MIL-C-6026B
9 OCTOBER 1959
SUPERSEDING
MIL-C-6026A(ASG)
2 OCTOBER 1953

MILITARY SPECIFICATION

CONTROL UNIT, PRESSURE GENERATING, MANUALLY OPERATED, AIRCRAFT HYDRAULIC BRAKE SYSTEM

This specification has been approved by the Department of Defense and is mandatory for use by the Departments of the Army, the Navy, and the Air Force.

1. SCOPE

1.1 This specification covers manual pressure-generating brake control units as defined by Specification MIL-H-5440.

2. APPLICABLE DOCUMENTS

2.1 The following documents, of the issue in effect on date of invitation for bids, form a part of this specification:

SPECIFICATIONS

MILITARY

MIL-H-5440 — Hydraulic Systems: Design, Installation and Tests of Aircraft (General Specification for).

MIL-P-5517 — Plastic Parts in Aircraft Hydraulic Equipment; General Tests for.

MIL-H-5606 — Hydraulic Fluid, Petroleum Base, Aircraft and Ordnance.

MIL-B-8584 — Brake Systems, Wheel, Aircraft, Design of.

MIL-A-8625 — Anodic-Coatings, for Aluminum and Aluminum Alloys.

MIL-A-8629 — Airplane Strength and Rigidity.

MIL-H-8775 — Hydraulic System Components, Aircraft, General Specification for.

STANDARDS

MILITARY

MIL-STD-105 — Sampling Procedures and Tables for Inspection by Attributes.

MIL-STD-129 — Marking for Shipment and Storage.

(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 Preproduction sample. Prior to beginning quantity production, preproduction samples shall be subjected to preproduction testing. The preproduction sample shall be

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produced by the same method and of the same material that will be used for quantity production of the item.

3.2 **General.** The requirements of specification MIL-H-8775 apply as a requirements of this specification with the exceptions and additions specified herein. When the two specifications conflict, this specification shall govern.

3.3 **Design and construction.** Design of control units for manually operated hydraulic brake systems shall consist of a mechanically actuated hydraulic power generator. The incorporation into the unit of a reservoir to maintain a reserve supply of fluid shall be optional. This unit shall be operable by the pilot's brake pedal, and it shall conform to the applicable requirements of Specification MIL-B-8584.

3.3.1 *Operation temperatures.* The control units shall be designed and constructed for operation at temperatures of from —54° to 71°C. (—65° to 160°F.).

3.3.2 *Operating pressure.* Normal operating pressure shall be that pressure required to lock the wheels of the airplane, assuming a coefficient of friction of 0.31 between the tires and the ground. Maximum operating pressure shall be that pressure required to lock the wheels of the airplane, assuming a static coefficient of friction of 0.55 between the tires and the ground.

3.3.3 *Pumping.* Control units shall be designed to permit "pumping up" of the hydraulic pressure in a brake system where the control unit travel to operate the brake may become greater than the travel normally required, such as in the case of a failed packing in the unit, or a leak in the brake system. It shall also serve to facilitate bleeding of air from the brake system and maintaining an airfree system. The pumping valve shall remain sealed at all times during the operating stroke of the unit, but shall be designed to open immediately at any time when the brake line hydraulic pressure may become appreciably less than the reservoir pressure. Pressure drop through the valve during pumping shall be sufficiently low to assure compliance with the pumping test specified in 4.8.3.

3.3.3.1 *Return mechanism.* A means shall be provided within the unit to return the pressure generator to its relaxed position upon release of the actuating force. The return rate shall be sufficiently rapid to provide a pressure drop in the unit enough greater than that in the brake system to assure a buildup to the required pressure within the required number of pumping strokes when tested as specified in 4.8.3.

3.3.4 *Bleeding.* Provisions shall be made in the design of the control unit in order that the pumping valve is mechanically unseated and remains open when the unit is in the relaxed position with no mechanical force applied.

3.3.5 *Structural strength.* The structural strength of the control units shall be such that no part of the unit or its mounting shall give evidence of failure under the maximum imposed mechanical operating loads, or wrench torque loads required for making connections. Operating load strengths shall be as specified in Specification MIL-A-8629.

