MILITARY SPECIFICATION

FILTER AND DISPOSABLE ELEMENT, FLUID PRESSURE, HYDRAULIC, 3 MICRON ABSOLUTE

This specification has been approved by the Naval Air Systems Command, Department of the Navy.

1. SCOPE

1.1 Scope - This specification covers hydraulic line filters and noncleanable filter elements which retain all particles larger than 3 microns and are suitable for use as specified in 6.1.

1.2 Classification - Hydraulic filter assemblies and filter elements shall be of the following styles and sizes as specified (see 6.2).

TABLE I. Filter and Filter Element Specification Sheet Part Numbers

Assembly Part Number			Element Part Number	Element Adapter Part Number	Flow Rate (gpm)
Style A Mechanical Indicator	Style B Electrical Indicator	Style C Gauge Indicator			
M81836/1-6	M81836/2-6	M81836/3-6	M81836/4-6	-	3
M81836/1-8	M81836/2-8	M81836/3-8	M81836/4-8	-	6
M81836/1-10	M81836/2-10	M81836/3-10	M81836/4-10	-	10
M81836/1-12	M81836/2-12	M81836/3-12	M81836/4-12	M81836/5-12	20
M81836/1-16	M81836/2-16	M81836/3-16	M81836/4-16	M81836/5-16	30
M81836/1-24	M81836/2-24	M81836/3-24	M81836/4-24	—	60

FSC 4920

2. APPLICABLE DOCUMENTS

2.1 The following documents, of the issue in effect on date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein:

SPECIFICATIONS

Federal

PPP-B-601	Boxes, Wood, Cleated-Plywood
PPP-B-621	Boxes, Wood, Nailed and Lock-Corner
PPP-B-636	Box, Fiberboard

Military

MIL-P-116	Preservation, Methods of
MIL-B-121	Barrier Material, Greaseproofed, Waterproofed, Flexible
MIL-E-5272	Environmental Testing, Aeronautical and Associated Equipment, General Specification for
MIL-C-5501	Caps and Plugs, Protective, Dust and Moisture Seal
MIL-G-5514	Gland Design; Packing, Hydraulic, General Requirements for
MIL-H-5606	Hydraulic Fluid, Petroleum Base, Aircraft, Missile, Ordnance
MIL-H-6083	Hydraulic Fluid, Petroleum Base, for Preservation and Testing
MIL-H-8775	Hydraulic System, Components Aircraft and Missiles, General Specification for
MIL-F-81836/1	Filter, Fluid, Pressure, Hydraulic, 5000 PSI, 3 Micron Absolute, Style A, Mechanical Indicator

SPECIFICATIONS

Military (Cont'd)

MIL-F-81836/2	Filter Fluid, Pressure, Hydraulic, 5000 PSI, 3 Micron Absolute, Style B, Electrical Indicator
MIL-F-81836/3	Filter Fluid, Pressure, Hydraulic, 5000 PSI, 3 Micron Absolute, Style C, Gauge Indicator
MIL-F-81836/4	Filter Element, Disposable, Fluid Pressure, Hydraulic, 3 Micron Absolute
MIL-F-81836/5	Adapter, Filter Element

STANDARDS

Military

MIL-STD-105	Sampling Procedures and Tables for Inspection by Attributes
MIL-STD-129	Marking for Shipment and Storage
MIL-STD-130	Identification Marking of U. S. Military Property
MIL-STD-143	Standards and Specifications, Order of Precedence for the Selection of
MIL-STD-831	Test Reports Preparation of
MIL-STD-889	Dissimilar Metals
AN 814-4	Plug and Bleeder - Screw Thread
ANA 438	Age Controls of Age Sensitive Elastomeric Items
AND 10064	Fitting, Installation of Flared Tube, Straight Threaded Connectors

STANDARDS

Military (Cont'd)

MS 3102	Connector, Receptacle, Electric, Box Mounting
MS 9058	Ring Back Up, Boss Connection AMS 3651
MS 28774	Retainer, Packing Backup, Single Turn, Tetrafluoroethylene
MS 28775	Packing, Preformed, Hydraulic, Plus 275°F (O-Ring)
MS 33649	Bosses, Fluid Connection-Internal Straight Thread

PUBLICATIONS

Military

MIL-HDBK-5	Metallic Materials and Elements for Aerospace Vehicle Structure

(When requesting applicable documents, refer to both title and number. Copies of unclassified documents may be obtained from the Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, Pennsylvania 19120. Requests for copies of classified documents should be addressed to the Naval Publications and Forms Center, via the cognizant Government representative.)

2.2 Other Publications - The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on the date of invitation for bids or request for proposal shall apply.

Society of Automotive Engineers

ARP 598	Procedure for the Determination of Particulate Contamination of Hydraulic Fluids by the Particle Count Method

(Application for copies should be addressed to the Society of Automotive Engineers, Two Pennsylvania Plaza, New York, N. Y. 10001.)

3. REQUIREMENTS

3.1 Qualification - The filter assemblies, or elements, furnished under this specification shall be a product which has been tested, and which has passed the qualification tests specified herein, and which has been listed on or approved for listing on the applicable Qualified Products List at the time set for opening of bids (see 4.4 and 6.3).

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

3.3 Selection of specifications and Standards - Specifications and standards for necessary commodities and services not specified herein shall be selected in accordance with MIL-STD-143.

3.4 Materials -

3.4.1 Compatibility - Filter assemblies and elements shall be constructed of materials that will not adversely affect or be affected by hydraulic fluid conforming to MIL-H-5606, MIL-H-6083 and other test fluids included herein.

3.4.2 Process Controls, Limitations - If the filter element is of the type wherein resinous or other material is used for elimination of imperfections, not more than 5 percent of the filtering area shall be covered by the applied material. Filter element media having an initial bubble point of less than 3 inches of water before repair shall be cause for rejection. The manufacturer's qualification test report shall define the resin employed for joining or patching, application technique, curing cycle, and procedures followed to insure adhesion of the resin. The manufacturer's drawings shall specify the limitations or process controls that will govern manufacturing variations in media obstruction due to braze wicking, seam width, and crimp length in addition to the existing limits on repair.

3.4.2.1 Filter element repair procedures shall be submitted for approval to the activity responsible for qualification. These repair procedures shall specify, but shall not be limited to, the resin employed for joining or patching, application techniques, curing cycle, procedures to be followed to insure adhesion of the resin, and special tools and test equipment required. The approved repair procedures shall be furnished to the Government with each procurement.

3.4.3 Metals - Unless otherwise specified herein, physical properties of all metals shall meet the minimum requirements specified in MIL-HDBK-5, except that 2014 aluminum alloy shall not be used.

3.4.3.1 Metals shall be of the corrosion resistant type, or shall be suitably protected to resist corrosion due to the environments required by this specification or the environmental conditions likely to be met in storage and normal service.

3.4.3.2 Dissimilar metals - Unless protected against electrolytic corrosion, dissimilar metals shall not be used in intimate contact with each other. Dissimilar metals are defined in MIL-STD-889.

3.4.4 Nonmetals - When plastics, synthetic rubber, and non-metallic materials other than military approved articles are used, adequate proof of their suitability shall be submitted along with test articles submitted for evaluation testing. The use of these articles shall be with proper consideration of the resistance to air and hydraulic fluid (where applicable) including the special problems of dimensional stability, aging characteristics, moisture absorption, and thermal embrittlement in the environmental conditions likely to be met in storage and normal service.

3.4.4.1 Seals - All packings shall be in accordance with Standard MS 28775. Backup rings shall be in accordance with Standard MS 28774 or MS 9058.

3.4.4.2 Fungi nutrients - Materials which are not nutrients for fungi shall be used wherever possible. Where fungus-nutrient materials must be used, they shall be treated with a fungicidal agent acceptable to the procuring activity.

