INCH-POUND

MIL-DTL-5498E
15 May 2007
SUPERSEDING
MIL-A-5498D
11 April 1988

DETAIL SPECIFICATION

ACCUMULATORS, HYDRAULIC, CYLINDRICAL 3000 PSI, AIRCRAFT

Reactivated after 15 May 2007 and may be used for new design and existing designs and acquisitions.

This specification is approved for use by all departments and agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers hydraulic accumulators having a single-shell design with a piston type separator for use in aircraft hydraulic systems at rated pressures ranging to 3,000 pounds per square inch (psi) between the temperature range of -65 °F to 275 °F.

1.2 Size. Accumulators are of the sizes specified in table I (see 6.2).

Comments, suggestions, or questions on this document should be addressed to Defense Supply Center Richmond, ATTN: DSCR-VEB, 8000 Jefferson Davis Highway, Richmond, VA 23297-5616 or e-mailed to STDZNMGT@dla.mil. Since contact information can change, you may want to verify the currency of this address information using the ASSIST database at http://assist.daps.dla.mil.

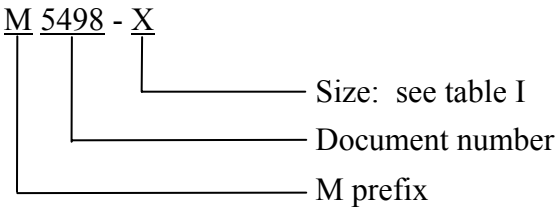
TABLE I. Dimensions.

Size number	Gas volume[1] (cubic inches)		Tube size reference	A ±0.062	B ±0.062	C +0.000 -0.031	D	E +0.000 -0.016	G max.	H +0.000 -0.016
	Max.	Min.								
1	27	23	0.50	12.500	3.938	4.625	2.250	1.375	2.812	1.125
2	54	46	0.50	20.375	3.938	12.500	2.250	1.375	2.812	1.125
3	54	46	0.50	12.500	4.438	3.625	3.187	1.375	3.812	1.125
4	108	92	0.50	20.375	4.438	11.500	3.187	1.375	3.812	1.125
5	216	184	0.50	36.125	4.438	27.250	3.187	1.375	3.812	1.125
6	216	184	0.75	20.000	5.438	9.125	4.750	1.750	5.500	1.500
7	416	384	0.75	33.375	5.438	22.500	4.750	1.750	5.500	1.500

[1]The gas volume in the table denotes the total gas volume of the accumulator with the piston bottomed on the fluid end of the accumulator.

NOTE: Dimensions are in inches. Unless otherwise specified, the tolerances are ±0.031.

1.3 Part or identifying number (PIN). The PIN to be used for accumulators acquired to this specification is created as follows:



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 the documents cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks 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 (see 6.2).

DEPARTMENT OF DEFENSE SPECIFICATIONS

AN818 - Nut, Tube Coupling, Short.
MIL-PRF-83282 - Hydraulic Fluid, Fire Resistant, Synthetic Hydrocarbon Base, Metric, NATO Code Number H-537.

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-130 - Identification Marking of U.S. Military Property.

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

2.2.2 Other government documents, drawings, and publications. The following other government documents, drawings, and publications 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 (see 6.2).

STANDARDIZATION DOCUMENTS

SD-6 - Provisions Governing Qualification.

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

2.3 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 (see 6.2).

ASTM INTERNATIONAL

ASTM E 1417 - Standard Practice for Liquid Penetrant Testing.
ASTM E 1444 - Standard Practice for Magnetic Particle Testing.

(Copies of these documents are available online at http://www.astm.org/ or from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959.)

SAE INTERNATIONAL

SAE AS1933 - Age Controls for Hose Containing Age-Sensitive Elastomeric Material.
SAE AS5168 - Fitting, Plug, Tube End, Flared.
SAE AS5202 - Port or Fitting End, Internal Straight Thread, Design Standard.
SAE ARP5316 - Storage of Elastomer Seals and Seal Assemblies Which Include an Elastomer Element Prior to Hardware Assembly.

