

MIL-F-5504B**17 OCTOBER 1958****SUPERSEDING****MIL-F-5504A****1 MAY 1952****MILITARY SPECIFICATION****FILTERS AND FILTER ELEMENTS, FLUID PRESSURE,
HYDRAULIC MICRONIC TYPE**

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

1. SCOPE

1.1 Scope. This specification covers micronic type hydraulic filters and filter elements suitable for use in hydraulic systems having a temperature range -65°F to $+160^{\circ}\text{F}$.

1.2 Classification. Hydraulic filter elements and filter assemblies shall be of the following types and classes as specified (see 6.3).

1.2.1 Types. Filter and filter elements shall be as specified in table I.

1.2.2 Classes.

1.2.2.1 Replaceable elements, micronic line-type filter assemblies shall be furnished in one class suitable for use with operating pressures up to and including 3,000 psi.

1.2.2.2 Replaceable element, micronic vent-type filter assemblies and elements, and micronic reservoir-type elements shall be furnished in one class suitable for use in

TABLE I. *Filter elements and assemblies*

| Replaceable micronic element | Assembly part No. | Filter element AN part No. | Rated flow capacity |
|------------------------------------|------------------------------|--------------------------------|------------------------|
| Reservoir | None | AN6236-1 -2 -3 | gpm fluid |
| | | | 7½ |
| | | | 15 |
| | | | 30 |
| Line | MS28720-4 -6 -8 -12 | AN6235-1A -2A -3A -4A | ½ |
| | | | 3 |
| | | | 6 |
| | | | 12 |
| Vent | AN6240-1 | AN6237-1 | cfm air |
| | | | 3 |

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applications not exceeding the performance requirements set forth herein.

2. APPLICABLE DOCUMENTS

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

SPECIFICATIONS**FEDERAL**

- NN-P-515 — Plywood, Container Grade.
- QQ-C-320 — Chromium Plating (Electrodeposited).
- QQ-P-416 — Plating, Cadmium (Electrodeposited).
- QQ-Z-325 — Zinc Plating (Electrodeposited).
- PPP-B-601 — Boxes, Wood, Cleated, Plywood.
- PPP-B-621 — Boxes, Wood, Nailed and Lock-Corner.
- PPP-B-636 — Boxes, Fiber.

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- MIL-B-121 — Barrier Material, Greaseproofed, Flexible (Waterproofed).
- MIL-D-5028 — Drawings and Data Lists: Preparation of Manufacturers' (for Production Aeronautical and Associated Equipment)
- MIL-C-5501 — Closure, Aircraft, Tubing, Protective.
- MIL-P-5514 — Packings, Installation and Gland Design of Aircraft Hydraulic and Pneumatic, General Specification for.
- MIL-P-5516 — Packings and Gaskets; Hydraulic, Aircraft.
- MIL-R-5520 — Reservoirs; Hydraulic.

- MIL-H-5606 — Hydraulic Fluid, Petroleum Base, Aircraft and Ordnance.
- MIL-H-6083 — Hydraulic Fluid, Petroleum Base, Preservative.
- MIL-P-6906 — Plates, Information and Identification.
- MIL-S-7742 — Screw Threads, Standard, Aeronautical.
- MIL-A-8625 — Anodic Coatings, for Aluminum and Aluminum Alloys.
- MIL-H-8775 — Hydraulic System Components Aircraft (General Specification for).

STANDARDS**MILITARY**

- MIL-STD-129 — Marking for Shipment and Storage.
- MS20995 — Wire, Lock.
- MS28720 — Filter, Aircraft Hydraulic Line Type, 3,000 psi.

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- AN814 — Plug and Bleeder—Screw Thread.
- AN6235 — Filter Element — Hydraulic Replaceable Micronic Line Type.
- AN6236 — Filter Element — Hydraulic Replaceable Micronic Reservoir Type.
- AN6237 — Filter Element — Hydraulic Replaceable Micronic Vent Type.
- AN6240 — Filter — Hydraulic Replaceable Element Vent Type.
- AN6290 — Gasket — Straight Thread Tube Fitting, Boss.
- AND10050 — Bosses, Standard Dimensions for Gasket Seal Straight Thread.
- AND10074 — Boss Spacing—Hydraulic.

MIL-F-5504B**PUBLICATIONS****AIR FORCE-NAVY AERONAUTICAL
BULLETIN****No. 143 Specifications and Standards;
Use of**

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

3.2 Materials. Materials and processes used in the manufacture of these filters shall be of high quality, suitable for the purpose intended and shall conform to applicable Government specifications. Materials conforming to contractor's specifications may be used provided the specifications are approved by the Government and contain provisions for adequate tests. The use of contractor's specifications will not constitute waiver of Government inspection.

3.2.1 Metals. All metals used in the construction of these filters, except metal in constant contact with the hydraulic fluid, shall be of a corrosion-resistant type or shall be adequately protected to resist corrosion during the normal service life of the filter.

3.2.1.1 Dissimilar metals. The use of dissimilar metals in contact with each other (particularly brass, copper, or steel in contact with aluminum, magnesium, or their alloys) shall be avoided. Where contact between dissimilar metals is unavoidable, they shall be suitably protected against electrolytic corrosion.

3.2.2 Plastic parts. The use of plastic parts shall be subject to the approval of the Services for the specific application involved.

3.2.3 Replaceable filter element materials. When replaceable filter elements are used in accordance with the requirements of this specification, the materials of the replaceable filter elements shall not change the composition of hydraulic fluid conforming to Specification MIL-H-5606, nor shall the material be altered enough to affect the intended function of the replaceable filter elements.

3.2.4 Selection of materials. Specifications and standards for all materials, parts, and Government certification and approval of processes and equipment, which are not specifically designated herein and which are necessary for the execution of this specification, shall be selected in accordance with ANA Bulletin No. 143, except as provided in the following paragraph.

3.2.4.1 Standard parts. Standard parts (MS or AN) shall be used wherever they are suitable for the purpose, and shall be identified on the drawing by their part numbers. Commercial utility parts such as screws, bolts, nuts, cotter pins, etc, may be used, provided they possess suitable properties and are replaceable by the standard parts (MS or AN) without alteration, and provided the corresponding standard part numbers are referenced in the parts list and, if practicable, on the contractor's drawings. In the event there are no suitable corresponding standard parts in effect on date of invitation for bids, commercial parts may be used provided they conform to all requirements of this specification.

3.3 Design and construction.**3.3.1 General.**

3.3.1.1 The flow of fluid through the filter elements shall be from outside in except in vent-type filter assemblies, in which the flow may be in either direction.

3.3.1.2 Line-type filter.

3.3.1.2.1 Filter assemblies shall be so designed that the elements may be removed for

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service and inspection without disconnecting fittings or disturbing mountings.

3.3.1.2.2 Filters shall be of the full-flow type.

3.3.1.2.3 Filter assemblies shall be so designed that fluid entering the housing cannot impinge directly upon the element filter medium nor upon the relief valve poppet.

3.3.1.2.4 The relief valve shall be so designed that no malfunction can occur from flow surges up to 150 percent of the rated flow of the filter. At 150 percent of rated flow through the relief valve and at $100^{\circ} \pm 10^{\circ}$ F, the differential pressure across the relief valve shall not exceed 120 psi.

3.3.1.2.5 The relief valve shall be non-adjustable in order that it can be serviced in the field and parts replaced without the necessity of recalibration.

3.3.2 *Structural strength.* Line-type filter housings shall be designed to withstand all the structural loads imposed by the performance requirements of this specification. In addition, the mounting and housing shall possess enough strength and rigidity to withstand the wrench torque loads needed for making tube connections and replacing filter elements.

3.3.3 *Dimensions.* The configuration dimensions and other details of design shall conform to the applicable MS standards or AN drawings.

3.3.4 *Temperature range.* The filters shall be designed to operate satisfactorily throughout a temperature range of -65° to $+160^{\circ}$ F.

3.3.5 *Plugs.* All plugs except permanently installed plugs, which will not have to be removed during the life of the filter, shall conform to Standard AN814 and shall be sealed with gaskets conforming to Standard AN6290. Permanently installed plugs may be pipe

threaded or may be of any form suitable for the purpose intended.

3.3.6 *Assembly.* Line- or vent-type filter assemblies shall be so designed that it will be impossible to assemble the filter if the filter element is reversed.

3.3.7 *Threads.* Except for permanently installed plugs, and unless otherwise specified on the applicable standard, only straight threads conforming to Specification MIL-S-7742, Unified Fine Thread Series, Classes UNF 3A or UNF 3B shall be used.

3.3.8 *Bosses.* All bosses for connecting fittings shall conform to Standards AND10050 and AND10074.

3.3.9 *Seals.* All packings and gaskets and installations thereof shall conform to Specification MIL-P-5516 and Specification MIL-P-5514.

3.3.10 *Safetying.* All threaded parts shall be positively locked or safetied by safety wiring, self-locking nuts, or other approved methods. Safety wire shall have a minimum diameter of 0.032 inch and shall conform to Standard MS20995.

3.3.11 *Snap rings.* Snap rings, if used, shall be used in accordance with the requirements of Specification MIL-H-8775.

3.3.12 *Relief valves.* All line-type filter assemblies shall incorporate a suitable relief valve to permit by-passing of the element by the hydraulic fluid in the event of excessive restriction. Vent-type filter assemblies shall incorporate provisions for by-passing the filter element when the pressure differential through the element exceeds the value specified in 4.5.5. Reservoir-type filter elements shall be installed with a suitable relief valve, as required by Specification MIL-R-5520.