3.4.5 Age controls - Age controls for synthetic parts shall be in accordance with ANA Bulletin No. 438.

3.4.6 Lubrication - Filters shall be designed so that hydraulic fluid conforming to either MIL-H-5606 or MIL-H-6083 can be used alternatively for lubrication of O-rings and back-up rings during assembly in service. Additional lubricants shall be provided when necessary in the initial (manufacturing) assembly of the unit and shall require approval of the procuring activity before use. No other lubricants shall be required during the operating life specified herein.

3.4.7 Protective treatment - When materials are used in the construction of the filter elements which are subject to deterioration when exposed to climatic and environmental conditions likely to occur during service use, they shall be protected against such deterioration in a manner that will in no way prevent compliance with the performance requirements of this specification. The use of any protective coating that will crack, chip, or scale with use, age, or extremes of climatic and environmental conditions shall be avoided.

3.5 Design and construction -

3.5.1 Filter assemblies, filter elements and filter element adapters shall be designed and constructed as specified herein and in the applicable specification sheets. Filter assemblies shall be of such design and construction that the elements may be removed for service and inspection without disconnecting fittings or disturbing mountings, removing or disconnecting differential pressure indicators or removing inlet or outlet lines. Filter assemblies shall be so designed that fluid entering the filter housing cannot impinge directly upon element filter medium. The filter assemblies shall be capable of withstanding 1,000 hours of operation of 275°F fluid and ambient temperature. The manufacturer shall verify compliance with this requirement by analysis.

3.5.2 Filter assemblies shall be of the full-flow type. The flow through the filter elements shall be from "outside-in".

3.5.3 The design of filter assemblies shall be such that the filter element cannot be installed reversed.

3.5.4 Filter housings shall be designed to withstand all the structural loads imposed by the functional test requirements of this specification. In addition, the filter housing and mountings shall be of such strength and rigidity as to withstand the wrench loads required for making tube connections in accordance with AND10064 and the replacing of filter elements.

3.5.5 Interchangeability - It shall not be possible to interchange filter bowls and heads between the various sizes of filter assemblies.

3.5.6 Standard parts - All components of the filter assembly shall be standard AN or MS parts or other government standard parts with Federal Stock Numbers. Other components, especially expendable components, shall be standard parts with Federal Stock Numbers unless the manufacturer justifies the use of nonstandard parts to the agency responsible for qualification of the product.

3.5.7 Surface finishes - All sealing surfaces, e.g., O-ring grooves, including chamfers, and all mating surfaces in contact with O-rings and other seals, including their chamfers, shall conform to the requirements of MIL-G-5514.

3.5.8 Protective cover - The element shall be provided with a permanent woven or perforated cover, or other device, to minimize element handling damage. The protective cover shall not interfere with the performance of the element.

3.5.9 Reliability - The filter (both housing and element) shall be designed and constructed as specified herein and successfully complete the qualification tests of 4.4, with no failures preventing satisfactory performance.

3.5.10 Structural integrity - The filter (both housing and element) shall be so designed and constructed that no parts will work loose in service. The filter shall withstand the stresses, jars, vibrations and other conditions incident to shipping, storage, installation and flight line service.

3.5.11 Handles - Any housing which weighs more than twenty pounds when filled with fluid (MIL-H-5606) shall be provided with handles or hand-holds, so that no more than two men will be required to change elements without power tools, lifts, jacks or hoists.

3.5.12 Alignment of ports - The axes of inlet and outlet ports shall lie in the same straight line.

3.5.13 Foolproofness - Where improper installation of an item could cause malfunctioning of that item or the system in which it is installed, an unsymmetrical mounting means shall be provided. This mounting shall be so designed that the item can only be installed in its proper operating position.

3.5.14 Maintainability - The filter unit shall be designed and constructed as specified herein and to provide the following:

(a) Minimum number of parts consistent with the reliability and performance specified herein.

(b) Minimum amount of training and time necessary for assembly, disassembly, location of trouble sources, and maintenance including servicing.

(c) Permit maintenance with general-purpose tools and equipment normally available commercially. Use of special-purpose tools and equipment shall be subject to procuring activity approval.

(d) Permit adjustments, servicing, replacement of parts and components, and other maintenance with minimum disturbance to other equipment parts or components (3.5.1). Parts and components shall be located for ample and rapid access, unless performance or reliability will be appreciably degraded by the accessible location.

(e) Minimum number of tools required for maintenance by design practices such as reducing the number of different bolthead sizes to the practicable minimum.

3.5.15 Differential pressure indicator - The filter housing shall incorporate an integral device to indicate when the differential pressure across the filter element exceeds 105 ± 10 psid. The indicating device shall be mechanical, electrical or a gauge as specified in paragraph 6.2 and shall conform to the applicable specification sheet. The three types of indicators shall be mechanically interchangeable for any one filter manufacturer's assembly. It shall be possible to change the indicating device, with ordinary tools, while the filter unit is mounted on a bulkhead by its standard mounting bracket. The devices shall be changeable while the system is filled with fluid but not under pressure. The mechanical and electrical devices shall be actuated whenever the differential pressure exceeds 105 ± 10 psid for a period longer than one second except that it shall not be actuated when the temperature of the filter and the hydraulic fluid is below 70 ± 15°F. Once actuated the mechanical and electrical indicators shall continue to give its indication until reset manually. The manual reset device shall be external, readily visible and easily accessible.

3.5.15.1 Electrical indicator - The electrical differential-pressure indicator shall be capable of actuating either a 24-V, d-c or 110-V, a-c electrical signal. The indicator shall incorporate an MS3102R10SL-3P electrical receptacle with pin arrangement as follows:

Pin A - Normally open
Pin B - Common
Pin C - Normally closed

The switch current rating shall be as follows:

5 amp. at 110-Vac, 28-Vdc (resistive)
3 amp. at 110-Vac, 28-Vdc (inductive)

3.5.15.2 Mechanical indicator - The differential-pressure indicator shall provide a visual warning by raising a red anodized pin when actuated. For adaptation to night operations, the indicator shall be readily apparent when illuminated by a low-intensity red light (i.e. two-cell flashlight with red lens). The view of the indicator shall be unobstructed. Once actuated, the indicator shall remain extended until reset manually. The indicator shall be readily accessible for reset. When the indicator is in the reset position, it shall be hidden from view.

3.5.15.3 Gauge indicator - The gauge shall be a differential pressure type and have a range from 0 to 200 psid, graduated in 5 psid increments. Every eighth graduation shall be indicated by its numerical equivalent. The gauge shall have an accuracy of ±14 psid throughout its entire range, while pushing the secondary pointer. Numerals shall be a minimum of 1/16 inch. The face of the gauge shall be a minimum of 1 1/2 inches in diameter or 1 1/2 inches by 1 inch rectangular. The differential-pressure gauge shall be able to withstand all of the pressures, differential pressures, temperatures and vibrations in Section 3.5, 3.6 and their sub-sections. It shall have the specified accuracy during and after those conditions. The gauge shall indicate in red at all differential pressures above 105 psid. The beginning and ending of the scale shall be marked. The instrument shall be marked "Differential Pressure". The gauge shall have (in addition to its indication of actual differential pressure) a manually resettable pointer to show the maximum differential pressure reached since the last resetting. The gauge is not required to comply with 4.6.1.4.4 (Flow Surge), but the indicating device of the gauge shall be steady enough to permit easy and accurate reading during normal use of the Ground Support Equipment in which it may be installed.

3.5.16 Drain and bleed ports - Filter assemblies sizes - 16 and larger shall include drain and bleed ports conforming to MS33649-4 and plugs conforming to AN814-4. The ports shall be located so that adequate bleeding of entrapped air and draining of fluid will be insured.

3.6 Performance -

3.6.1 Filter assemblies, filter housings, and filter elements shall perform satisfactorily when subjected to the tests specified under the applicable sub-paragraphs of 4.6 as specified in 4.4.2. Performance requirements are summarized in Table II.