SAE INTERNATIONAL - Continued.

SAE AS8775 - Hydraulic System Components, Aircraft and Missiles, General Specification for.

(Copies of these documents are available online at http://www.sae.org/ or from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001.)

2.4 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, 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 Qualification. The accumulators furnished under this specification shall be products that are authorized by the qualifying activity for listing on the applicable qualified products list before contract award (see 4.3 and 6.3).

3.2 Precedence. The requirements of SAE AS8775 apply as requirements of this specification. If there is a conflict between the two documents, MIL-DTL-5498 shall govern.

3.3 Design and construction. Accumulators shall be designed and constructed to contain gas and hydraulic fluid under pressure. The accumulator shall be provided with a fluid port, a gas port, and a suitable piston type separator to separate the fluid and the gas within the accumulator. Accumulators shall contain a safety provision to ensure dissipation of the accumulator gas pressure and fluid pressure before any component parts can be disassembled.

3.3.1 Dimensions. Accumulators shall conform to table I and figure 1.

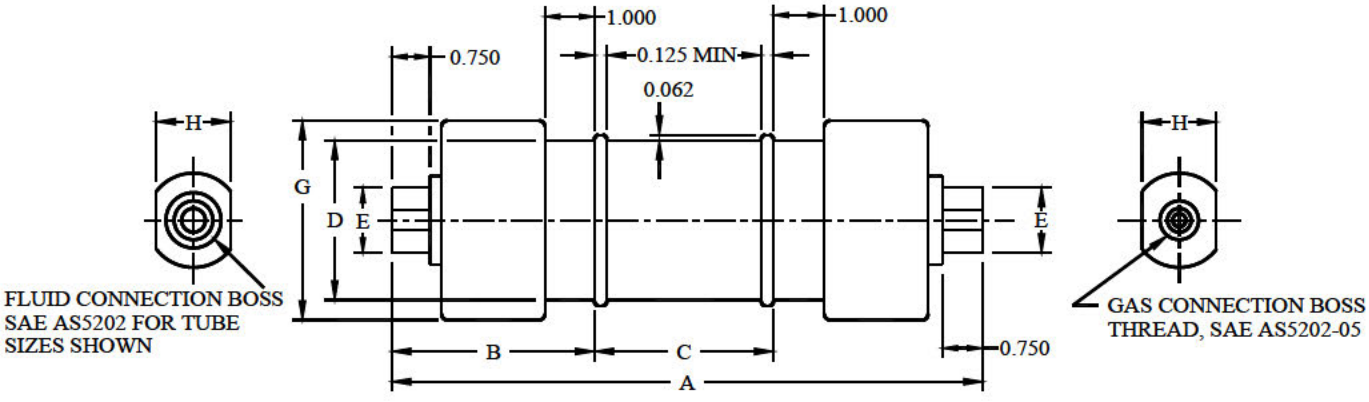


FIGURE 1. 3,000 psi cylindrical hydraulic accumulator.

3.3.2 Fluid port. The fluid port shall be designed to offer minimum restriction to fluid flow. Means shall be provided to prevent a metal-to-metal seal between the piston and the parts it contacts when the piston is bottomed on the fluid end.

3.3.3 Pressures. The accumulators shall be designed and constructed for operating at a hydraulic pressure of 3,000 psi and shall be based on a maximum gas charge pressure of 2,000 psi with all fluids exhausted. Separators shall be designed to withstand a pressure differential from the oil to air side or air to oil side of 4,500 psi without damage. The accumulator shall be designed to withstand proof pressure (6,000 psi) and burst pressure (12,000 psi) tests at 275 °F after loss of strength of the materials caused by aging at 275 °F for 1,000 hours.