3.4 **Performance.** The control unit shall satisfy the performance requirements specified in Section 4 when subjected to the following tests:

(a) Immersion (4.8.2).
(b) Pumping (4.8.3).
(c) Elevated temperature cycling (4.8.4).
(d) Cold temperature cycling (4.8.5).
(e) Life (4.8.6).
(f) Proof pressure and leakage (4.8.7).
(g) Efficiency (4.8.7.3).
(h) Burst pressure (4.8.8).

3.5 **Marking.** All ports for tube connections shall be clearly and permanently marked to indicate the proper connections to be made.

4. QUALITY ASSURANCE PROVISIONS

4.1 Unless otherwise specified herein, the supplier is responsible for the performance of all inspection requirements prior to submission for Government inspection and acceptance. Except as otherwise specified, the supplier may utilize his own facilities or any commercial laboratory acceptable to the Government. Inspection records of the examinations and tests shall be kept complete and available to the Government as specified in the contract or order.

4.2 The quality assurance provisions of Specification MIL-H-8775 shall apply as quality assurance provisions of the specification with the exceptions and additions specified herein. When the two specifications conflict, this specification shall govern.

4.3 Classification of tests. The inspection and testing of control units shall be classified as follows:

(a) Preproduction tests (4.4).

(b) Acceptance tests (4.5).

4.4 Preproduction tests.

4.4.1 One sample test unit of a new design shall be made with critical fits within 10 percent of the minimum allowed clearances specified by the detail drawing tolerances and with maximum squeeze piston and rod packings. This unit shall be used for the elevated temperature cycling test and the cold temperature cycling test, as specified in 4.8.4 and 4.8.5, respectively.

4.4.2 The second sample unit shall be made with critical fits within 10 percent of the maximum allowed clearances specified by the detail drawing tolerances. It shall also have maximum squeeze piston and rod packings. It shall be subjected to the Life test (4.8.6) and all other tests required by this specification, as described under 4.8.

4.4.3 *Tests.* The preproduction tests of brake control units shall consist of all the tests of this specification as described under 4.8.

4.5 Acceptance tests. The acceptance tests shall consist of individual tests and sampling tests.

4.5.1 *Individual tests.* Each control unit submitted for acceptance under contract shall be subjected to the following tests, as described under "Test methods":

(a) Examination of product (4.8.1).

(b) Pumping (4.8.3).

(c) Proof pressure and leakage (4.8.7).

4.5.2 *Sampling tests.* Sample control units shall be selected from each inspection lot in accordance with Standard MIL-STD-105 at inspection level II using an acceptable quality level (AQL) of 1.0 percent defective for the following tests described under 4.8:

(a) Immersion (4.8.2).

(b) Elevated temperature cycling (4.8.4).

(c) Cold temperature cycling (4.8.5).

(d) Life test (4.8.6).

(e) Efficiency (4.8.7.3).

(f) Burst pressure (4.8.8).

(g) Packing, packaging, and marking (4.9).

4.5.3 *Rejection and retest.*

4.5.3.1 *Preproduction test failure.* The failure of any preproduction test unit subjected to the tests as the first unit of a new design shall be cause for rejection of the design represented. The acceptance of the remaining control units on a contract or purchase order shall be dependent upon approval of the test results on the preproduction sample required by 4.4.3 of this specification.

4.5.3.2 *Acceptance test failure.* Rejected lots may be resubmitted in accordance with paragraph titled "Resubmitted lots" of Standard MIL-STD-105. A resubmitted lot shall be inspected using tightened inspection. Before resubmitting, full particulars concerning the previous rejections and the action taken to correct the defects found in the original units shall be furnished to the inspector. The units rejected after retest shall not be resubmitted without the specific approval of the procuring activity.

4.5.3.3 *Inspection lot.* For purpose of inspection sampling, an inspection lot shall be all control units manufactured under the same conditions and offered for inspection at one time.

4.6 Report of tests. A test report, in duplicate, showing the quantitative results for all the tests required by this specification, shall be submitted to the procuring activity.