3.6.2 Bubble point - The Supplier shall determine the initial bubble point occurring in the filter elements, that bubble point shall be correlated against maximum particle passed, the method thoroughly defined and both

submitted to the procuring activity for approval. For qualification of filter elements, the initial bubble point value shall meet the value established by the activity responsible for qualification and shall be determined as specified in 4.6.2.1. No element shall be accepted without passing the quality conformance bubble-point test specified in 4.6.2.1.3.

TABLE II. Performance Requirements

Operating Temperature	-65° to 275°F
Operating Pressure	5,000 psi
Proof Pressure	7,500 psi
Burst Pressure	11,250 psi
Differential Pressure Indicator	
Actuation Pressure	105 ± 10 psid
Lockout Temperature	70 ± 15°F
Absolute Rating	3 micron
Degree of Filtration	99.3%
Differential Pressure	
housing (psid max)	
-6, -8, -10, -12, -16 sizes	10
-24 size	20
element (psid max)	20
Dirt Holding Capacity	
(gms. to 100 psid)	
-6 size	6
-8 size	8
-10 size	15
-12 size	30
-16 size	45
-24 size	90

3.7 Operational markings -

3.7.1 Direction of flow - The direction of flow shall be clearly and permanently indicated by at least two arrows marked on opposite sides of the housing.

3.7.2 Instruction plate - Each filter unit shall be provided with a permanently mounted instruction plate. The plate shall show location and part number of all O-ring seals and back-up rings.

3.8 Identification of product -

3.8.1 Filter housing - Each filter housing shall be clearly and permanently marked by steel stamping or by a permanently attached nameplate. The method of marking and attaching shall be in accordance with MIL-STD-130. The marking shall provide the following information:

FILTER, FLUID, PRESSURE, HYDRAULIC, 5000 PSI
3 MICRON ABSOLUTE, MAXIMUM TEMPERATURE 275° F

M81836/X-XX
FSN
Manufacturer's Part No.
Manufacturer's Serial No.
Manufacturer's Name or Trade Mark
Rated Flow in gallons per minute
Replacement Element (identify by specification sheet no.)

3.8.2 Filter element - Each filter element shall be clearly and permanently marked, on one end, by steel stamping, electro-etching, or by a permanently attached nameplate. The method of marking shall be in accordance with MIL-STD-130. If placed on a sealing surface, the markings shall not affect the sealing of the element. The marking shall provide the following information:

M81836/4-XX
FSN
Manufacturer's Part No.
Manufacturer's Lot No.
Manufacturer's Name or Trademark
Noncleanable
Maximum pressure drop when new at xx gpm
Element rating: 3 micron absolute
Fluid specification: MIL-H-5606

The marking indicating noncleanability shall be made more conspicuous than the other markings by size, position, color or other means. Elements shall be marked "NONCLEANABLE".

3.8.3 Filter element adapter - Each filter element adapter shall be clearly and permanently marked by steel stamping, electro-etching, or by a

permanently attached nameplate. The method of marking shall be in accordance with MIL-STD-130. The markings shall not be placed on a sealing surface. The markings shall provide the following information:

MIL-F-81836/5-XX
Manufacturer's Name or Trademark

3.8.4 Part numbering of interchangeable parts - The manufacturer's part number and drawing number shall be the same.

3.9 Workmanship - All details of workmanship shall be of a sufficiently high grade to insure proper operation. Particular attention shall be given to neatness and thoroughness of assembly and to freedom of parts from burrs and sharp edges.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection - Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or order, the supplier may utilize his own facilities or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.2 Classification of inspection - The inspection of the filter assembly and element shall be classified as follows:

(a) Qualification tests (4.4)

(b) Quality conformance tests (4.5)

4.3 Test conditions -

4.3.1 Test fluid - Unless otherwise specified, the hydraulic fluid used for all tests shall conform to MIL-H-5606 (with no free water). For quality conformance tests, hydraulic fluid conforming to MIL-H-6083 or MIL-H-5606 (with no free water) may be used.

4.3.1.1 Test fluid filtration - Unless otherwise specified, the test fluid shall be continuously filtered through a 3-micron absolute filter conforming to this specification during testing.

4.3.1.2 Test fluid temperature - Unless otherwise specified, the actual temperature of the test fluid shall be 100° ± 10°F.

4.3.2 Temperature - Unless otherwise specified, the tests shall be conducted at a room temperature of 70° to 90°F, measured within 12 inches of the test sample.

4.3.3 Immersion - Prior to performing the qualification tests, filters shall be immersed in hydraulic fluid (see 4.3.1) for a period of 100 hours at a fluid temperature of 300°F. All internal parts shall be in contact with the test fluid during this period. After immersion, the filter shall remain in this fluid at room temperature until further tests are conducted.

4.3.4 Test air - The air used to pressurize the test apparatus shall be filtered through an 0.45-micron membrane filter (type HA Millipore, or equivalent).

4.3.5 Weight, measurement of -

4.3.5.1 Precision (of weighing) - Unless specified otherwise, all weights shall be measured with a precision of one part in one thousand or better.

4.3.5.2 Static electricity, elimination of - A device to eliminate static electricity shall be in proximity to the filter membrane disc, or to the pan on which it rests, whenever any object or material is being weighed to a precision of ±0.1 gram or finer. The age of the device shall not exceed the value stated by the manufacturer as its rated service life.

4.3.6 Test dust, source of supply - All test dust used for qualification tests shall be obtained from the Aeronautical Materials Dept. (AMD), Naval Air Development Center (NADC), (Attention of Code MAEF), Warminster, Pa. 18974.

4.3.7 Test equipment housings for elements submitted without housings - Manufacturers are permitted to submit elements alone, without housings, for qualification under this specification. Filter housings for use as test equipment (in the qualification testing of the elements submitted without housings) shall be provided by the manufacturer of the said elements, but the qualifying agency may, at its option, supply the test-equipment housings itself.

(a) Housings used as test equipment under this paragraph shall comply with the dimensional and compatibility requirements of this specification and with the following subsections of 3.4: 3.4.1, 3.4.3, 3.4.3.1, 3.4.3.2, 3.4.4, 3.4.4.1, 3.4.7.

(b) Test housings shall comply with all applicable parts of 3.5 except that differential-pressure indicators are not required.

4.4 Qualification tests -

4.4.1 Sampling instructions -

4.4.1.1 Filter housing -

4.4.1.1.1 Samples for qualification tests of filter housings shall consist of two specimens of each size upon which qualification is desired.

4.4.1.1.2 The specimens shall be assembled of parts which conform to manufacturer's drawings. Manufacturer's qualification shall not have been performed on these samples.

4.4.1.1.3 The manufacturer shall provide calculations showing that adequate clearance of moving parts is provided at -65° and +275°F, using the most adverse dimensions. The room temperature reference point shall be 70°F.

4.4.1.2 Filter elements -

4.4.1.2.1 Qualification test samples of filter elements shall consist of six elements of each size upon which qualification is desired. Manufacturer's qualification tests shall not have been performed on these samples. The manufacturer shall submit reports of the qualification tests on other specimens of the same design. A submittal procedure similar to that outlined for filter housings shall then be followed.

4.4.1.2.2 If the elements are of the type in which repair material is applied to eliminate imperfections, the qualification test elements shall have a minimum of 5 percent of the filtering area repaired. The areas repaired shall contain at least three imperfections whose initial bubble point is 3 inches of water or less.

4.4.2 Tests - The qualification tests shall consist of the tests specified under 4.6, conducted on the applicable specimens, in the order specified in Table III.