3.3.4 Performance. The accumulator shall pass the tests as specified in section 4.

3.4 Markings. Each accumulator shall be provided with a permanent, legible, attached warning in red letters as follows:

MAXIMUM OPERATING PRESSURE 3,000 PSI.
RELEASE GAS AND FLUID PRESSURE BEFORE DISASSEMBLING, STORING, OR SHIPPING ACCUMULATOR.

3.5 Nameplate. Each accumulator shall be furnished with a nameplate marked in accordance with MIL-STD-130 and shall include the following information:

a. PIN (see 1.3).
b. Manufacturer's name.
c. Manufacturer's part number.
d. Manufacturer's serial number.

3.6 Age controls. Accumulators containing elastomeric seals shall be marked in accordance with SAE AS1933 and SAE ARP5316.

3.7 Use of alignment rings. When alignment rings are used on pistons, it shall not be possible to trap pressure between the piston seal area and the alignment ring area (the alignment ring must not be able to act as a seal). The use of multi-turn spiral backup rings as alignment rings is prohibited.

3.8 Use of retainer (snap) rings. When retainer rings are used to secure end caps, it shall not be possible to incorrectly assemble the parts, thereby forcing the retainer ring out of its groove by the end cap or other parts of the accumulator.

3.9 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.

4. VERIFICATION

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

a. Qualification inspection (see 4.3).
b. Conformance inspection (see 4.4).

4.2 Inspection conditions. Unless otherwise specified herein, all inspections shall be performed in accordance with the test conditions as specified in 4.6.

4.3 Qualification inspection. The qualification test units (as specified in 4.5) shall be subjected to the following inspections in the order listed:

a. Separator under pressure (see 4.6.1).
b. Volumetric efficiency (see 4.6.2).
c. Fluid immersion (see 4.6.3).
d. Proof pressure (see 4.6.4).
e. Cycling and endurance (see 4.6.5).
f. Leakage (see 4.6.6).
g. Seizing of parts (see 4.6.7).
h. Non-destructive inspection (see 4.6.8).
i. Burst pressure (see 4.6.9).
j. Fragmentation (see 4.6.10).

4.4 Conformance inspection. Each accumulator submitted for acceptance shall be subjected to the following tests:

a. Examination of product (see SAE AS8775).
b. Non-destructive inspection (see 4.6.8).
c. Leakage (see 4.6.6).
d. Proof pressure (see 4.6.4).

4.5 Qualification test units. Two qualification test units shall be built for each size ordered. The first unit shall be tested to ensure that the clearance between sliding parts will be within 10 percent of the minimum clearance permitted by the manufacturer's detail drawings. The second unit shall be tested to ensure that the clearance between sliding parts is at least 80 percent of the maximum clearance permitted by the manufacturer's detail drawings.

4.6 Methods of inspection.

4.6.1 Separator under pressure. With the accumulator mounted in a vertical position and with the gas port down, the accumulator separator shall withstand 4,500 psi ± 100 psi fluid pressure applied to the fluid port with the gas port open for two minutes without leakage or damage. With the accumulator mounted in a vertical position and with the fluid port down, the accumulator separator shall withstand 4,500 psi ± 100 psi fluid pressure applied to the gas port with the fluid port open for two minutes without leakage or damage.

4.6.2 Volumetric efficiency. The accumulator shall be mounted in a vertical position with the gas port down and with the piston bottomed on the gas end. The accumulator shall be filled with fluid and the volume of the fluid shall be measured and recorded. Pressure shall then be applied to the gas port and the piston shall be allowed to travel until it is bottomed on the fluid end. The volume of fluid exhausted shall be measured and recorded. The volumetric efficiency shall be determined by the following formula:

$$\text{Volumetric efficiency percent} = 100 \text{ X } \frac{\text{Volume of exhausted fluid}}{\text{Volume of admitted fluid}}$$

The volumetric efficiency shall not be less than 95 percent. With a gas precharge of 500 psi ± 25 psi and the separator bottom at the fluid end of the accumulator, the fluid pressure required to move the piston shall not exceed 700 psi. Under 3,000 psi ± 50 psi fluid pressure, the piston shall not bottom at the gas end.

