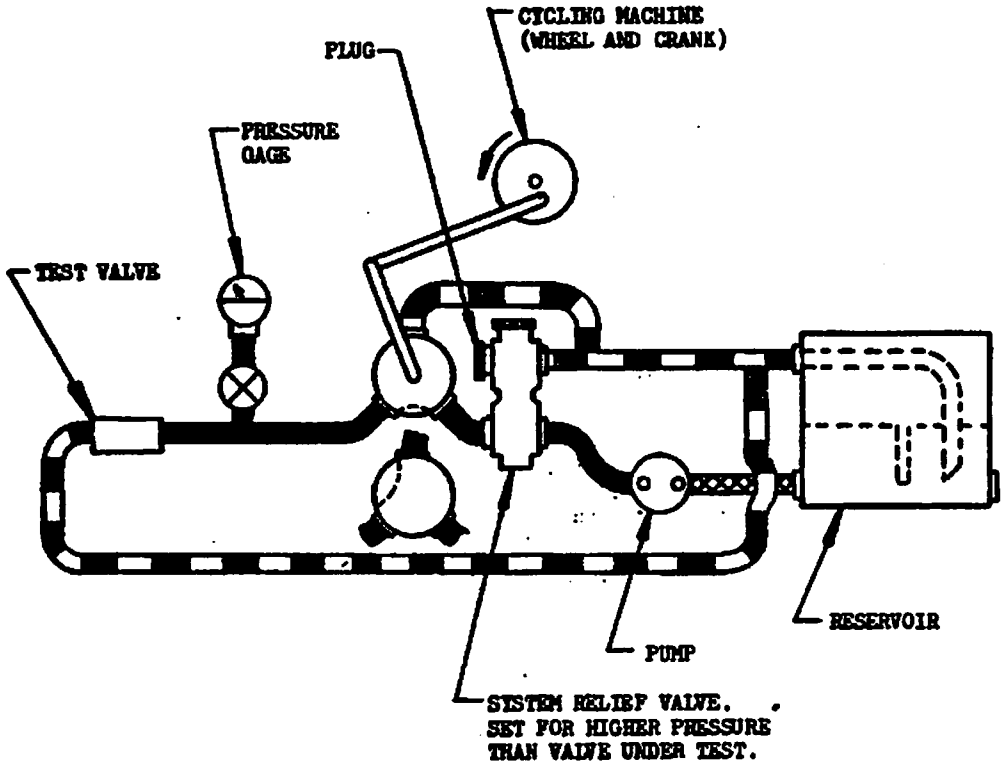


FIGURE 3. Typical relief valve Endurance test installation

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.

6. NOTES

6.1 General.- The notes contained in section 6 of Specification MIL-H-8775 form a part of this specification.

6.1.1 Intended use.- Pressure relief valves covered by this specification are intended for use in type II, aircraft hydraulic systems, conforming to Specification MIL-H-5440. The function of these relief valves is to relieve pressure in excess of the applicable system or subsystem operating pressure.

6.2 Provisions for qualification.- With respect to products requiring qualification, awards will be made 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.

6.2.1 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. Requests 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.

Custodians:
Navy - Bureau of Aeronautics
Air Force

Preparing activity:
Navy - Bureau of Aeronautics