TABLE III. Qualification Tests

Filter Assembly	Reference
Examination of product	4.6.1.1
Proof pressure test	4.6.1.2
Pressure-drop test	4.6.1.3
Differential pressure indicator tests	4.6.1.4
Type A and B operation	4.6.1.4.1
Type C operation	4.6.1.4.2
Endurance	4.6.1.4.3
Surge test	4.6.1.4.4
Salt spray test	4.6.1.4.5
Sand and dust	4.6.1.4.6
Fungus	4.6.1.4.7
Extreme temperature test	4.6.1.5
Vibration	4.6.1.6
Maintainability demonstration of	4.6.1.7
Impulse	4.6.1.8
Differential pressure indicator operation	4.6.1.4.1, 4.6.1.4.2
Burst pressure	4.6.1.9
Filter Element	**Reference**
Element No. 1 (2nd lowest bubble-point)	
Examination of product	4.6.1.1
Bubble point	4.6.2.1
Cold start	4.6.2.8
Degree of filtration	4.6.2.3
Bubble point	4.6.2.1
Flow fatigue	4.6.2.4
Bubble point	4.6.2.1
Element No. 2 (lowest bubble point)	
Examination of product	4.6.1.1
Bubble point	4.6.2.1
Cold start	4.6.2.8
Maximum particle passed	4.6.2.5
Bubble point	4.6.2.1
Fluid degradation test	4.6.2.6
Bubble point	4.6.2.1
Element No. 3 (highest bubble point)	
Examination of product	4.6.1.1
Bubble point	4.6.2.1
Cold start	4.6.2.8
Pressure buildup and collapse test	4.6.2.7
Bubble point	4.6.2.1

TABLE III. Qualification Tests (Cont'd)

Filter Element	Reference
Element No. 4	
Examination of product	4.6.1.1
Bubble point	4.6.2.1
Cold start	4.6.2.8
Bubble point	4.6.2.1
Media migration and vibration	4.6.2.9
Bubble point	4.6.2.1

4.4.3 Qualification test report - The manufacturer shall prepare qualification tests reports in accordance with MIL-STD-831 and furnish three complete copies of the report to the activity responsible for qualification. See paragraph 6.3.

4.4.3.1 Reliability and maintainability information - The following information shall be submitted as an attachment accompanying the qualification test report (same number and sort of copies) or shall be included as part of that report:

(a) All failures, maintenance, and other events recorded shall be identified by accumulated operating time, cycles, or position in the test procedure as appropriate. Test conditions during failures or irregular operations shall be recorded.

(b) A description of the engineering reasoning and of any tests conducted to determine assignable cause for all failures and irregular operations.

(c) A description of the engineering reasoning behind any corrections which have been made, corrections to be made on production items, or corrections to be proposed; this should include the engineering reasoning behind the predicted effectiveness of such corrections.

(d) Comments on field conditions or procedures to be avoided or promulgated to increase the reliability and useful life of the item.

4.5 Quality conformance tests - Quality conformance tests shall consist of:

(a) Individual tests (4.5.1)

(b) Sampling tests (4.5.2)

4.5.1 Individual tests - The individual tests shall consist of the tests specified in Table IV, conducted on each filter housing and filter element in that order. Any filter housing or filter element containing a defect shall be rejected.

TABLE IV. Individual Tests

Filter Housing	Reference
Examination of product	4.6.1.1
Proof pressure (at room temperature)	4.6.1.2
Differential pressure indicator operation	4.6.1.4.1, 4.6.1.4.2
Filter Elements	**Reference**
Examination of product	4.6.1.1
Quality conformance (Bubble point)	4.6.2.1.3

4.5.2 Sampling tests - Sampling of filter assemblies and elements shall be in accordance with MIL-STD-105, using special inspection level S-3 and an acceptable quality of 1 percent defective. Sampling tests shall consist of the cleanliness and pressure buildup and collapse tests specified in paragraphs 4.5.2.1 and 4.5.2.2, conducted on the same test specimen.

4.5.2.1 Cleanliness - To assure that the filter elements and housing are being cleaned properly, and to assure that the parts are not contaminated during packaging, sample filter elements or assemblies shall be unpacked and tested for cleanliness. The filter elements shall be installed in a precleaned housing. The migration analysis tests shall be conducted in accordance with paragraph 4.6.2.9.2. The requirements of paragraph 4.6.2.9.2 shall be met except that the weight of contaminant collected shall not exceed 5 milligrams.

4.5.2.2 Pressure buildup and collapse - A pressure buildup and collapse test shall be conducted in accordance with paragraph 4.6.2.7.

4.5.3 Lot - For purposes of quality conformance inspection, a lot shall be defined as all those units of product manufactured under essentially the same conditions and offered for acceptance at one time in quantities as detailed in 4.5.2.

4.5.4 Report of failure of sampling test - When a filter unit or filter element fails to pass a sampling test, the entire lot represented shall be rejected. All failures of the tested units and elements shall be reported immediately by telephone or message. Full particulars concerning previous similar failures, the current failures and action taken to correct the defects shall be submitted to the procuring agency in writing. The lot represented by the unsatisfactory sample shall not be resubmitted until approval of resubmission has been issued by the procuring agency.

4.6 Test methods -

4.6.1 Filter assembly -

4.6.1.1 Examination of product - The filter assembly, including element, shall be examined to determine compliance with the requirements specified herein with respect to the applicable specification sheet, materials, workmanship, dimensions, and marking. All items, including differential-pressure indicators, and other accessory components, shall be examined also for compliance with the appropriate drawings of the manufacturer.

4.6.1.2 Proof pressure test - The filter shall be assembled with the outlet port plugged. The filter shall then be filled with clean test fluid and maintained at 275° ± 5°F for 72 hours for qualification tests only. Proof pressure of 7,500 psi shall be applied at least twice while at 275°F and held for 2 minutes at each application. The pressure shall be reduced to zero between applications. Any evidence of permanent deformation, malfunction, or leakage shall be cause for rejection. For quality conformance testing pressure shall be applied at room temperature.

4.6.1.3 Pressure-drop test - The plug in the outlet end of the filter unit shall be removed and the unit installed in a set-up similar to that in Figure 7.

(a) A differential-pressure gauge or mercury manometer, shall be connected between inlet and outlet lines and shall be provided with protective cut-off valves.

(b) The differential pressure gauge shall have a full-scale reading not more than 200 psid and its indicating accuracy shall be ±1.0 psid or better.

(c) Elements which have successfully withstood the tests specified in 4.6.1.1 and 4.6.2.1 shall be installed.

(d) Fluid shall be flowed through the filter at rated flow, and 100 ± 5°F.

(e) The viscosity of the fluid shall be a minimum of 13 centistokes.

(f) The pressure drop test shall be repeated without a filter element installed. The housing pressure drop and element pressure drop shall be in accordance with Table II.

4.6.1.4 Differential pressure indicator tests -

4.6.1.4.1 Type A and B operation - Each style of filter housing shall be tested for differential pressure indicator operation with the element port plugged. By means of a power-driven pump, the pressure shall be slowly increased at the inlet port of the filter housing until the pressure indicator actuates fully and locks. This shall be considered the indicator operating pressure. The indicator operating pressure shall occur at 105 ± 10 psid (Paragraph 3.5.15). The pressure shall then be raised to 5,000 psid and dropped to zero psid. The indicator shall stay locked in the extended position throughout the pressure range from the pressure at which it extended to 5,000 psid and back to zero. The indicator shall then be manually reset. For electrical type indicators a 24V and a 110V power supply and test light shall be wired through the indicator to determine actuation pressure.

4.6.1.4.2 Type C operation - The test specified in paragraph 4.6.1.4.1 shall be repeated. The accuracy of the gauge shall be checked at 40, 80, 120, 160 and 200 psid increments on increasing pressure and at 80 psid on decreasing pressure. The gauge reading shall be within ±14 psi of the test set-up differential pressure gauge, throughout its entire range.