3.4 *Interchangeability.* All parts having the same manufacturer's part number shall be directly and completely interchangeable

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with each other with respect to installation and performance. Changes in manufacturer's part numbers shall be governed by the drawing number requirements of Specification MIL-D-5028. Line and vent filter bodies shall be designed to accommodate the least favorable dimensional and operational conditions permitted herein for applicable filter elements.

3.5 Finish.

3.5.1 Aluminum-alloy parts. Unless otherwise specified, all aluminum-alloy parts shall be anodized in accordance with the requirements of Specification MIL-A-8625.

3.5.2 Steel or copper-alloy parts. Unless otherwise specified, all non-corrosion-resistant steel or copper-alloy parts, except those in constant contact with hydraulic fluid, shall be cadmium plated in accordance with Specification QQ-P-416, type I, class B, chromium plated in accordance with Specification QQ-C-320, or zinc plated in accordance with Specification QQ-Z-325. Cadmium- or zinc-plating may be used in contact with hydraulic fluid provided there is no rubbing or abrasion on the surfaces to which it is applied, unless otherwise specified by the procuring activity. Surfaces in sliding contact with each other may be chromium plated.

3.5.3 No finishes or paints, other than those specified above, or no color markings other than those specified herein or otherwise authorized by the Services, shall be applied to the filters either externally or internally prior to installation.

3.6 Performance. Filter housings and filter elements shall perform satisfactorily when subjected to the tests specified in section 4 headed as follows:

Filter housings

| | |
|-----------------------------------|-----------------------|
| Examination of product | (4.5.1) |
| Proof pressure | (4.5.2) |
| Pressure drop | (4.5.5.2 and 4.5.5.3) |
| Relief-valve operation | (4.5.7) |
| Extreme-temperature operation ... | (4.5.8) |
| Impulse | (4.5.10) |
| Burst pressure | (4.5.11) |

Filter elements

| | |
|------------------------------------|-----------------------|
| Examination of product | (4.5.1) |
| Permanence of bonding material.... | (4.5.3) |
| Filter element displacement | (4.5.4) |
| Pressure drop | (4.5.5.1) |
| Degree of filtration | (4.5.9) |
| Impulse | (4.5.10.1) |
| Burst pressure | (4.5.11) |
| End load resistance | (4.5.11.4) |
| Air bubble | (4.5.6) |
| Media migration | (4.5.9.6) |
| Pressure buildup..... | (4.5.9.2 and 4.5.9.5) |
| Differential pressure | (4.5.11.3) |

3.7 Special tools. Filter assemblies shall be capable of being assembled or disassembled without the use of special tools.

3.8 Markings.

3.8.1 Direction of flow. The direction of flow shall be clearly and permanently indicated by at least two arrows marked on opposite sides of the line-type filter body. Ports on line-type and vent-type filter assemblies shall be clearly and permanently identified as noted on applicable drawings.

3.9 Identification of product.

3.9.1 Manufacturer's part number. The manufacturer's basic part number and drawing number shall be the same.

3.9.2 Nameplate. Each filter assembly shall be clearly and permanently identified by stamping, or by a securely attached nameplate conforming to Specification MIL-P-6906, with the following information. A decalcomania will not be considered permanent marking.

**FILTER, FLUID PRESSURE,
HYDRAULIC, MICRONIC TYPE
MS or AN (part No.)
Stock No. (USAF or Navy,
as applicable).
AN part No. of replaceable element.
Manufacturer's part No.
Manufacturer's name or trade-mark.**

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3.9.3 Each replaceable filter element shall have stamped or molded on a suitable part of the surface the following information. If placed on a sealing surface, the marking shall not affect the sealing of the element.

AN part No.

Manufacturer's part No.

Manufacturer's name or trade-mark.

3.9.4 *Use of AN or MIL designations.* AN or MIL designations shall not be applied to a product, except for Qualification test samples, nor referred to in correspondence, until notice of approval has been received from the activity responsible for qualification.

3.10 *Workmanship.* All details of workmanship shall be of sufficiently high grade to insure proper operation and service life.

4. QUALITY ASSURANCE PROVISIONS

4.1 *Classification of tests.* The inspection and testing of filters shall be classified as follows:

- (a) *Qualification tests:* Qualification tests are those tests performed on samples submitted for approval as qualified products.
- (b) *Acceptance tests:* Acceptance tests are those tests performed on individual lots which have been submitted for acceptance.

4.2 Qualification tests.

4.2.1 *Sampling instructions.* The Qualification test samples shall consist of two filter housings for each size upon which qualification is desired (see 4.2.1.2) and six non-metallic or three metal filter elements of each size upon which qualification is desired. Samples, together with data specified herein, shall be forwarded to the activity responsible for qualification as designated in the letter of authorization from that activity (see 6.4). One sample will be subjected to Qualification tests, and the second sample will be held for

comparison of results. Samples shall conform to the manufacturer's drawings.

4.2.1.1 The manufacturer shall provide calculations showing that no interference of moving parts will be encountered owing to differences in coefficients of expansion of materials of construction at -65°F. and $+160^{\circ}\text{F.}$

4.2.1.2 *Preliminary tests to be performed by manufacturer.* Prior to forwarding samples specified in 4.2.1, the manufacturer shall subject one filter housing of each size upon which qualification is desired to all the tests of this specification. Upon satisfactory completion of these tests, the manufacturer shall submit two copies of a test report, two sets of detail and assembly drawings of the device (see 6.2), and a letter requesting Qualification tests, to the activity responsible for qualification, with duplicate copies to the other Service.

4.2.1.2.1 *Filter elements.* The Preliminary tests to be performed by manufacturer are not required for filter elements. The manufacturer shall submit reports of the Qualification tests of other specimens of the same design and two sets of detail and assembly drawings (see 6.2).

4.2.1.3 *Identification of samples.* For shipping, the samples shall be plainly identified by securely attached durable tags marked with the following information:

Sample for Qualification test.

FILTER, OR FILTER ELEMENTS,
FLUID PRESSURE, HYDRAULIC,
MICRONIC TYPE

AN or MS part No.

Manufacturer's part No.

Submitted by (name of manufacturer)
(date) for Qualification tests in accordance with the requirements of Specification MIL-F-5504B under authorization (reference letter authorizing tests).

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4.2.1.4 Filters in series. In the case of series of filters in which each filter is intended to serve the same general function as the others in a hydraulic or pneumatic system, qualification of one filter of the series may, at the discretion of the Services, be applied to any other filter of the series if all of the internal working parts are identical in every detail with the corresponding internal working parts of the qualified filter and provided each filter meets proof, burst pressure, and such performance requirements as may be designated by the Services. For example, qualification of this type would apply to all filters which differ from previously qualified filters only in port size, port location, external body dimensions, and external body configuration.

4.2.1.5 Design change. Qualification approval applies only to the design, materials, construction, and nominal dimensions of the samples tested. These features shall be identified by the manufacturer's part number submitted in his test report. Any change in any of these features that may result in a change in performance may require new Qualification tests at the option of the activity responsible for qualification. Such changes shall be identified by the assignment of new members to the manufacturer's drawings of the filter or its component parts, or both, and shall receive Government approval prior to incorporation in production. At the option of the Government, minor changes in these features may be approved without an attendant change in the part number. The contractor shall submit to the qualifying activity a list of all parts which make up the component giving drawing numbers with dated revisions at the time of submitting samples for Qualification Tests. This list shall be revised and resubmitted when any changes are incorporated.

4.2.2 Tests. The Qualification tests of filter housing and elements shall consist of all the applicable tests listed in 3.6, entitled "Performance," and described under "Test methods."

4.3 Acceptance tests. The Acceptance tests shall consist of Individual tests.

4.3.1 Individual tests.

4.3.1.1 Filter housings. Each filter housing shall be subjected to the tests listed below and described under "Test methods." In addition, they shall be subjected to any other tests specified herein that the Inspector considers necessary to determine conformance to this specification.

- (a) Examination of product .. (4.5.1)
- (b) Proof pressure (4.5.2)

4.3.1.2 Filter elements. Each filter element shall be subjected to the tests listed below and described under "Test methods." In addition, they shall be subjected to any other tests specified herein that the Inspector considers necessary to determine conformance to this specification.

- (a) Examination of product .. (4.5.1)
- (b) Bubble test (4.5.6)

4.3.2 Rejection and retest. Failure of any filter to conform to any of the requirements of the specification shall be cause for rejection of that filter and the filters represented. Filters that have been rejected may be reworked or have parts replaced to correct the defects in the original and resubmitted for acceptance. Before resubmission full particulars concerning previous rejection and the action taken to correct the defects found in the original shall be furnished the Inspector. Units rejected after retest shall not be resubmitted without the written approval of the procuring activity.

4.4 Test conditions.

4.4.1 Test fluid. The hydraulic fluid used for all tests shall conform to Specification MIL-H-5606.

4.4.2 Temperature. Unless otherwise specified, the tests shall be conducted with the

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oil at a temperature of 90° to 110° F. The oil temperature during each test specified herein shall be noted in the test reports.

4.5 Test methods.

4.5.1 Examination of product. Each filter element and filter housing shall be examined carefully to determine conformance to applicable manufacturer's and AN or MS standards, and to the material, workmanship, and identification requirements of this specification.

4.5.2 Proof pressure. Filter housings shall withstand proof pressure as listed below without evidence of permanent deformation, malfunction, or external leakage. Proof pressures shall be applied at least twice and held for 2 minutes at each application. The pressure shall be reduced to zero between applications.

| <i>Line</i> | <i>Vent</i> |
|-------------|-------------|
| 4,500 psi | 50 psi |

4.5.3 Performance of bonding material. The element shall be subjected to the following aging cycle three successive times:

- (a) The element shall be placed in an atmosphere maintained at 70 to 75 percent relative humidity and at approximately 200° F. over a saturated aqueous solution of sodium chloride and maintained in this condition for 24 hours.
- (b) The element shall then be placed in a cold box for 24 hours at approximately — 65° F.
- (c) The element shall then be placed in a circulating-air oven for 24 hours at approximately 200° F.
- (d) The element shall then be placed in a cold box for 24 hours at approximately — 65° F.