4.7 Test conditions.

4.7.1 *Test fluid.* Hydraulic fluid used for all tests shall conform to the requirements of Specification MIL-H-5606.

4.7.2 *Temperature.* Unless otherwise specified, tests shall be conducted with the oil at a temperature of 21° to 48°C. (70° to 110°F.). The actual temperature shall be reported.

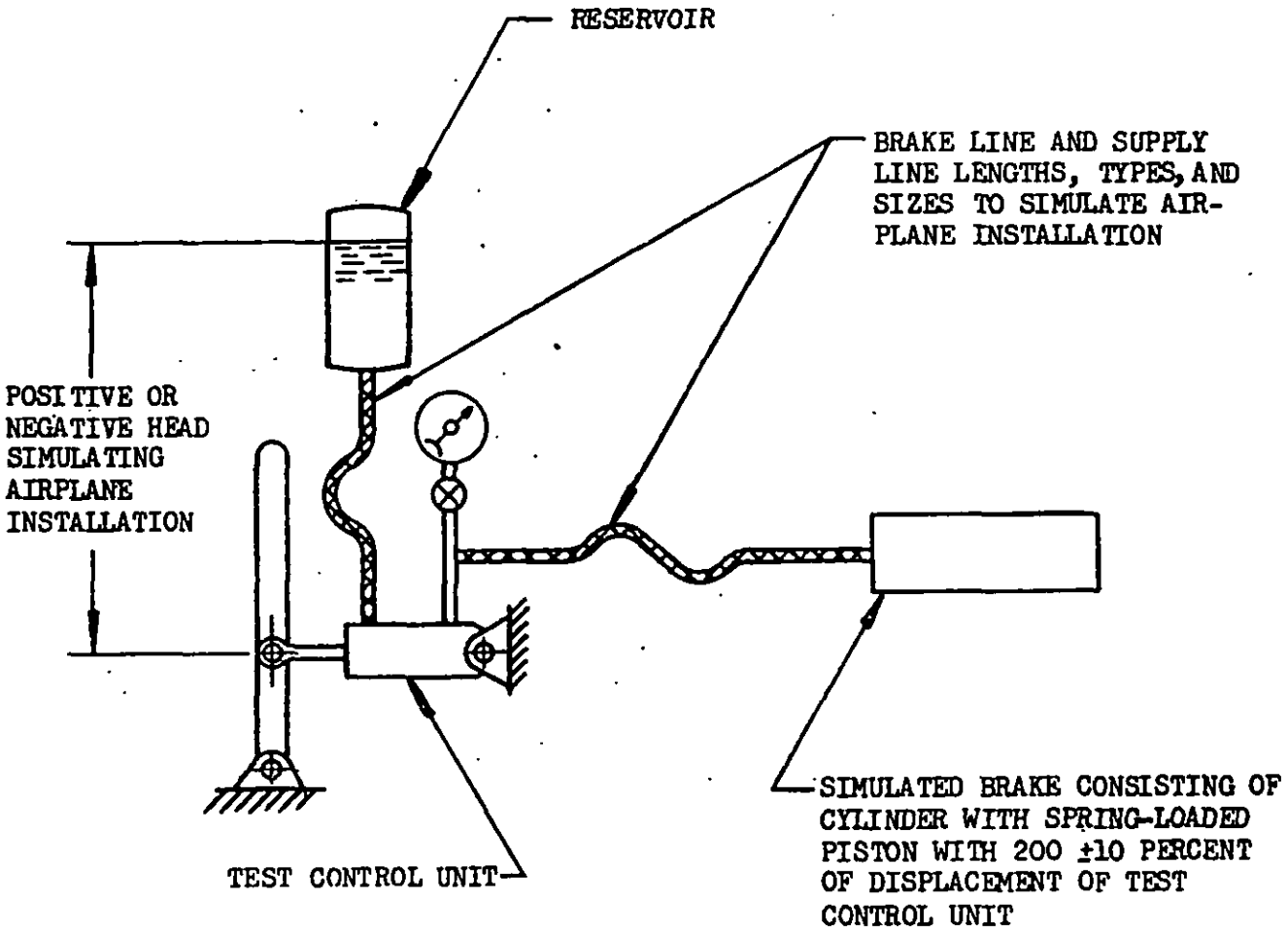
4.7.3 *Pressure.* Operating pressures for all tests shall be those required by the particular brake installation for which the control unit will be used, as specified in 3.3.3.