4.6.3 Fluid immersion. All accumulators shall be filled with hydraulic fluid conforming to MIL-PRF-83282 in such a manner that all internal parts of the unit are in contact with the fluid. The accumulator shall then be immersed continuously in hydraulic fluid conforming to MIL-PRF-83282 for a period of 72 hours at a fluid temperature of not less than 225 °F in a closed container prior to conducting the remainder of the qualification tests specified. After the 72 hour soak period, the accumulators shall remain in the fluid at normal room temperature until ready for further testing.

4.6.4 Proof pressure. With the piston in approximately mid-position, completely fill both ends of each accumulator with fluid and plug the gas end. Fluid pressure shall be applied at the fluid port until a pressure of 6,000 psi ± 100 psi is obtained and maintained for 5 minutes. There shall be no leakage of fluid or sign of failure in any part of the accumulator.

4.6.5 Cycling and endurance. With all fluid exhausted, the accumulator shall be precharged with pure dry nitrogen gas as specified in the steps of table II. The tests for steps 1 through 6 will be conducted in a test rig similar to that shown in figure 2. The tests for step 7 will be conducted in a test rig similar to that shown in figure 3. Fluid shall then be cycled to the accumulator in accordance with the corresponding pressures and temperatures specified. The fluid and the gas in the accumulator shall attain the specified temperature before tests are started. The tests shall be conducted in the order specified. Tests 4.6.6.1 and 4.6.6.2 are performed between steps 6 and 7. The stabilized gas temperature, the pressure, and the leakage of fluid and gas shall be recorded and shall not exceed that specified in table II. There shall be no external leakage or malfunctioning of the accumulator during the test. Only one set of packing gland seals shall be used throughout steps 1 through 6.

Table II. Cycling and endurance tests[1].

Step number	Total cycles (minimum)	Cycle rate (cycles per minute)	Gas charge (psi ± 25 psi)	Fluid pressure cycling limits (psi)		Temperature (°F ± 10°F except as noted)		Leakage of fluid to gas side (percent of accumulator's volume)[5]	Leakage of gas (percent drop in gage pressure)
				Lower limit max.	Upper limit min.	Fluid	Ambient air		
1	2,000	0.2 to 2	1,000	200	3,000	275 min.	--[2]	2	1
2	Gas charge leakage test (see 4.6.5.1)								
3	50	--[3]	500	200	3,000	-65 max.	-65 max.	0.5	5
4	500	0.2 to 2	500	200	3,000	-40 max.	-65 max.	1	3
5a	2,500	3 to 10	1,000	200	3,000	275	--[2]	3	3
5b	7,500	3 to 10	1,000	200	3,000	225	--[2]	3	3
6a	12,500	3 to 10	500	2,600	3,000	275	--[2]	2	3
6b	37,500	3 to 10	500	2,600	3,000	225	--[2]	2	3
7a	12,500	Optional	N/A[4]	10	3,500	100	--[2]	N/A	N/A
7b	500,000	Optional	N/A[4]	200	3,000	275	--[2]	N/A	N/A
7c	1,000,000	Optional	N/A[4]	2,000	3,000	100	--[2]	N/A	N/A

[1]The tests for steps 1 through 6 will be conducted in a test rig similar to that shown in figure 2. During all cycling tests, the gas side of the accumulators shall be lubricated with an amount of fluid equal to approximately 0.50 of 1 percent of the accumulator rated volume. Fluid leakage shall be determined by draining through the gas port without disassembling the accumulator. Gas pressure shall be measured at stabilized and identical temperature before and after each step of table II.

[2]Ambient temperature shall be maintained so that the gas temperature equals or exceeds the fluid temperature at the end of each compression stroke.