At the conclusion of (a), (b), (c), and (d) above in sequence three times, the element shall be immersed in fluid conforming to Specification MIL-H-5606 at 160° F. for 50

hours. The element shall then be subjected to a flow test at rated flow using fluid conforming to Specification MIL-H-5606 at 160° F. The element shall not be damaged upon removal from the case.

4.5.3.1 The Air bubble test is to be conducted on line and reservoir filter elements before and after the Permanence of bonding material test. The initial bubble pressure observed before and after the Permanence of bonding material test shall vary not more than ± 10 percent.

4.5.4 Filter element displacement (dry-reservoir type). The element shall be immersed in the specified fluid for 30 minutes following which it shall be centrifuged around the element's central axis for 10 minutes at a speed of 1,200 rpm to remove excess fluid. The element shall then be inserted in a test container having a known volume of fluid and allowed to remain for 10 minutes. The difference between the original volume of fluid in the container and the volume after the element has been inserted for 10 minutes will be considered to be the dry displacement of the element and shall not exceed the values specified on Standard AN6236.

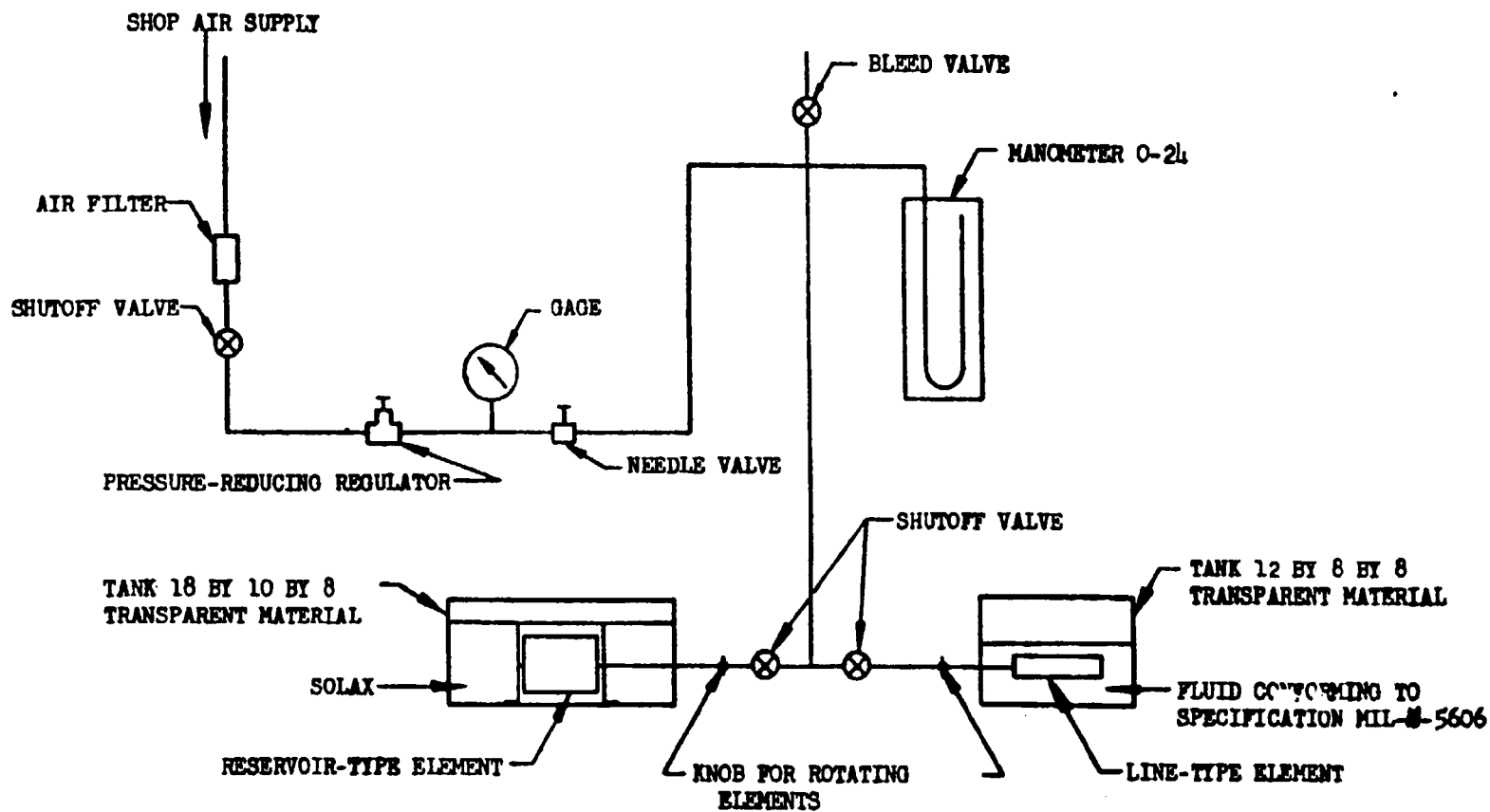
4.5.5 Pressure drop.

4.5.5.1 Filter element. The maximum pressure drop through the clean filter element with fluid previously filtered to 2 microns shall not exceed that specified in table II at rated flow.

TABLE II. Pressure drop

| Element type | Pressure drop between inlet and outlet — maximum |
|---------------------|---|
| Reservoir | 2 in. Hg (Mercury) |
| Vent | 2½ in. water |
| Line | 10 psi |

4.5.5.2 Line-type housing. The maximum pressure drop at rated flow between the inlet and outlet of the line-type filter assembly, using an AN approved filter element, shall not exceed 12 psi.



DIMENSIONS IN INCHES

FIGURE 1. Schematic diagram for Air bubble test.

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4.5.5.3 Vent-type filter housing. The vent-type filter assemblies shall be subjected to a 3-cfm flow of clean standard sea-level air during which time the pressure drop shall not exceed 3 inches of water. The element shall be clean and the air filtered to 2 microns for this test.

4.5.6 Air bubble (filter element). Line and reservoir filter elements shall be subjected to the following test:

(a) The test element shall be installed in a setup similar to that shown on figure 1. Fluid level shall be maintained $\frac{1}{2} \pm \frac{1}{32}$ inch above the top of the test element. The element shall be slowly rotated while the air pressure is gradually increased by means of the needle valve. The area of greatest porosity shall be determined by observing the first bubble on the surface of the element, and the manometer reading in inches of water at which this bubble emerges from the element. This shall be recorded as the initial bubble point. The initial-bubble-point pressure for each element shall not vary more than ± 10 percent of the value established during Government qualification.

4.5.6.1 The Air bubble test shall be conducted on filter elements before and after the Permanence of bonding material test (4.5.3) and Impulse test (4.5.10).

4.5.6.2 Reservoir-type elements shall be sealed by means of a gasket and metal plate before installation in test fixture.

4.5.6.3 Tests shall be conducted at room temperature.

4.5.7 Relief-valve operation. To test line-type filter for relief valve operation, an effective means for stopping flow through the filtering element shall be provided. By means of a power-driven pump, pressure shall be applied to the inlet port of the filter, beginning with a pressure of 25 psi and increasing

in increments of 5 psi or less until cracking pressure of the relief valve in the filter being tested is reached. At each increment the pressure shall be maintained constant for 5 minutes. At each pressure increment, time shall not be considered "in" or leakage noted until the beginning of the third minute. The leakage rate, as noted during the last 3 minutes of each pressure increment, shall be recorded. The pressure at which the leakage rate through the valve amounts to 4.0 cc (approximately 80 drops) per minute shall be considered as cracking pressure. Cracking pressure for line filters shall occur at 50 ± 5 psi. Leakage up to 40 psi shall not exceed 2.0 cc (approximately 40 drops) per minute. Pressure shall be increased until rated flow through the filter is obtained. Rated flow shall occur at a pressure differential between inlet and outlet ports not exceeding 80 psi. Pressure shall be reduced in 5-psi decrements, as above, until leakage through the valve does not exceed the rate of 2.0 cc (approximately 40 drops) per minute. This will be considered the valve reseating pressure, and shall occur at a pressure of 32 psi or above.

4.5.7.1 Cracking pressure for vent-type filter relief valves shall be determined as specified above and shall be between 4 and 5 psi.

4.5.8 Extreme-temperature operation. Filter assemblies shall be subjected to a temperature of -65° F. for 24 hours. During this period, pressure applied shall not exceed 10 psi. At the end of the specified time, operation of the relief valve shall be checked. Rated pressure shall then be applied. The temperature of the fluid used during this test shall be -65° F. The filter assembly shall then be permitted to warm up rapidly to $+160^{\circ}$ F. During this warmup period, external leakage, and relief-valve leakage and operation shall be checked at least 10 equally spaced temperature intervals up to and including 160° F. There shall be no external leakage, and relief-valve leakage shall not exceed the values specified above.