4.8 Test methods.

4.8.1 *Examination of product.* Each control unit shall be carefully examined to determine conformance to this specification with respect to materials, workmanship, and conformance to the limiting dimensions indicated on the applicable manufacturer's drawings as approved by the procuring activity.

4.8.2 *Immersion of plastic parts.* Control units containing plastic parts shall be subjected to and shall meet the test requirements of Specification MIL-P-5517. These tests shall be conducted prior to all other tests for first articles unless these tests are specifically waived by the procuring activity on the grounds that the plastic material used has been previously approved in similar usage.

4.8.3 *Pumping.* The reservoir inlet port of the control unit shall be connected to a supply reservoir and the brake port to a simulated brake consisting of a cylinder having a spring-loaded piston. Line lengths, types, and sizes, together with reservoir head pressure used (or intended to be used) in the airplane installation, shall be simulated in the test. The simulated brake shall require a minimum of 30 psi for initial movement of the piston, after which pressure reaction shall increase linearly with displacement, reaching at least 200 psi after having been displaced by a volume equivalent to 200 ±10 percent of the minimum full displacement of the control unit. At that point it shall bottom. The control unit shall fully displace the piston and reach normal operating pressure within five actuating strokes with hydraulic fluid and the control unit at (a) 71° ±3°C. (160° ±5°F.), and (b) —29° ±3°C. (—20° ±5°F.). Return of the unit to its relaxed position preparatory to the next pumping stroke, shall be self-motivated. A schematic diagram of the test setup is shown in figure 1.



PUSH-TYPE CONTROL UNIT SHOWN IN THIS SCHEMATIC DIAGRAM. REVERSE PORTING FOR PULL-TYPE CONTROL UNIT.

FIGURE 1. Pumping test setup

4.8.3.1 A qualitative type of pumping test may be substituted in place of the foregoing test for individual tests only, in which the brake port shall be capped while the control unit is held in its fully actuated position. As the control unit is cycled, a rapid decrease in the length of successive pressure strokes of the piston shall be noted. Return of the piston, preparatory to the next pressure stroke, shall be self-motivated. This test shall be conducted at a room temperature of 9.9° to 43°C. (50° to 110°F.) and with hydraulic fluid at a temperature of 21° to 54°C. (70° to 130°F.).

4.8.4 *Elevated temperature cycling.* Both the reservoir supply port and the brake port of the control unit shall be connected to a reservoir, with a shut-off valve in the brake port line. The shutoff valve shall be opened and the unit and lines filled with hydraulic fluid. The reservoir shall provide a static fluid pressure head to the unit of at least 2 feet. The unit shall be so mounted that all working ports, gaskets, and seals are in contact with the fluid. The unit shall be held in the fully actuated position (but with zero operating pressure) and the temperature of the unit maintained at 70° ±1°C. (158°

±2°F.) for 8 hours. Observation shall be made for any external leakage. The shutoff valve in the brake port line shall then be closed and the unit operated through at least 20 cycles at the elevated temperature. Where part of the test setup is outside the hot box, care should be taken in order that no cool fluid comes in contact with the unit. One elevated temperature cycle shall consist of one complete suction stroke followed by the application of sufficient force to produce maximum operation pressure. This force shall be maintained for 5 minutes, and any indication of pumping valve leakage as evidenced by visible rod movement after the force is applied shall be noted. Any binding within the unit, failure of the unit to generate pressure, or any other malfunctioning at any point in the cycle shall be noted. Not more than one or two drops of external leakage shall be allowed during the temperature stabilizing period or the pumping phase of the test. A schematic diagram of the test setup is shown in figure 2.