4.6.1.4.3 Endurance - Mechanical, electrical and gauge style indicators shall be subjected to the following tests.

4.6.1.4.3.1 Low system pressure - With the filter element port plugged and the outlet port vented to atmosphere, the pressure shall be increased at a rate of 20 psi per minute at the inlet port of the filter housing, until the pressure indicator actuates fully. This shall be considered the indicator operating pressure, and shall occur at 105 ± 10 psid for type A and B indicators. The inlet pressure shall then be reduced to zero and the indicator manually reset. The pressure shall then be cycled 1,000 times at any practical cycling rate from zero to 115 psid and back to zero psid. The indicator shall actuate and shall be reset at the end of each cycle. The indicator operating pressure shall

be checked following cycling and shall occur at 105 ± 10 psid. For the electrical style indicator a 110V power supply and test light shall be wired through the indicator to determine actuation pressure. The gauge style indicator shall meet the requirements of paragraph 4.6.1.4.2

4.6.1.4.3.2 High system pressure - The filter element port shall be blocked with a plug containing an orifice designed to provide rated flow at 115 psid differential pressure across the orifice. The outlet port of the filter housing shall be throttled to provide rated flow through the orifice at 5,000 psi inlet pressure. The flow shall be cycled from zero to rated flow and the differential pressure at which the indicator actuates fully shall be noted. This shall occur at a differential pressure of 105 ± 10 psid. The inlet pressure shall then be raised to 5,000 psi and dropped to zero psi. After actuation, the indicator shall remain in the extended position. The indicator shall then be manually reset. This cycle shall be repeated 1,000 times. The differential pressure indicator operating pressure at 5,000 psi inlet pressure shall then be rechecked and shall occur at 105 ± 10 psid. For the electrical style indicator a 110V power supply and test light shall be wired through the indicator to determine actuation pressure. The gauge style indicator shall meet the requirements of paragraph 4.6.1.4.2

4.6.1.4.4 Surge test - Styles A and B filter housings shall be tested for inadvertent differential pressure indicator operation due to a temporary flow surge. The filter element port shall be blocked. With a power-driven pump and a quick opening valve the pressure shall be rapidly raised from 0 to 115 psid. The differential pressure indicator shall not actuate during the first 0.1 second of pressure application. The differential pressure indicator shall actuate within 1 second from the start of pressure application. The test shall be repeated at 200, 300, 400, and 500 psid and the differential pressure indicator shall actuate within the specified 0.1 to 1 second time range.

4.6.1.4.5 Salt spray test - Each style of filter assembly shall be subjected to a salt spray test in accordance with paragraph 4.6.1, Procedure I, of MIL-E-5272. The indicator shall be checked for conformance to paragraphs 4.6.1.4.1 and 4.6.1.4.2 following this test.

4.6.1.4.6 Sand and dust - Each style of filter assembly shall be subjected to a sand and dust test in accordance with paragraph 4.11.1, Procedure I of MIL-E-5272. The indicator shall be checked for conformance to paragraphs 4.6.1.4.1 and 4.6.1.4.2 following this test.

4.6.1.4.7 Fungus - Each style filter assembly shall be subjected to a fungus test in accordance with MIL-E-5272, Procedure I, paragraph 4.8.1. The indicator shall be checked for conformance to paragraphs 4.6.1.4.1 and 4.6.1.4.2 following this test.

4.6.1.5 Extreme temperature test - With the element port blocked, styles A, B and C filter housings shall be subjected to a temperature of -65° to -70°F for 24 hours. During this period, pressure applied shall not exceed 10 psi. At the end of this period, a pressure of 115 psi shall be applied to the inlet port of the unit and held for 10 minutes, with the outlet port vented to atmosphere. Proof pressure shall then be applied to the inlet port for 2 minutes. The temperature of the hydraulic fluid used for these tests shall be -65° to -70°F. Within 20 minutes, the filter housing shall be removed from the cold box and placed in an ambient temperature of 275°F. A pressure of 115 psi shall be applied to the inlet port of the unit with the outlet port vented to atmosphere. The fluid temperature at which the differential pressure indicator actuates shall be measured and shall be 70 ± 15°F for style A and B assemblies. The indicator operating pressure shall be checked at 5, 10, and 60 minutes, and 24 hours after the first indicator actuation. Indicator operating pressure and gauge reading shall be within the range specified in 4.6.1.4.1 and 4.6.1.4.2.

4.6.1.6 Vibration - Each style of filter assembly shall be subjected to the Media Migration and Vibration Tests, (Section 4.6.2.9 and its subsections). There shall be no damage to any part of the filter unit, including appurtenances, such as the differential-pressure indicator. There shall be no migration identifiable as coming from the filter media. The weight of the contaminant emitted shall not exceed the value listed in Table V.

4.6.1.7 Maintainability, demonstration of - The manufacturer shall be responsible for demonstrating maintainability as follows:

(a) The filter unit shall be attached by its normal mounting bolts to a vertical bulkhead of sufficient size that no part of any man or tool can extend behind the plane of the bulkhead.

(b) A horizontal top shall be provided over the bulkhead, not more than 48 inches above the level floor, so that no part of any man or tool can extend above it.

(c) If the highest point on the filter housing (excluding dial gauge) is more than four inches (4") below the top described above, a horizontal baffle shall be installed four inches (4") above the highest point of the filter. This baffle shall extend at least six inches (6") horizontally beyond all parts of the filter housing.

(d) A straight piece of hydraulic tubing at least one foot in length shall be attached to each port (inlet and outlet) of the filter housing.

(e) The filter unit shall be mounted on the bulkhead at such height that not more than two inches (2") clearance exist between the bottom of the fully installed filter element and the top of the bowl which rests on the floor.

(f) The bowl containing a filter element shall be filled with hydraulic fluid. Filter unit and tubing need not be filled.

(g) Only two men at the same time may touch any part of the filter unit, directly or by means of tools, except during the mounting and dismounting demonstration. At that time, a third man may be allowed working access to the back of the bulkhead.

4.6.1.7.1 The demonstration shall consist of performing each operation in the list below three times. The report shall include (for each separate operation) the time required and the average time. The total time for performing all the operations, three times, shall be a maximum of 45 minutes.

MAINTENANCE OPERATIONS

(a) Removing drain plug

(b) Draining bowl

(c) Replacing drain plug

(d) Removing bowl

(e) Removing element

(f) Reinstalling element

(g) Replacing all O-ring and back-up rings

(h) Replacing bowl, full of fluid

MAINTENANCE OPERATIONS (Cont'd)

(i) Removing bleed plug (filling to displace air is not required)

(j) Replacing bleed plug

(k) Removing inlet and outlet tubing

(l) Replacing inlet and outlet tubing

(m) Removing differential-pressure indicator (If two or more mounted, time each one and each type separately)