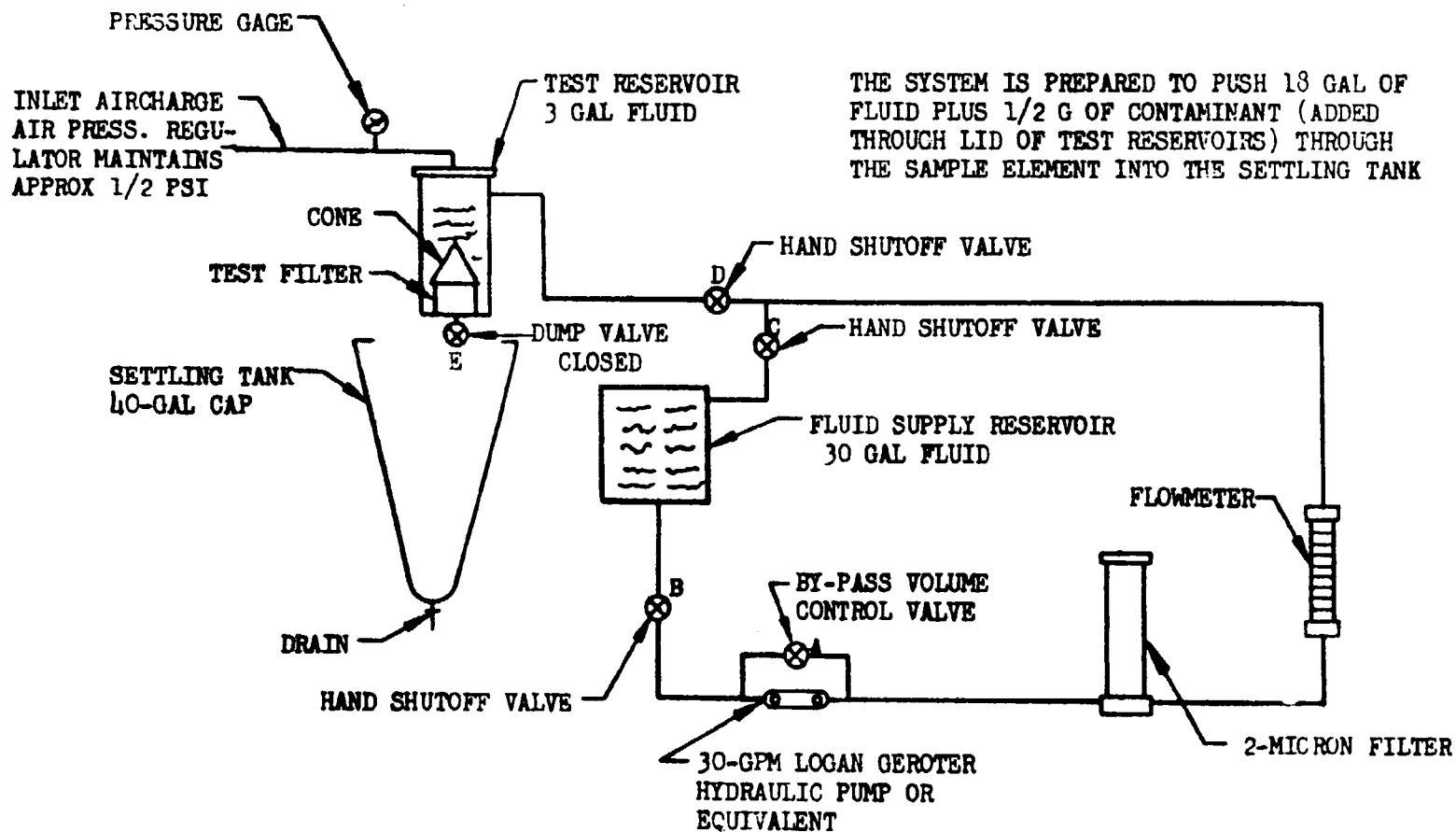


FIGURE 2. Setup for determining filter efficiency of reservoir type (Phase 1).

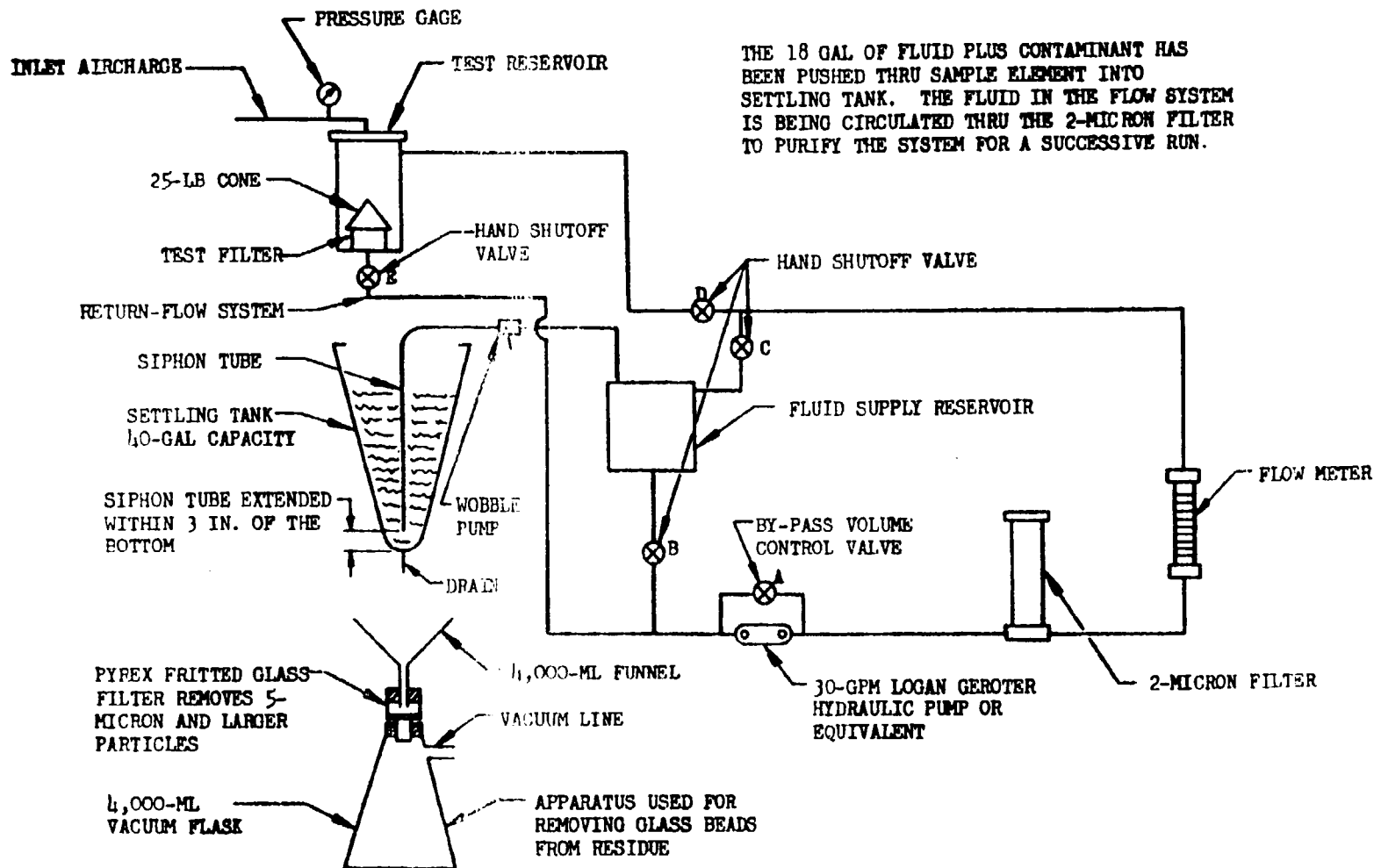


FIGURE 8. Setup for determining filter efficiency of reservoir type (Phase 2).

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4.5.9 Degree of filtration, pressure buildup, differential burst, and media migration (element). It is of primary importance that the hydraulic fluid or air be clean and filtered prior to test. Test air shall be passed through a filter that will remove all contaminant over 2 microns. The hydraulic fluid shall be filtered until a maximum contamination of 1 mg per liter is present as determined by centrifugal gravimetric methods.

4.5.9.1 Degree of filtration, reservoir-type (element). The element to be tested shall be installed in a filter test stand or in a test apparatus similar to the one shown in figures 2 and 8. The test outlined below shall be used for the dash 2 size.

- (a) Using apparatus as shown in figure 3, filter oil conforming to Specification MIL-H-5606 in the system through the 2-micron commercial 30-gpm filter for approximately 1 hour or until conditions specified in 4.5.9 are obtained.
- (b) Weigh clean pyrex fritted glass filter (capable of removing 100 percent of 10- to 20-micron glass spheres) and 0.5 gram of 10- to 20-micron glass spheres in a watch glass on an analytical balance to accuracy of 0.1 milligram.
- (c) Insert filter element to be qualified in test reservoir (on a $\frac{1}{32}$ -inch flat annular rubber gasket) with the 25-pound lead cone holding the element in place (a solid $\frac{1}{32}$ -inch flat rubber gasket is used between cone and element).
- (d) Connect return-flow-system line to hand shutoff valve (E) as shown in figure 3; open all valves but (C); and after starting pump, regulate flow by valve (A) to 15 gpm.
- (e) Shut off pump, close valve (E), and remove return line and cap off as shown in figure 2. (Test reservoir should contain 8 gallons.)
- (f) Secure chemist-type hose clamp to Tygon S22-1 plastic tube, or equivalent, at base of settling tank.
- (g) Start circulating-pump and fill test reservoir tank with fluid to a height of 16 inches.
- (h) Mix 0.5 gram of 10- to 20-micron glass spheres with a few drops of petroleum ether into a slurry-paste.
- (i) Rinse slurry into test reservoir with a wash bottle containing petroleum ether, analytical grade, with boiling range 95° to 180° F.
- (j) With system as shown in figure 2 apply a small air charge. Open dump valve (E) and start pump simultaneously allowing the effluent to fall into the settling tank. Maintain rated flow and fluid level in tank by manually regulating the air pressure. (For reservoir elements conforming to part numbers AN6236-1 and -2 use a pressure of 0.5 to 5 psi.)
- (k) For AN6236-2 elements maintain rated flow for 1 minute and push out the fluid in the test reservoir by air pressure. (Valve (D) is closed or the air pressure will blow into fluid supply system.)
- (m) Rinse drip tube with petroleum ether into settling tank.
- (n) Place cover on settling tank and allow fluid to settle for a suitable period of time. For a 20-inch depth of fluid, allow 40 hours for settling. The filtration efficiency valve will be in error by less than 0.1 percent. (Note: It is advised that in the event it is necessary to modify the procedure to shorten the length of settling time a 20-hour period will result in a 0.9-percent inaccuracy.)