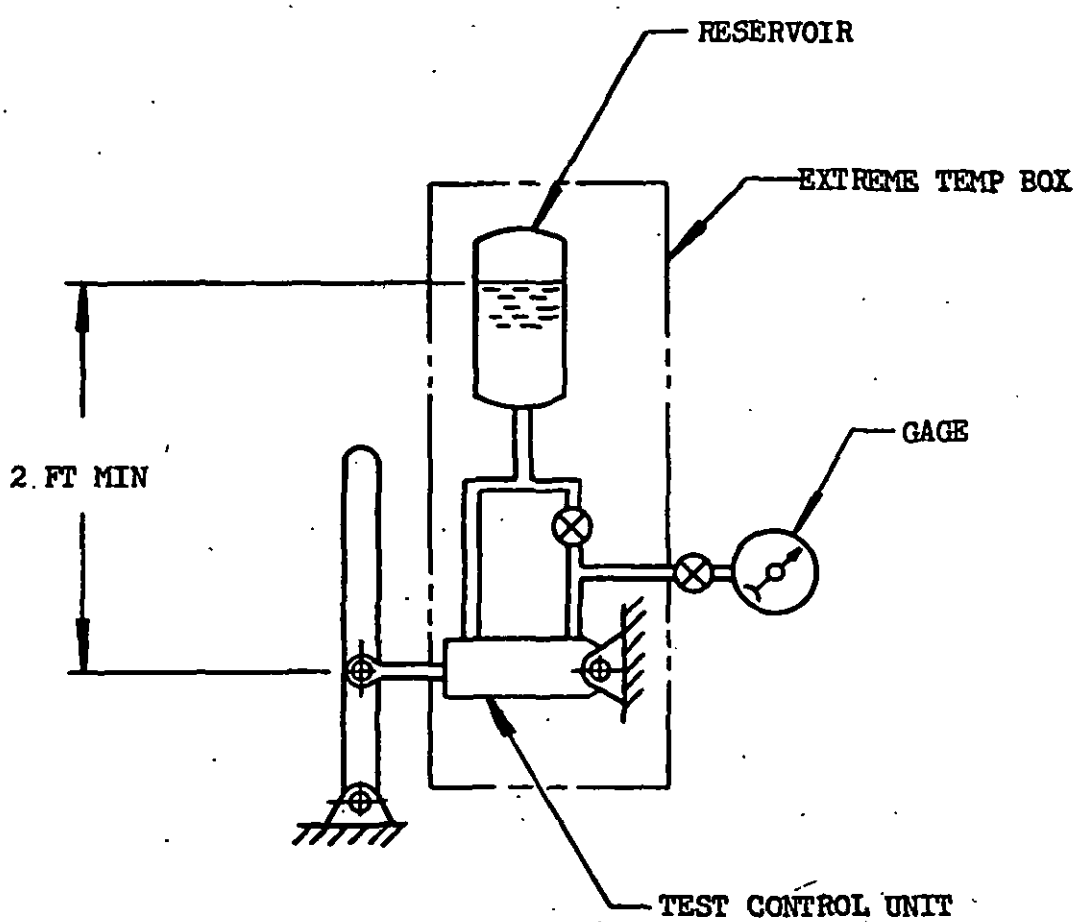


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FIGURE 2. Extreme temperature cycling test setup

pressure. The unit shall pump at least 25 percent of its rated displacement through the relief valve during each cycle. Each stroke of the unit shall be at least 90 percent of that stroke required for maximum fluid displacement of the unit, and maximum operating pressure shall be reached at least once during each cycle. At the conclusion of this test, the unit shall pass the proof pressure and leakage test (4.8.7), the volumetric efficiency test (4.8.7.4), and the Mechanical efficiency test (4.8.7.5). A schematic diagram of the test setup is shown in figure 3.

4.8.7 *Proof pressure and leakage.*

4.8.7.1 *Harnessed condition.* With the control unit harnessed in midposition, hydraulic pressures of 25 psi and 200 percent of maximum operating pressure shall be applied at the brake port with the reservoir filler port open. After the pumping valve is closed, internal leakage shall not exceed two drops per minute in 2 minutes after the first minute at either pressure. There shall be no permanent distortion, failure, of malfunctioning of any part of the unit.