[3]The accumulators shall be charged to a minimum of 3,000 psi fluid pressure. Accumulators shall be maintained in this condition for 24 hours at the temperature specified in step 3 of table II. The 50 cycles shall be fast discharge followed immediately by recharge with oil at the specified temperature. A 2 hour minimum interval shall elapse between each cycle.

[4]The accumulator piston shall be removed for all tests of step 7. The gas port shall be capped during this test. This test is intended to prove design of the accumulator shell construction and end cap construction. These tests shall be conducted in a test rig similar to that shown in figure 3. The rate of pressure buildup and the peak pressures shall be recorded at the start and finish and at least 10 equally spaced intervals during each test. The pressure buildup rate shall be between 100,000 psi and 200,000 psi per second.

[5]Be sure not to count the lubrication fluid on the gas side as leakage.

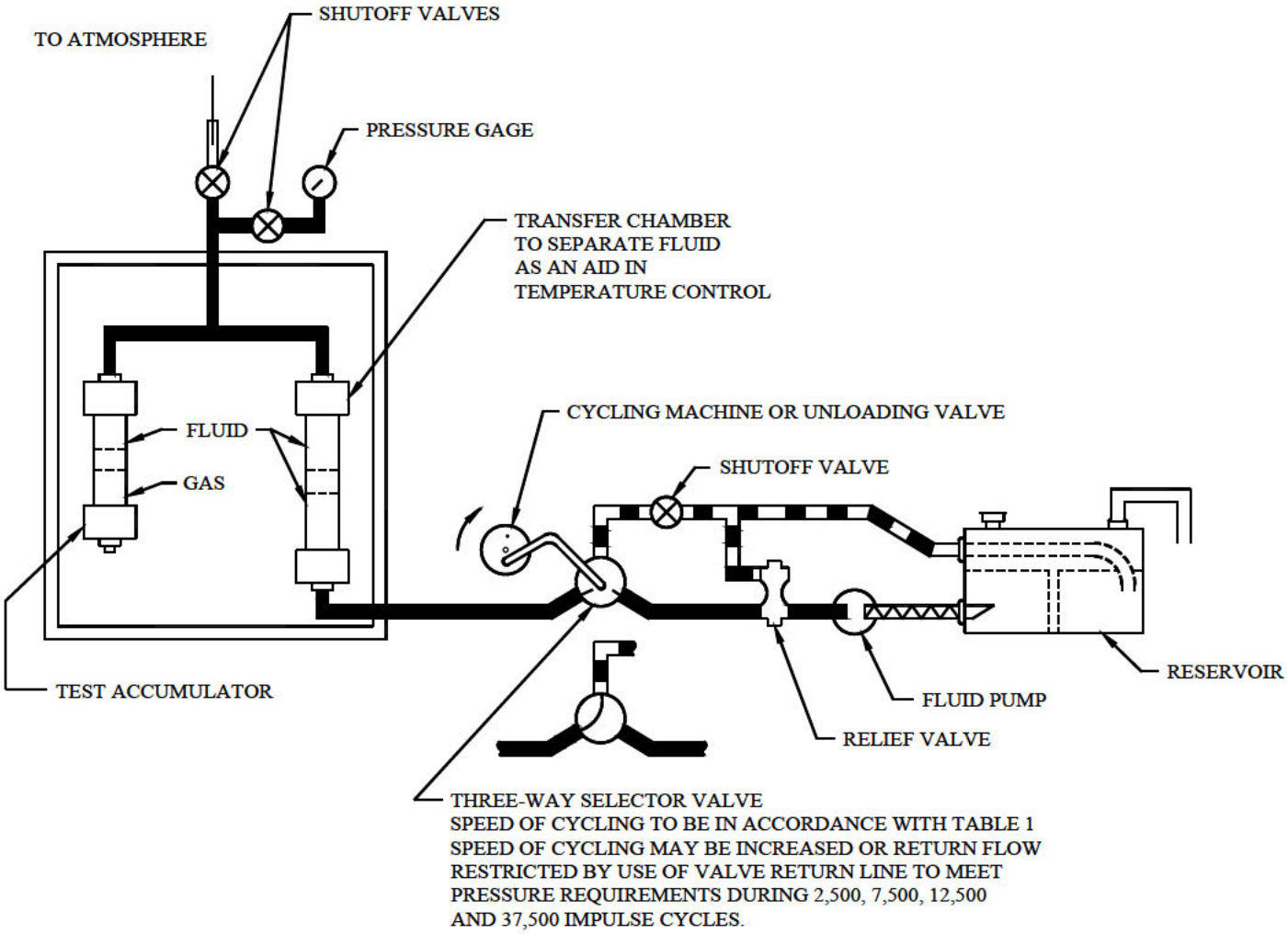
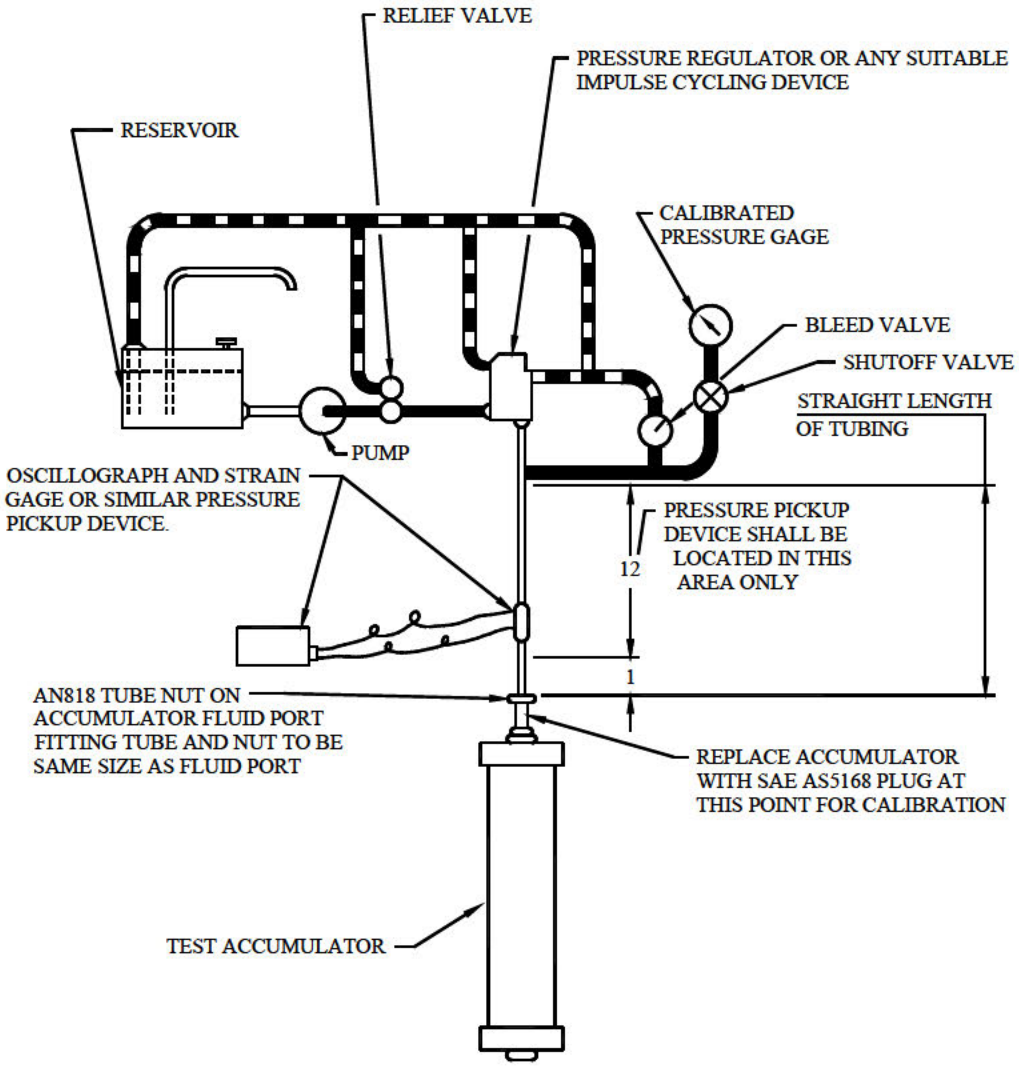