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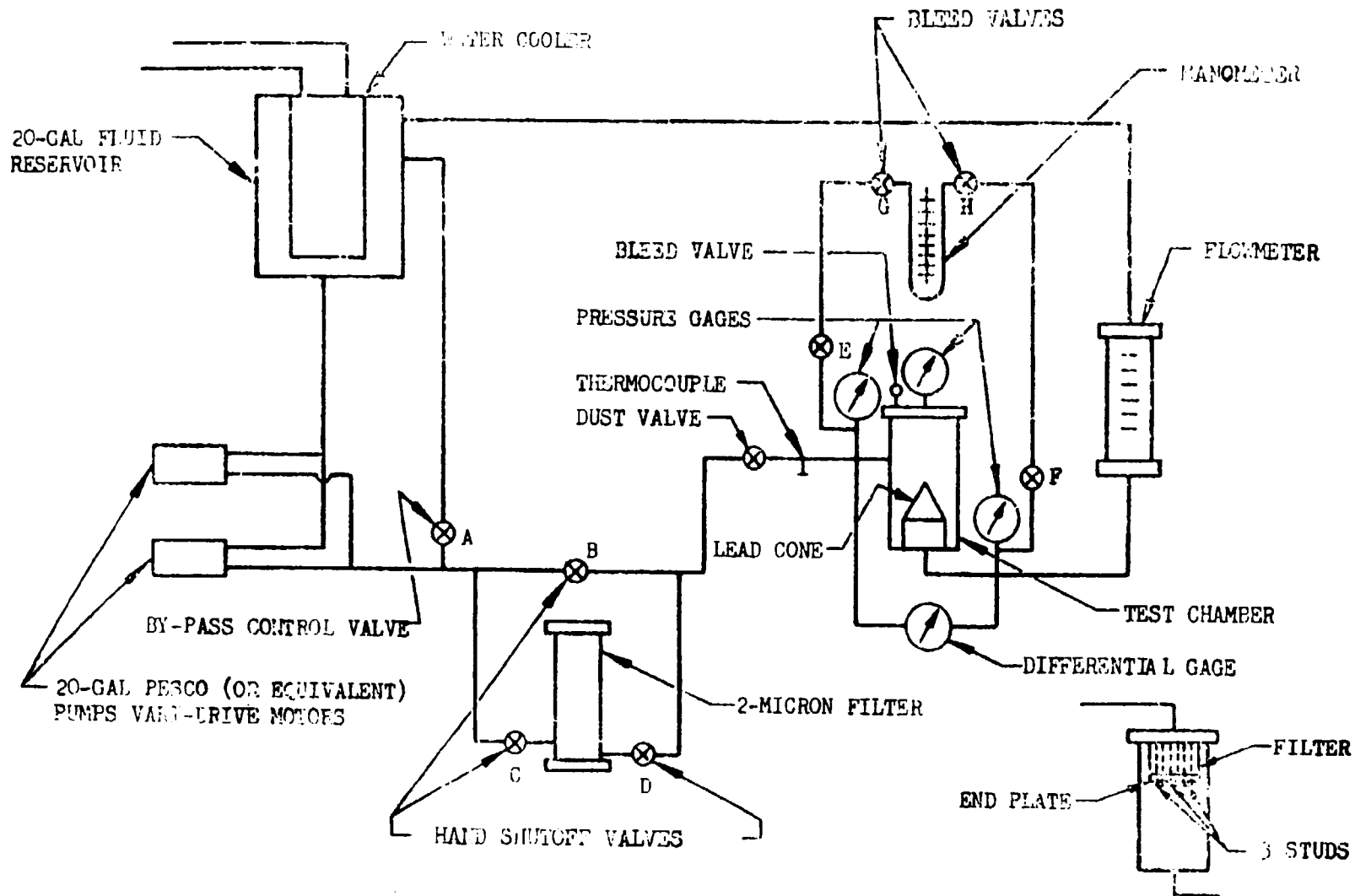


FIGURE 4. Setup for pressure buildup and burst pressure.

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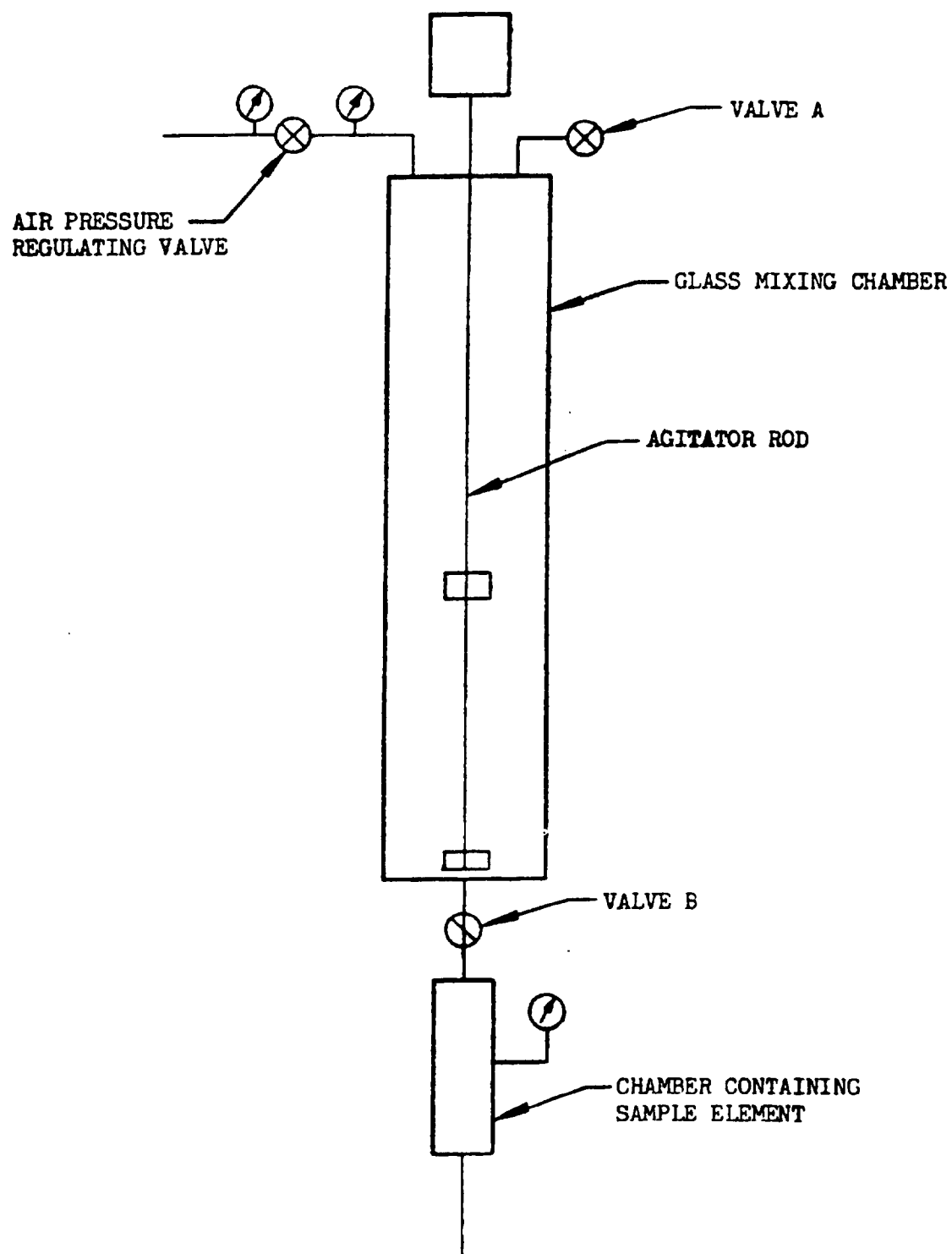


FIGURE 5. Apparatus for determining filtration efficiency of line-type elements.

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- (o) Remove settling-tank lid and syphon 20 inches of the supernatant fluid, leaving a residue 3 inches deep.
- (p) Loosen the hose clamp and allow the residue to drain out the 0.5-inch-diameter Tygon S22-1 plastic tube, or equivalent, into the 4,000-ml glass funnel directly beneath. Spray the internal surfaces first with 1,000 ml of petroleum naphtha and then with 1,000 ml of petroleum ether to wash any remaining beads into the funnel.
- (q) When the fluid has passed through the pyrex fritted glass filter, wash the funnel and filter with petroleum ether. Place the pyrex filter in an oven at 160 to 200° F. to vaporize the moisture for 15 minutes, allow to cool at room temperature in a desiccator for 30 minutes, and immediately weigh on an analytical balance to an accuracy of 0.1 milligram.
- (r) Subtract the weight of the clean pyrex filter from the weight of the filter containing the residue of glass-bead contaminant. This is the portion of the original 0.5-gram contaminant sample, designated X, that passed through the sample filter.

$$\text{Filtration efficiency in percent} = 100 \frac{(0.5 \text{ gram} - X \text{ gram})}{0.5 \text{ gram}}$$

- (s) Reservoir-filter elements shall remove 98 percent of 10- to 20-micron glass spheres added.