4.8.7.2 *Unharnessed condition.* With the control unit unharnessed, a static hydraulic pressure of 5 psi and 200 psi shall be applied to both the brake and reservoir filler ports. There shall be no external leakage at either pressure, nor shall there be any permanent distortion, failure, or malfunctioning of any part of the unit.

4.8.7.3 *Efficiency.*

4.8.7.4 *Volumetric efficiency.* Before and after the life test (4.8.6), the fluid displacement of the unit shall be measured by directing the unit output through a relief valve, sea at the maximum operating pressure and into a fluid graduate. The average value of displacement perstroke for five successive 100-percent strokes of the unit shall in no case be less than the rated displacement of the unit.

4.8.7.5 *Mechanical efficiency.* The unit, including its return mechanism shall be so mounted that a mechanical load can be applied to actuate the unit. A means shall be provided to measure the mechanical load applied. The unit shall then be operated through at least 90 percent of its available stroke to produce the maximum operating pressure, and the mechanical force applied to the unit to produce this pressure shall be measured. To facilitate this procedure, the displaced fluid may be pumped through a relief valve set at the maximum operating pressure. The ratio of the force calculated to produce the same hydraulic pressure in the unit, neglecting packing friction, mechanical friction, and return mechanism forces, to the force actually required, shall be known as the mechanical efficiency.

$$\text{Efficiency (percent)} = \frac{\text{Calculated force} \times 100}{\text{Actual force}}$$

Mechanical efficiency shall be determined both before and after the life test (4.8.6). At no time shall this efficiency be less than 80 percent.

4.8.8 *Burst pressure.*

4.8.8.1 *Harnessed condition.* With the control unit harnessed in midposition, a hydraulic pressure of 400 percent of maximum operating pressure shall be applied at the brake port with the reservoir port open, and held for a period of 1 minute. There shall be no external leakage or rupture of any part of the unit.

4.8.8.2 *Unharnessed condition.* With the control unit unharnessed, a static hydraulic pressure of 400 psi shall be applied at both the brake and the reservoir filler ports and held for a period of 1 minute. There shall be no external leakage or rupture of any part of the unit.

4.9 Packing, packaging, and marking. The inspector shall ascertain that the packing, packaging, and marking of the control units

conform to the requirements of section 5 of this specification.

5. PREPARATION FOR DELIVERY

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

6. NOTES

6.1 Intended use. The control units covered by this specification are intended for use in aircraft hydraulic brake systems as covered by Specification MIL-B-8584 and are the mechanisms used to transform the force applied by the aircraft personnel into hydraulic force. The control units should not be used with any hydraulic fluid other than that conforming to Specification MIL-H-5606 unless otherwise specified by the Government.

6.2 Ordering data. Procurement documents should specify the following:

(a) Title, number, and date of this specification.

(b) Selection of applicable levels of packaging and packing.

6.2.1 It is expected that the contract or purchase order will specify that two control units of each size will be required as preproduction samples and that these preproduction samples will be subjected to the preproduction tests to determine compliance with the requirements of this specification. The invitation for bids and the contract should specify the point of inspection for these tests.