FIGURE 2. Typical accumulator cycling test setup (steps 1 to 6).



Dimensions in inches.

FIGURE 3. Typical cycling and endurance test setup (step 7).

4.6.5.1 Gas charge leakage. Immediately after completion of the tests specified in step 1 of table II, the fluid port shall be opened to the atmosphere. The accumulator shall be placed in a cold box and the temperature shall be reduced to -65 °F. The gas pressure shall be replenished to provide 1,000 psi pressure when the temperature is stabilized at -65 °F. The accumulator shall be kept in a horizontal position for a period of 24 hours. There shall be no external leakage. Leakage of gas through the fluid port shall not exceed the rate of:

a. 2 milliliters (mL) of free gas per hour for M5498-1 and -2 accumulators.
b. 3 mL of free gas per hour for M5498-3, -4, and -5 accumulators.
c. 10 mL of free gas per hour for M5498-6 and -7 accumulators.

4.6.6 Leakage. After completion of step 6 in table II, the leakage tests specified in 4.6.6.1 and 4.6.6.2 or 4.6.6.3 and 4.6.6.4 shall be performed. After completion of the leakage tests, the accumulator shall be disassembled and the accumulator piston removed. A new set of packing gland seals may be installed at this time. The accumulator will then be reassembled with the accumulator piston not installed and step 7 of table II will be performed.

4.6.6.1 Normal temperature gas leakage for qualification tests. With the fluid port open to atmosphere, gas pressure shall be applied to the gas port at both 200 psi ± 25 psi and 2,000 psi ± 50 psi. There shall be no evidence of external leakage. Internal leakage shall be no greater than:

a. 5 mL per hour of free gas for M5498-1 and -2 accumulators.
b. 10 mL per hour of free gas for M5498-3, -4, and -5 accumulators.
c. 20 mL per hour of free gas for M5498-6 and -7 accumulators.

4.6.6.2 Fluid leakage for qualification tests. With the accumulator mounted in a vertical position with the gas port down and open to the atmosphere of 4 inches ± 0.5 inches of mercury and 3,000 psi ± 50 psi shall be applied to the fluid port for a period of 1 hour. There shall be no evidence of external leakage and internal leakage shall not exceed a total of two drops.

4.6.6.3 Normal temperature gas leakage for conformance tests. With the fluid port open to atmosphere, gas pressure shall be applied to the gas port at both 200 psi ± 25 psi and 2,000 psi ± 50 psi. There shall be no evidence of external leakage. Internal leakage shall be no greater than:

a. 2 mL per hour of free gas for M5498-1 and -2 accumulators.
b. 3 mL per hour of free gas for M5498-3, -4, and -5 accumulators.
c. 10 mL per hour of free gas for M5498-6 and -7 accumulators.

4.6.6.4 Fluid leakage test for conformance tests. This test shall be conducted in a manner similar to that described in 4.6.6.2 except that pressure shall be applied for a period of 3 minutes only.