4.5.9.2 Pressure buildup and differential burst pressure (reservoir-type element). The following test shall be performed:

- (a) With no element in the test reservoir, close valves (A) and (B), and open valves (C) and (D) (figure 4). Filter fluid conforming to Specification MIL-H-5606 through the 2-micron commercial

high-flow filter at 15 gpm for 1 hour.

- (b) When the filtering operation is complete, shut pumps off, open valves (A) and (B), and close valves (C) and (D).
- (c) Install sample reservoir element with suitable gaskets in test chamber with either lead-filled cone as a hold-down device or a plate suitably held to base of tank.
- (d) Bleed air from system at manometer and test chamber.
- (e) Start pumps and close valve (A) to divert flow through the test element. Adjust pump speed to give rated flow through test element.
- (f) Maintain 90 to 110° F. fluid temperature by water cooler or throttling valve (B).
- (g) Add 1-gram increments of A C Fine Dust or equivalent through the dust valve at 3-minute intervals and record the differential pressures 2 minutes after each dust addition until reaching the maximum number of dust increments specified (9, 18, and 36 grams respectively for elements conforming to Part No. AN6236-1, -2, or -3).
- (h) As the fluid is still being circulated at rated flow, determine the burst pressure by adding U. S. Army Standard Coarse Air Cleaner Test Dust in 10-gram quantities to the reservoir until a 75-psi pressure differential is reached.
- (i) Correct the differential pressure by subtracting from it the pressure drop with no filter in the test chamber and multiply this value by 0.915. (This factor corrects for a bifluid manometer with mercury and fluid conforming to Specification MIL-H-5606).

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- (j) After the 9-, 18-, or 36-gram addition, the pressure differential shall not exceed 4 psi or 8.14 in. Hg.
- (k) If the sample element bursts, allowing much contaminant to flow into the system, replace this with a standard 10-micron filter element to purify the system. This will increase the life of the 2-micron filter.

4.5.9.3 Degree of filtration and pressure buildup (vent-type element). Clean, standard sea-level air shall be passed through the clean filter element at a rate of 8 cfm. During this time, the differential pressure across the filter element shall not exceed 3 inches of water. The element shall be immersed in water for a period of 12 hours, and then clean air shall be passed through the filter element at a rate of 3.5 cfm for 10 minutes, during which time the differential pressure shall not exceed 5 inches of water. The element shall be immersed in clean hydraulic fluid for a period of 12 hours and then clean air shall be passed through the filter at a rate of 3.5 cfm for 10 minutes at a differential pressure not exceeding 14 inches of water. Clean air at the rate of 6 cfm shall be drawn through the filter element, during which time 0.5 gram of the test dust specified shall be introduced into the air stream. The dust shall be added in increments of 0.1 gram per minute, during which the differential pressure across the element shall not exceed 8 inches of water. A microscopic slide shall be located in the air stream, so placed that any dust particles passing through the element will be caught on the slide. The slide shall then be microscopically examined for size of dust particles. The filter element shall remove 98 percent of all particles of which the two smallest dimensions are greater than 10 microns.

4.5.9.4 Degree of filtration (line-type element). Degree of filtration for line-type filter elements shall be determined as shown in the following procedure for elements conforming to Part No. AN6235-2.

- (a) Using setup shown on figure 5, add 2,000 ml of hydraulic fluid conforming to Specification MIL-H-5606 (previously filtered down to 2 microns) to the glass chamber through the plug-valve (A). (Valve (B) is closed.)
- (b) Add a slurry of 0.5 gram 10- to 20-micron glass spheres to the fluid through a small glass funnel inserted through the plug-valve (A).
- (c) Distribute glass spheres uniformly by churning fluid for 1 minute with an agitator.
- (d) Close plug-valve (A) and pressurize the glass chamber containing hydraulic fluid and contaminant to 40 psi by the air regulator.
- (e) Open gate-valve (B), and air pressure forces fluid containing contaminant through sample element. Air regulator maintains flow. An orifice 0.144 inches in diameter located between valve (B), and sample element housing is used to attain rated flow of 3 gpm for AN6235-2 element. (A 0.059-inch orifice will maintain rated flow ($\frac{1}{2}$ gpm) for AN6235-1 element.) AN6235-3 and AN6235-4 elements may be evaluated in an apparatus similar to that used for reservoir-type filter elements.
- (f) Collect effluent fluid in a 4,000-ml beaker placed below discharge tube.
- (g) Pass 1,000 ml of petroleum naphtha (boiling range 190 to 285° F.) and 1,000 ml of petroleum ether (boiling range 95 to 130° F.) through the chamber successively, as described in foregoing steps (d), (e), and (f), to wash down any residual glass spheres that might cling to apparatus after step (f).

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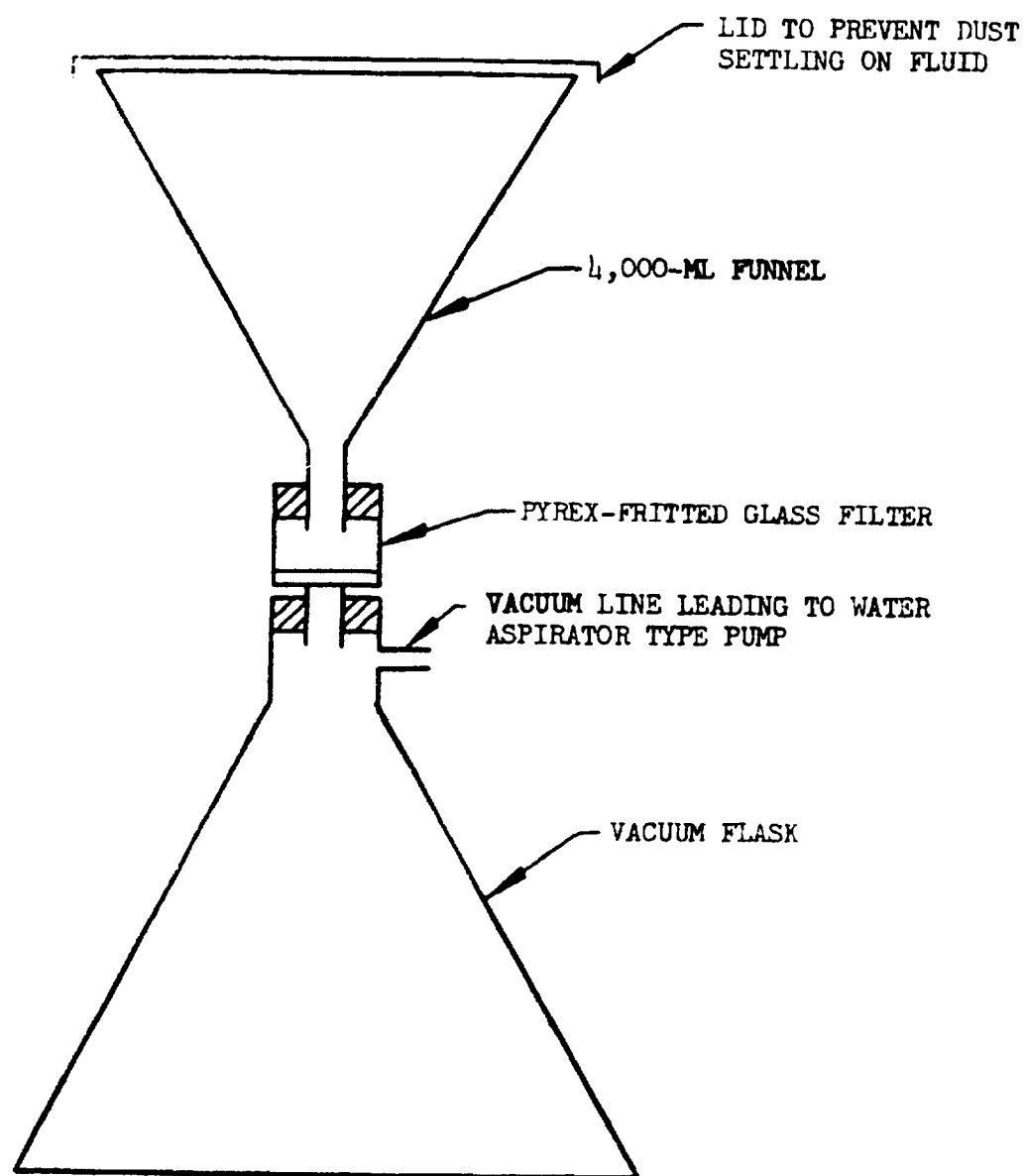


FIGURE 6. Funnel — pyrex filter — vacuum flask apparatus for removing contaminant from effluent.