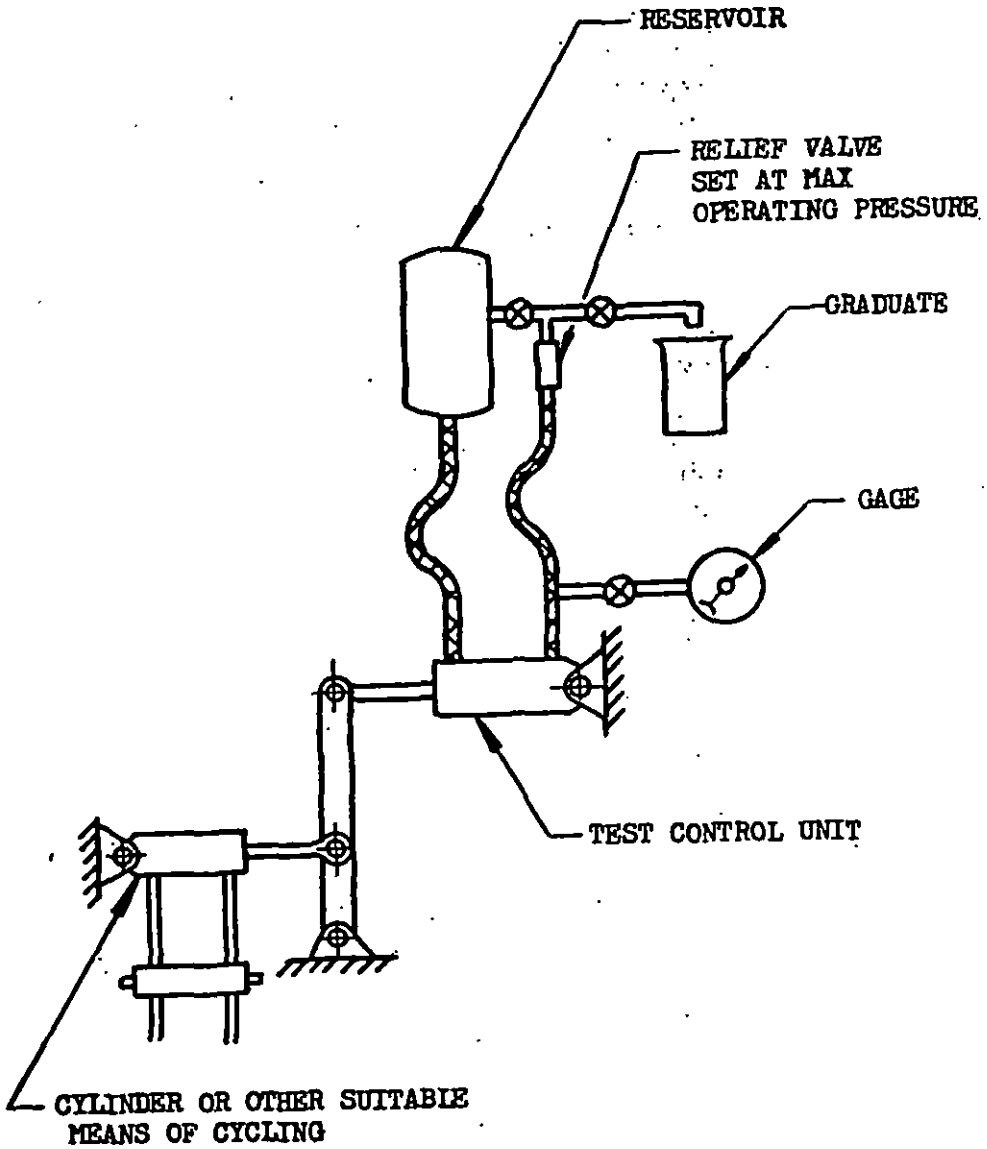
6.2.2 *Storage surveillance.* Items preserved and packaged in accordance with level B requirements must be inspected to determine condition when not used within the time period indicated. Items not used within the time period specified must either be preserved or packaged again in accordance with level B requirements in this specification or with level A requirements if storage beyond an additional year is anticipated.

Custodians:
Army—Transportation Corps
Navy—Bureau of Aeronautics
Air Force

Preparing activity:
Navy—Bureau of Aeronautics

4.8.5 *Cold temperature cycling.* The same procedure shall be followed and the same requirements met in the cold temperature cycling test as were specified for the elevated temperature cycling test (4.8.4) with the exception that the soaking and cycling temperature shall be not warmer than —54°C. (—65°F.). A schematic diagram of the test setup is shown in figure 2.

4.8.6 *Life test.* The control unit shall be subjected to a 100,000-cycle life test in which it shall be operated as a pump against a relief valve set at the maximum operating



RETURN OF THE TEST CONTROL UNIT MAY BE BY MEANS OF ITS OWN RETURN MECHANISM INSTEAD OF THE CYCLING MECHANISM AS PICTURED.

PUSH-TYPE CONTROL UNIT SHOWN IN THIS SCHEMATIC DIAGRAM. REVERSE PORTING FOR PULL-TYPE CONTROL UNIT.

FIGURE 3. Life test setup

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