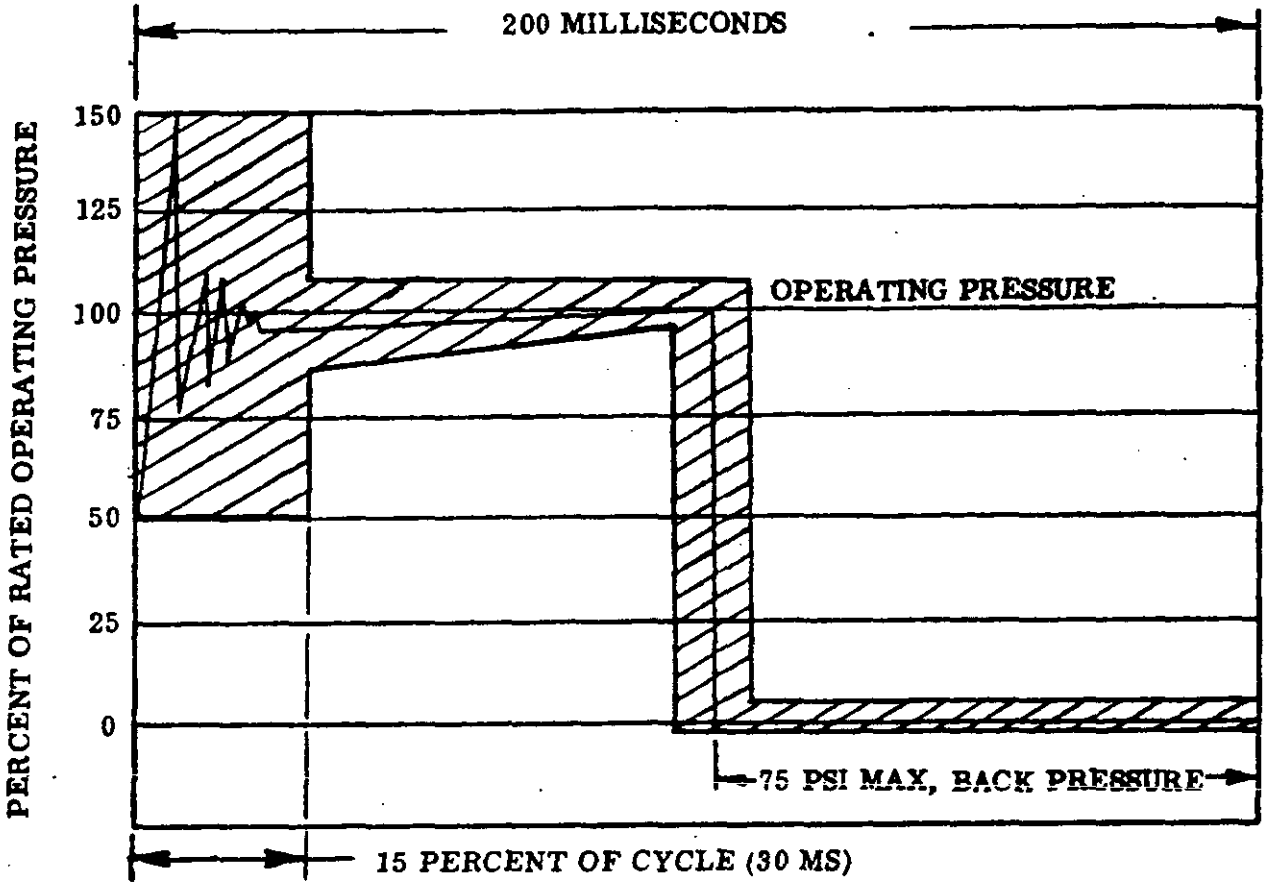
(n) Replacing differential-pressure indicator (Time every one and each type separately)

(o) Dismounting (removing from bulkhead) (Unit assembled, no oil. Tubing in position and remaining attached either to unit or to bulkhead throughout the operation)

(p) Mounting (same conditions as for dismounting)

4.6.1.8 Impulse - Filter-assemblies shall be subjected to 100,000 impulse cycles, 25,000 at a fluid temperature of 275°F and 75,000 at a fluid temperature of 225°F. Each impulse cycle shall consist of a pressure rise from zero to 5,000 psi and drop to zero. During each pressure increase, a peak surge pressure of 1.43 to 1.57 times the working pressure, as shown by an oscillograph, shall be obtained. Cycling shall be performed at a rate of 300 cycles per minute (cpm) maximum. There shall be no evidence of external leakage or structural failure during the performance of this test. See Figure 1 for impulse curve. Style A and B differential pressure indicators shall not actuate during the impulse test. The actual impulse pattern shall be recorded and reported. The indicator shall be checked for conformance to paragraphs 4.6.1.4.1 and 4.6.1.4.2.

4.6.1.9 Burst pressure - The burst pressure test shall be conducted at a fluid and ambient temperature of 275° F after a 5-hour soak at 275° F with the filter unit filled with test fluid. Pressure shall be applied with a hand pump or power driven pump at a maximum rate of increase of 25,000 psi per minute until the specified burst pressure of 11,250 psi is reached. Filter units shall show no leakage in the form of drops or rupture of internal or external parts at this pressure when held for 2 minutes.



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 THE PRESSURE PEAK RISE 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 IN THIS MANNER IS THAT RESULTS OF TESTS PERFORMED ON DIFFERENT TEST MACHINES WILL BE MORE NEARLY COMPARABLE.

INITIAL RATE OF RISE OF THE PRESSURE APPLIED SHALL BE BETWEEN 200,000 AND 300,000 PSI PER SECOND.

FIGURE 1. Impulse Curve

4.6.2 Filter elements -

4.6.2.1 Bubble point - Filter elements shall be tested to determine the initial bubble point. The filter element, containing no fluid, shall be installed in a setup similar to Figure 2. The fluid level shall be maintained at approximately 1/2 inch above the top of the filter element. The air pressure, as indicated in inches of water on the manometer, shall be slowly raised by small increments. The filter element shall be rotated 360 degrees about its longitudinal axis at each increment of air pressure so that the entire filter area can be observed for the appearance of the first bubble. The area of greatest porosity is determined by observing the first bubble on the surface of the filter element; and the manometer reading in inches of water at which this bubble emits from the filter element shall be recorded. This test shall be accomplished within a period of 10 minutes after immersion in the fixture. The fluid used shall be proprietary solvent #3 (U. S. Industrial Chemicals), or equivalent, at 70° ± 5°F filtered through 0.45-micron membrane Millipore filter, or equivalent.

4.6.2.1.1 Test point values - The initial bubble point value shall be the lowest initial bubble point of the four qualification test elements of each dash size and shall be determined prior to further testing. Filter element media having an initial bubble point of less than 3 inches of water will not be acceptable.

4.6.2.1.2 Test elements - The maximum particle passed test (see 4.6.2.5) shall be performed on the element with the lowest bubble point. The degree of filtration test (see 4.6.2.3) shall be performed on the element with the second lowest bubble point, and the pressure buildup and collapse test (see 4.6.2.7) shall be performed on the element with the highest bubble point.

4.6.2.1.3 Quality conformance - The filter element, containing no fluid, shall be installed in a setup similar to Figure 2. The fluid level shall be maintained at approximately 1/2 inch above the top of the filter element. The air pressure shall be preset to 0.1 inch of water less than the minimum initial bubble point. The filter element shall be rotated 360 degrees about its longitudinal axis and the entire filter area scanned for the appearance of any bubbles. There shall be no bubbles emerging from the filter. The fluid used shall be Proprietary Solvent #3, or equivalent, at 70° ± 5°F filtered through 0.45-micron membrane Millipore filter, or equivalent.