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- (h) Allow the fluids in the 4,000-ml beaker to settle overnight for 16 hours (or 1 hour for every 1/2-inch depth of fluid) to allow the contaminant to precipitate.
- (i) Syphon off the supernatant fluid in the beaker down to the 1-inch level.
- (j) Rinse the residual fluid with petroleum ether into the funnel-filter-vacuum-flask combination shown in figure 6.
- (k) After the fluid has passed through the pyrex fritted glass filter and has been washed down with petroleum ether, remove the pyrex filter containing the glass-bead contaminant from the apparatus, place it in an oven maintained at 160 to 200° F. for 15 minutes, cool it in a desiccator for 30 minutes, and weigh it on an analytical balance (accurate to 0.1 mg).
- (m) The weight of the pyrex filter containing contaminant minus the clean weight of the pyrex filter yields the residue weight, designated X, of 10- to 20-micron beads that passed through the sample AN-6235-2 type element.
Filtration efficiency in percent

$$= 100 \frac{(0.5 \text{ gram} - X \text{ gram})}{0.5 \text{ gram}}$$
- (n) Line-type filter elements shall remove 95 percent of 10- to 20-micron glass spheres added.
- (b) Install the sample line element in the housing with valves (A), (B), (F), (H), and (K) opened and valves (C), (D), (E), and (G) closed.
- (c) Start the pump with valve (A) closed, adjust the vari-drive to attain rated flow, and adjust the temperature of the flowing fluid to 100° F. (90 to 110° F. variation will be allowed).
- (d) Add A C Fine Dust or equivalent through the dust valve (H) at the following increments at 5-minute intervals: .02, .02, .05, and .10 gram for AN6235-1A, -2A, -3A, and -4A elements respectively.
- (e) Three minutes after each dust addition, record pressure differential, flow, and temperature indications. Add dust until reaching the maximum number of dust increments, which are 0.10, 0.14, 0.65, and 1.00 for AN6235-1A, -2A, -3A, and -4A sizes respectively.
- (f) As the fluid is still being circulated at rated flow, determine the burst pressure by adding U. S. Army Standardized Coarse Air Cleaner Test Dust in quantities ranging from 0.1 to 1.0 gram, depending upon pressure-buildup performance, until a 150-psi pressure differential is reached. Record total quantity of dust added.
- (g) After the 0.10-, 0.14-, 0.65-, and 1.00-gram totals of A C Fine Dust or equivalent (for AN6236-1A, -2A, -3A, and -4A elements respectively) the pressure differential shall not exceed 40 psi.

4.5.9.5 Pressure buildup and differential burst pressure (line-type element). The following test shall be performed:

- (a) Purify the fluid conforming to Specification MIL-H-5606 used in the system shown on figure 7 by flowing through the 2-micron filter. (Valves (A), (B), (C), and (G) are closed and (D), (E), (F), (H), and (K) are open.)

4.5.9.6 Media migration. Media migration tests for AN6236-1, -2, -3 reservoir-filter elements and AN6235-1A, -2A, -3A, -4A line-filter elements shall be conducted as follows:

- (a) Install filter elements in a suitable housing in a hydraulic test system

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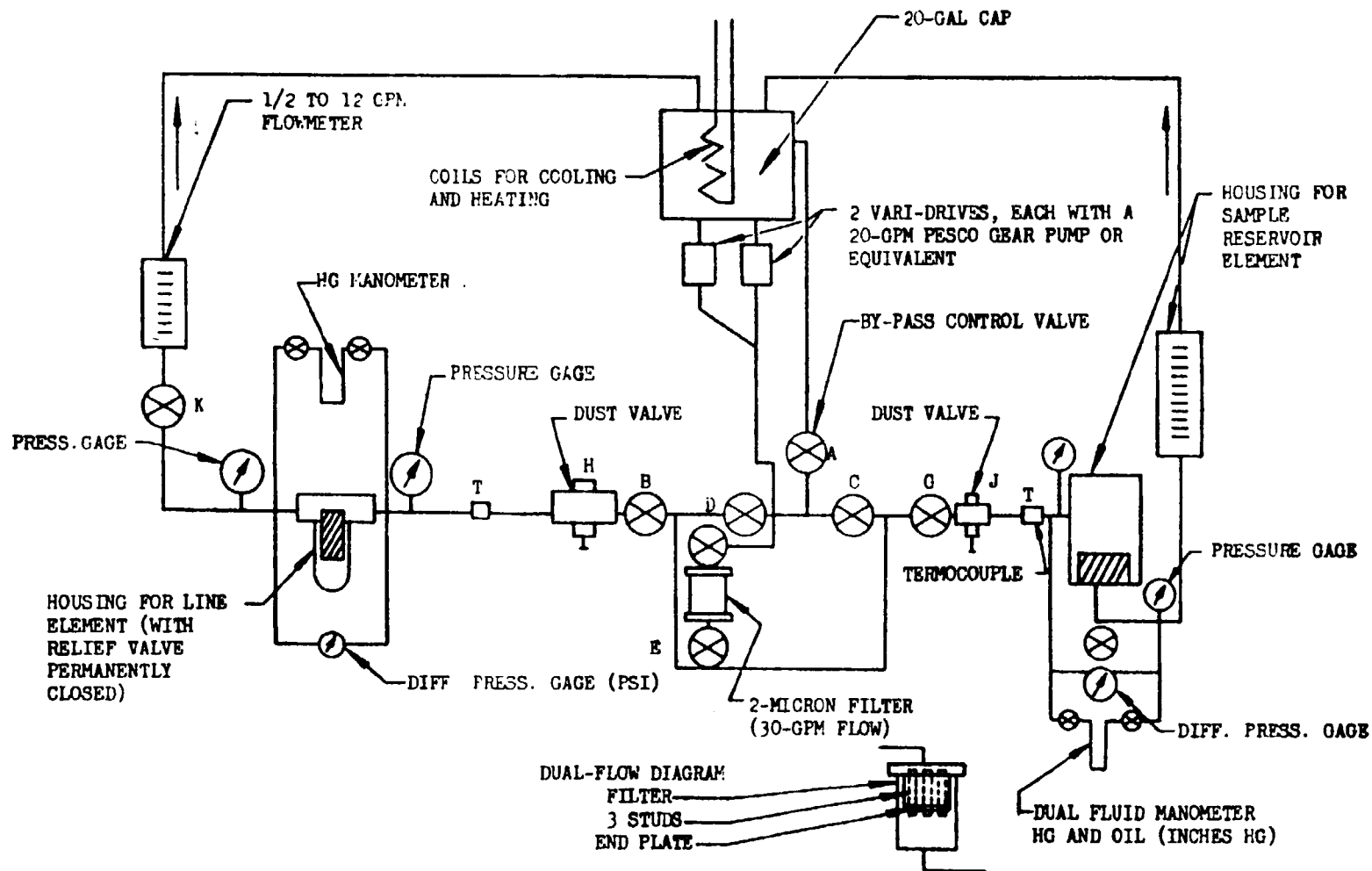


FIGURE 7. Setup for determining pressure buildup and burst pressure characteristics.

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in order that the rated flow of hydraulic fluid (conforming to Specification MIL-H-5606 at 90-110° F.) may be pumped through the elements in the normal manner. A part of the test system shall consist of a suitable metal strainer with openings 0.0015 ± 0.0005 inch in size so situated as to retain any material dislodged from the element on test.

- (b) Prior to installation of elements in the test housings, hydraulic oil at rated flow and at a temperature of 90 to 110° F. shall be flowed through the system for one hour. Stop the pump and drain the metal strainer housing into a clean beaker. Both the surface of the metal strainer and the interior of its housing shall be washed free of any material with n-pentane, and the washings collected in the beaker. Filter the drainings and washings through a piece of No. 12 Whatman filter paper or equivalent, previously weighed, employing a Buchner funnel. Wash the filter paper with 250 ml of n-pentane and dry at 221° F. for $\frac{1}{2}$ hour. The weight of material removed from the system shall be determined by subtracting the weight of the clean filter paper from the weight of filter paper plus washings and shall be known the "blank."

- (c) Repeat the test for each element with the requisite test element installed in the system. Test three elements of each type and size. The media migration factor shall consist of the weight migrated for each element minus the weight of the blank. The average of the three tests run shall be the "media migration factor."

- (d) The maximum media migration values for each element shall be as specified in table III.

TABLE III. Media migration factor

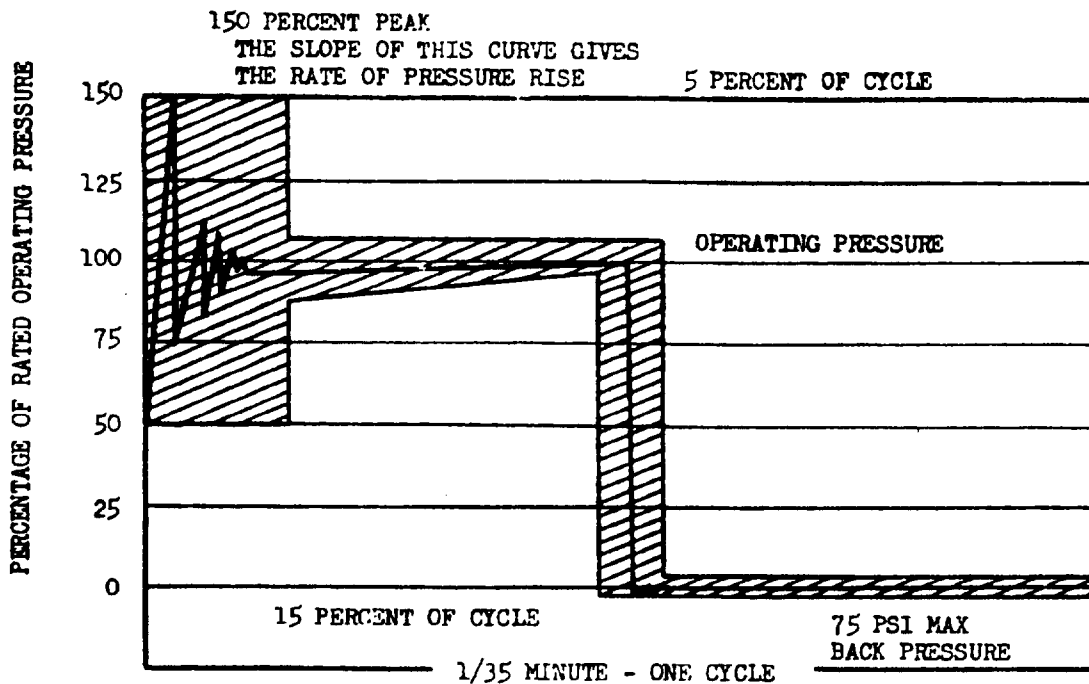
| AN part number | Media migration factor maximum value (mg) |
|----------------------------------|---|
| <i>Reservoir-type elements</i> | |
| AN6236-1 | 5 |
| -2 | 10 |
| -3 | 20 |
| <i>Line-type filter elements</i> | |
| AN6235-1A | 1 |
| -2A | 2 |
| -3A | 4 |
| -4A | 5 |

4.5.10 Impulse. Line-type filter housings shall be subjected to 100,000 impulse cycles, 10,000 of which shall be conducted with the filter element in place. Each impulse cycle shall consist of a pressure rise from 0 to 3,000 psi and drop to 0. During each pressure increase, a peak surge pressure of 1.43 to 1.57 times the working pressure, as shown by oscilloscope, shall be obtained. The impulse time (duration of impulse) shall be no longer than .05 second. Cycling shall be performed at a rate of 35 ± 5 cycles per minute. There shall be no evidence of external leakage or structural failure during the performance of this test. See figure 8 for impulse curve.