4.6.7 Seizing of parts. All accumulators shall be tested for seizing of parts throughout the temperature range of 275 °F to -65 °F. Operation of the unit during this test can be accomplished by removing the seals from the piston and then manually sliding the piston through its entire stroke by use of suitable push rods through the oil and air ports. If fluid is used to accomplish the cycling, the entire amount of fluid used shall have reached the proper stabilized temperature. The method used shall be recorded in the test report. The assembly shall be maintained at a temperature not less than 275 °F for at least 6 hours, after which two cycles of operation shall be made. The assembly shall then be rapidly cooled to a temperature not greater than -65ºF. The sliding parts shall be operated at least 10 full cycles of operation spaced throughout the cooling period and at least two complete cycles after the 24-hour period. The assembly shall then be rapidly warmed up to room temperature and operated at least 10 full cycles of operation spaced throughout the warming period. There shall be no evidence of malfunctioning or seizing of parts caused by thermal contraction or expansion of the parts.

4.6.8 Non-destructive inspection. All parts made of ferrous materials shall be subjected to magnetic inspection in accordance with ASTM E 1444. All aluminum parts shall be penetrant inspected in accordance with ASTM E 1417. These tests shall reveal no cracks or other injurious defects.

4.6.9 Burst pressure. The burst test shall be conducted on only one of the two qualification test units. The piston shall be in approximate mid-position and the gas chamber shall be filled with fluid. With the fluid and unit temperature stabilizing at a minimum temperature of 275 °F, the pressure shall be applied at the fluid port from a maximum pressure source of 25,000 psi until a pressure of 12,000 psi is obtained. The accumulator shall not rupture.

4.6.10 Fragmentation. This test shall be conducted on only one of the two qualification test units. The accumulator shall be pre-charged to 1,200 psi gas pressure, charged to 3,000 psi fluid pressure and shall be hit with a .50 caliber projectile fired at a range of 25 yards to 50 yards. The projectile shall have a muzzle velocity of 2,700 feet per second to 2,900 feet per second. The projectile shall tumble and shall not be considered tumbled unless the projectile produces an entry hole of at least 0.50 inch wide by 1.50 inches long. The accumulator shall be supported in a manner similar to a typical aircraft mounting. Attached to the fluid port shall be a length of tubing with a shutoff valve located 3 feet from the port. The projectile shall be directed so that it will hit the fluid side of the accumulator approximately midway between the piston and the mounting strap. The accumulator, when struck by gun fire as specified, shall remain in one piece and the greatest dimension of the opening (cut and tear) created by the projectile shall not exceed the dimensions of the hole (cut) created by the projectile by more than 3 inches in any one direction. Cutting shall be considered as the actual section of the accumulator cut by contact with the projectile and a tear shall be considered as an extension beyond the cut.

4.7 Maintenance of qualification. At specified intervals determined by the qualifying activity, the manufacturer must be able to demonstrate that the company still has the capabilities and facilities necessary to produce the QPL items in accordance with this specification and the provisions governing qualification specified in SD-6.

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 command. 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. This aircraft hydraulic accumulator is intended for use in aircraft for both type I and type II hydraulic systems specified in SAE AS5440. Unless otherwise authorized by the contracting activity, only hydraulic fluids conforming to MIL-PRF-83282 should be used in the accumulator.

6.2 Acquisition requirements. Acquisition documents should specify the following:

a. Title, number, and date of this specification.
b. Size (see 1.2 and table I).
c. The specific issue of individual documents referenced (see 2.2.1, 2.2.2, and 2.3).
d. Packaging (see 5.1).

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products that are, at the time of award of contract, qualified for inclusion in Qualified Products List QPL-5498 whether or not such products have actually been listed by that date. The attention of the contractors is called to these requirements, 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. Information pertaining to qualification of products may be obtained from Defense Supply Center Richmond, Attn: DSCR-VEB, 8000 Jefferson Davis Highway, Richmond, VA 23297 or STDZNMGT@dla.mil.

6.4 Subject term (key word) listing.

fluid port
gas port
piston
separator

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.

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

Preparing Activity:
DLA - GS1

(Project 1650-2006-001)

Review Activity:
Air Force - 71

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 database at http://assist.daps.dla.mil.