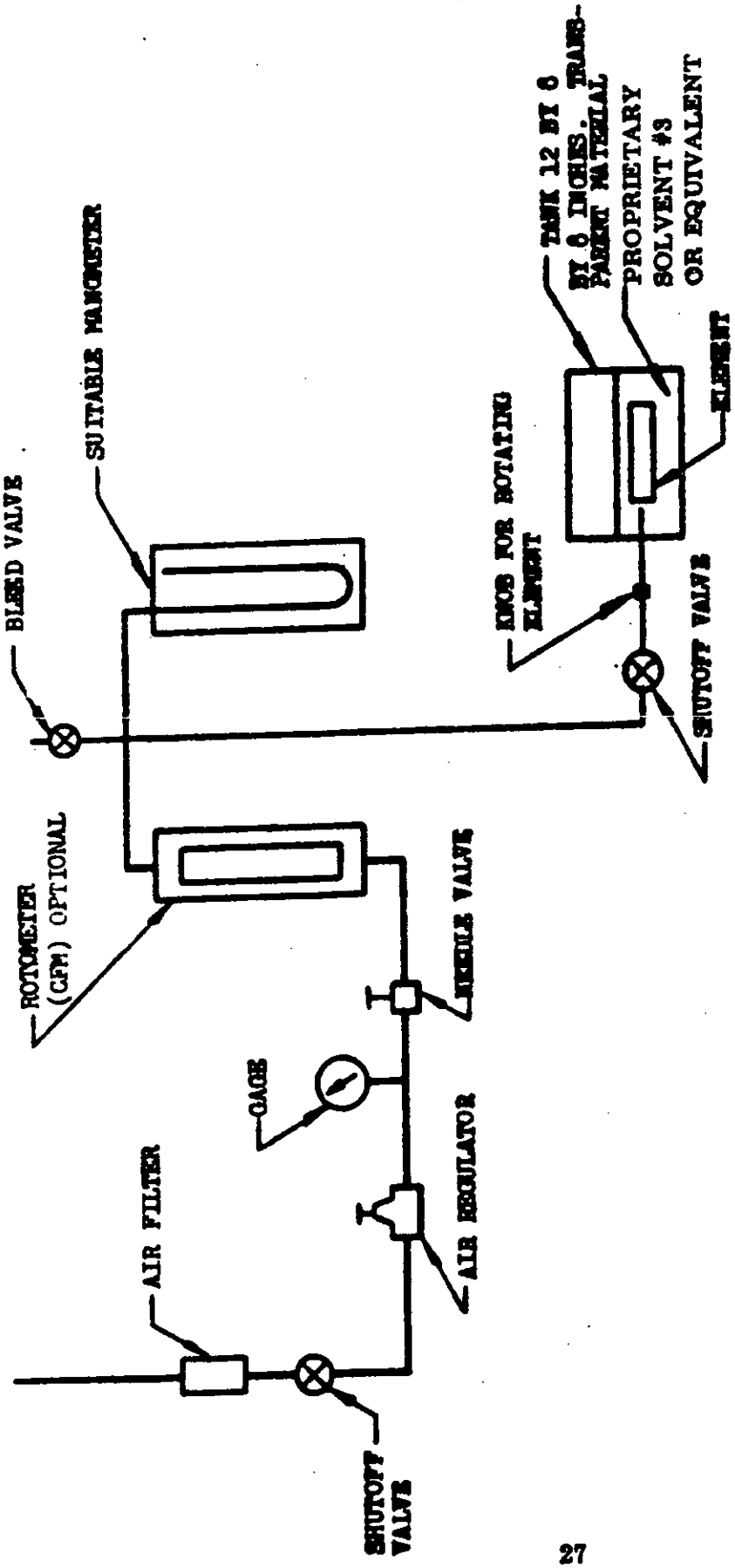


FIGURE 2. Typical Schematic Diagram for Air Bubble Test

4.6.2.2 Determination of hydraulic fluid cleanliness - The cleanliness of the hydraulic fluid shall be determined by the following method:

(a) The clean-up apparatus shall be similar to the setup shown in Figure 3 without the filter element installed in the test housing.

(b) Fluid shall be circulated through the system at a flow rate at least equal to the flow rate of the filter to be tested, with at least periodic agitation of the fluid in the contaminant mixing chamber until a sample of fluid is tested and is found satisfactorily clean as stated in item (c).

(c) As a check on cleanliness, a 2000 ml sample of hydraulic fluid shall be passed through the filter housing at rated flow of the element to be tested. (Use 4000 ml for -24 size filter element.) The contamination shall be less than 0.0004 gm/2000 ml of fluid.

4.6.2.3 Degree of filtration - The degree of filtration for filter elements shall be determined by the test specified herein. It is of primary importance that the hydraulic fluid and air used in the degree of filtration test be clean and filtered prior to test. Figure 3 shows a degree of filtration test setup with a cleanup device attached.

Test procedure:

(a) A setup shall be made as shown on Figure 3 without installing the filter element in the test housing.

(b) Flush 2000 ml of prefiltered hydraulic fluid through the contaminant mixing chamber and the filter housings and discard. (Use 4000 ml for -24 size filter element.) This operation shall be repeated.

(c) The hydraulic fluid shall be checked in accordance with 4.6.2.2.

(d) Add 2000 ml of previously filtered hydraulic fluid through plug valve A. (Use 4000 ml for -24 size filter element.) The element shall be installed in the filter housing.

(e) Valve B shall be closed.

(f) A 5 ml slurry containing a contaminant in accordance with Table V shall be added to the hydraulic fluid through a small funnel inserted in the plug valve A. The contaminants shall be APM F-9 beads, conforming to Figure 4 and A-C test dust conforming to para. 4.6.2.7.

TABLE V. Contaminants

Filter element Part No.	Flow rate (gpm)	Degree of Filtration add rate		Maximum Particle add rate		Pressure Buildup		Media Migration
		F-9 beads (gms)	A-C dust (gms)	F-9 beads (gms)	Iron E (gms)	Add rate A-C dust (gms)	Minimum A-C dust to 100 psid (gms)	Maximum Allowable (mg)
M81836/4-6	3	0.26	0.26	0.026	0.026	1.2	6	4
M81836/4-8	6	0.30	0.30	0.036	0.036	1.6	8	5
M81836/4-10	10	0.56	0.56	0.067	0.067	3.0	15	10
M81836/4-12	20	1.13	1.13	0.133	0.133	6.0	30	20
M81836/4-16	30	1.70	1.70	0.200	0.200	9.0	45	30
M81836/4-24	60	3.40	3.40	0.400	0.400	10	90	60