4.5.10.1 Line-type filter element. Line-type filter elements shall withstand 10,000 impulse cycles without evidence of structural failure. The Air bubble test specified in 4.5.6 shall be conducted before and after impulsing. This pressure shall not vary by more than ± 10 percent.

4.5.11 Burst pressure. Pressure shall be applied at a maximum rate of increase of 25,000 psi per minute until the specified burst pressure is reached. The pressure may be increased above that specified during Qualification tests in order to secure data on actual burst pressure.

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THE CURVE SHOWN ABOVE IS THE APPROXIMATE PRESSURE - TIME CYCLE DETERMINED TO BE OF PROPER SEVERITY FOR IMPULSE TESTING. ALTHOUGH IT IS MANDATORY ONLY THAT PRESSURE PEAK RISES TO 150 PERCENT OF THE OPERATING PRESSURE AT SOME POINT PRIOR TO LEVELING OFF AT RATED PRESSURE, IT IS CONSIDERED HIGHLY DESIRABLE THAT THE PRESSURE - TIME CURVE BE CONFINED TO THE SHADED AREA INDICATED. ONE VERY DESIRABLE BENEFIT TO BE GAINED BY THIS IS THAT RESULTS OF TESTS PERFORMED ON DIFFERENT TEST MACHINES WILL BE MORE NEARLY COMPARABLE.

FIGURE 8. *Impulse curve.*

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4.5.11.1 Line-type filter housings and elements. Line-type filter housings and elements shall withstand a pressure of 7,500 psi without rupture of internal or external parts.

4.5.11.2 Vent-type filter housings and elements. Vent-type filter housings and elements shall withstand a pressure of 100 psi without rupture of internal or external parts.

4.5.11.3 Differential pressure (element). Filter elements shall withstand differential pressures without permanent damage as specified in table IV.

TABLE IV. *Differential pressure*

| Type | Filter element AN part No. | Differential pressure (psi) |
|-----------|-------------------------------|-----------------------------------|
| Line | AN6235-1A, -2A, -3A, -4A | 150 |
| Reservoir | AN6236-1, -2, -3 | 75 |
| Vent | AN6237-1 | 30 |

4.5.11.4 End load resistance (reservoir element). Reservoir elements shall withstand the end loads specified in table V.

TABLE V. *End loads*

| Type | Filter element AN part No. | Minimum end load (lb) |
|-----------|-------------------------------|-----------------------------|
| Reservoir | AN6236-1 | 400 |
| | -2 | 300 |
| | -3 | 275 |

Elements to be tested shall be placed in an upright position on a horizontal flat metal plate. The specified load shall be so applied in 25-pound increments to the upper end of the element that it is evenly distributed over the end of the element. There shall be no evidence of deformation or damage to the elements at the specified loads.

5. PREPARATION FOR DELIVERY

5.1 Application. The requirements of section 5 apply only to direct purchases by or direct shipments to the Government.

5.2 Preservation. The internal surfaces of all parts of each filter shall be coated with a rust inhibiting fluid conforming to Specification MIL-O-6083. Elements shall be coated only on those metallic surfaces which may tend to rust or corrode. Parts shall be drained to the drip point. All ports shall be sealed in accordance with Specification MIL-C-5501.

5.3 Packaging.

5.3.1 Level A. Unless otherwise specified, a unit package shall consist of one filter cartridge wrapped in grade A barrier material conforming to Specification MIL-B-121, and placed in a container conforming to Specification PPP-B-636. Each filter or filter cartridge shall be suitably cushioned within the container to prevent damage during shipment or storage.

5.3.2 Level C. Filters or filter cartridges shall be individually packaged in accordance with standard commercial practice.

5.4 Packing. All shipping containers, insofar as possible, shall contain identical numbers of unit packages, shall be of uniform size, and shall be designed to enclose the contents in a snug, tight-fitting manner. The gross weight of the shipping container shall not exceed approximately 200 pounds.

5.4.1 Level A. Unless otherwise specified, unit packages shall be packed in nailed-wood or wood-cleated plywood boxes conforming to Specification PPP-B-621 or PPP-B-601 (overseas type). Plywood, if used, shall conform to Specification NN-P-515, type I or II, class 2.

5.4.2 Level B. Unless otherwise specified, unit packages shall be packed in nailed-wood, wood-cleated plywood, or fiberboard boxes conforming to Specification PPP-B-621, PPP-B-601 (domestic type) PPP-B-636. If fiberboard boxes are used, gross shipping container

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weights shall not exceed the weight limitations of the individual container specification.

5.4.3 *Level C.* Unless otherwise specified by the procuring activity, the unit package shall be packed in substantial commercial shipping containers so constructed as to insure acceptance by common or other carrier for safe transportation, at the lowest rate, to the point of delivery. Except as specified herein, the container shall conform to the requirements of Consolidated Freight Classification Rules in effect at the time of shipment. The use of corrugated or solid fiberboard having a minimum Mullen test of less than 275 pounds is prohibited.

5.5 **Marking of shipments.** Interior packages and exterior shipping containers shall be marked in accordance with Standard MIL-STD-129. The identification shall be composed of the following information listed in the order shown:

**FILTER (OR FILTER ELEMENT),
FLUID PRESSURE, HYDRAULIC,
MICRONIC TYPE**

Stock No. or other identification number
as specified in the purchase document*

MS or AN part No.

Manufacturer's part No.

Quantity

Month and year of manufacture

Type

Contract or order No.

Name of manufacturer

Name of contractor (if different from
manufacturer)

Applicable levels of packaging and pack-
ing required.

*Note. The contractor shall enter the Federal Stock No. specified in the purchase document or as furnished by the procuring activity. When the Federal Stock No. is not provided or available from the procuring activity, leave space therefor and enter the Stock No. or other identification when provided by the procuring activity.

6. NOTES

6.1 **Intended use.** The filters covered by this specification are intended for use in hydraulic systems operating with hydraulic oil conforming to Specification MIL-H-5606, at operating pressures not exceeding 3,000 psi.

6.2 **Assembly and detail drawings.** Two sets of assembly and detail drawings should be furnished, one set to each Service, with each new model filter submitted for Qualification tests. Assembly drawings should show a cutaway section of all details in their normal assembly positions and should carry part numbers of all details and subassemblies. The following data should be furnished on, or together with, all assembly drawings:

- (a) Mounting dimensions.
- (b) Port dimensions.
- (c) Over-all dimensions.
- (d) Rated capacity.
- (e) Dry weights.
- (f) Maximum operating pressure.
- (g) Complete dismantling procedure and description of tools needed.
- (h) Any special installation or operating instruction considered necessary.

6.3 **Ordering data.** Contracts and orders should state the MS or AN part number of the filter or replaceable element desired and whether overseas packing is required.

6.4 **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.

6.4.1 The attention of suppliers is called to this requirement, and manufacturers are urged to arrange to have the products that

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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.

Notice. When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government

procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data, is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

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Navy—Bureau of Aeronautics
Air Force

Preparing activity:

Navy—Bureau of Aeronautics

SPECIFICATION ANALYSIS SHEET

Form Approved
Budget Bureau No. 119-R004INSTRUCTIONS

This sheet is to be filled out by personnel either Government or contractor, involved in the use of the specification in procurement of products for ultimate use by the Department of Defense. This sheet is provided for obtaining information on the use of this specification which will insure that suitable products can be procured with a minimum amount of delay and at the least cost. Comments and the return of this form will be appreciated. Fold on lines on reverse side, staple in corner, and send to preparing activity (as indicated on reverse hereof).

SPECIFICATION

ORGANIZATION (of submitter)

CITY AND STATE

CONTRACT NO.

QUANTITY OF ITEMS PROCURED

DOLLAR AMOUNT

\$

MATERIAL PROCURED UNDER A

☐

DIRECT GOVERNMENT CONTRACT

☐

SUBCONTRACT

1. HAS ANY PART OF THE SPECIFICATION CREATED PROBLEMS OR REQUIRED INTERPRETATION IN PROCUREMENT USE?

A. GIVE PARAGRAPH NUMBER AND WORDING.

B. RECOMMENDATIONS FOR CORRECTING THE DEFICIENCIES.

2. COMMENTS ON ANY SPECIFICATION REQUIREMENT CONSIDERED TOO RIGID

3. IS THE SPECIFICATION RESTRICTIVE?

☐ YES☐ NO

IF "YES", IN WHAT WAY?

4. REMARKS (Attach any pertinent data which may be of use in improving this specification. If there are additional papers, attach to form and place both in an envelope addressed to preparing activity)

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