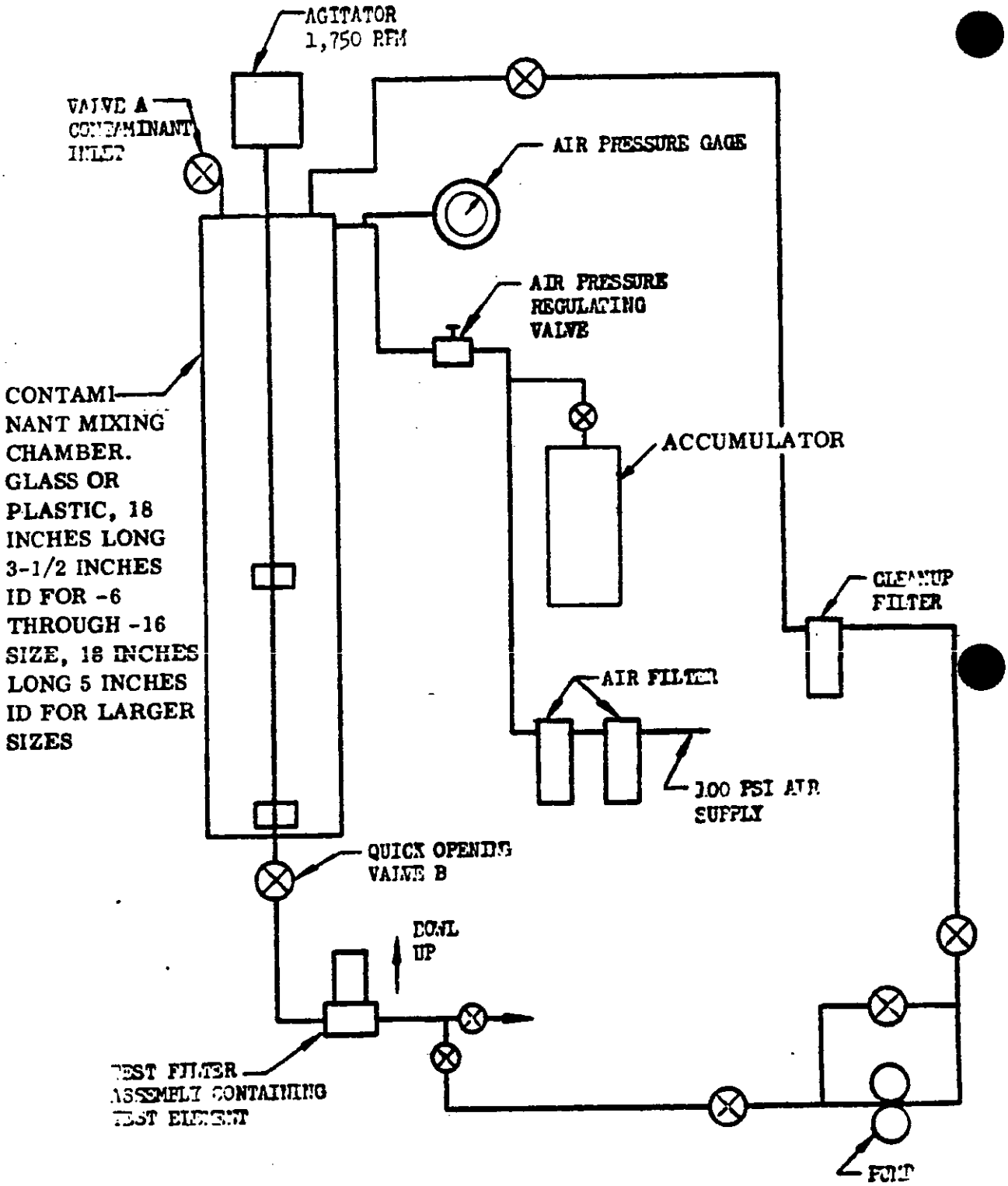
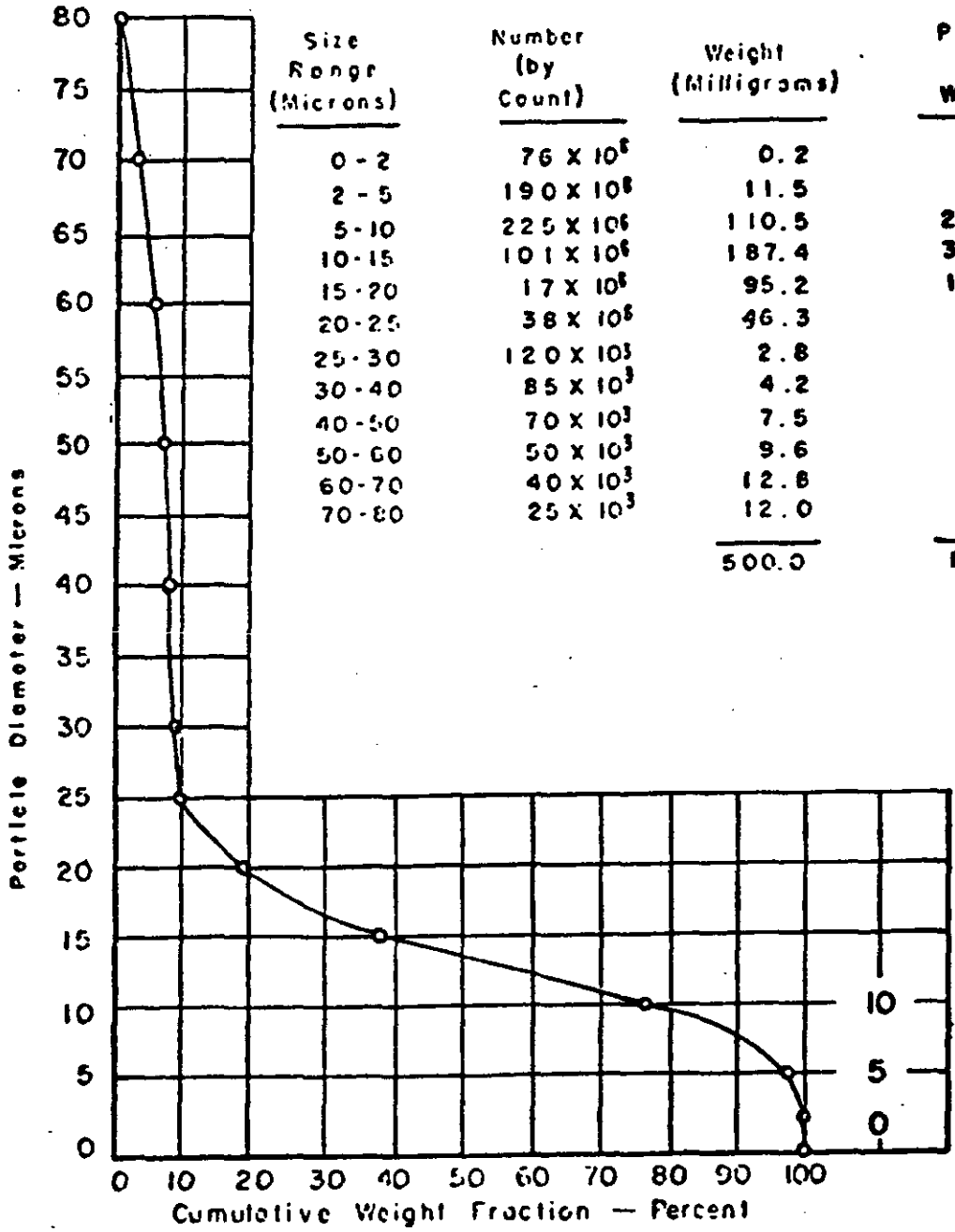


FIGURE 3. Typical Apparatus for Determining Filtration Efficiency of Element

MIL-F-XXXXX(AS)



Size Range (Microns)	Number (by Count)	Weight (Milligrams)	Percent (by Weight)
0 - 2	76×10^6	0.2	0.04
2 - 5	190×10^6	11.5	2.3
5 - 10	225×10^6	110.5	22.1
10 - 15	101×10^6	187.4	37.4
15 - 20	17×10^6	95.2	19.0
20 - 25	38×10^6	46.3	9.3
25 - 30	120×10^3	2.8	0.6
30 - 40	85×10^3	4.2	0.8
40 - 50	70×10^3	7.5	1.5
50 - 60	50×10^3	9.6	1.9
60 - 70	40×10^3	12.8	2.6
70 - 80	25×10^3	12.0	2.4
		500.0	100.0

Points on the Line Indicate Portions of Particles with Sizes Greater Than Diameter Noted.

FIGURE 4. Particle Size Distribution Curve APM F-9 Glass Beads

(g) The contaminant shall be distributed uniformly by churning the hydraulic fluid with an agitator for 3 minutes.

(h) Plug vaive A shall be closed and the glass chamber containing the hydraulic fluid and contaminant shall be pressurized using the air regulator. The air regulator is used to maintain rated flow.

(i) Valve B shall be opened and air pressure shall force the hydraulic fluid containing the contaminant through the sample filter assembly. The filtrate shall be collected in a clean beaker. Using a suitable wash bottle, 1500 ml of petroleum ether (boiling point (b.p.) 95° to 130°F) shall then be washed through the contaminant mixing chamber and test filter assembly. The wash fluid shall be collected in the same beaker.

(j) A membrane filter 47-mm diameter disk, absolute 0.8-micron type AA Millipore, or equivalent, shall be washed with 400 ml of prefiltered petroleum ether and dried to constant weight at 125°F. The weight shall be accurate to 0.1 milligram (mg.). The disk shall be heated at 125°F for 30 minutes and then cooled 30 minutes in a desiccator.

(k) The weighed filter membrane shall be assembled into the filter holder assembly (see Figure 5) and fitted to a vacuum flask connected to a suitable vacuum (minimum 25 inches of Hg vacuum).

(l) All hydraulic fluid passed through the test filter is filtered through the membrane disk. The beaker shall be washed with 1000 ml of prefiltered naphtha and 1000 ml of prefiltered petroleum ether (b.p. 95° to 130°F) and fluid from the washed beaker shall be passed through the membrane. The filter funnel shall also be washed down with 100 ml of prefiltered naphtha and 100 ml of prefiltered petroleum ether.

(m) Maintaining vacuum, the top half of the filter funnel assembly shall be removed. The membrane filter shall now be exposed for further washing.

(n) With a wash bottle of prefiltered petroleum ether (b.p. 95° to 130°F), the rim of the membrane filter shall be gently washed to remove traces of hydraulic fluid, being careful not to disturb the cake. Vacuum shall be maintained during this operation.

(o) The vacuum shall be shut off and the membrane filter removed. It shall be dried to a constant weight at 125°F and weighed to 0.1 of a mg.

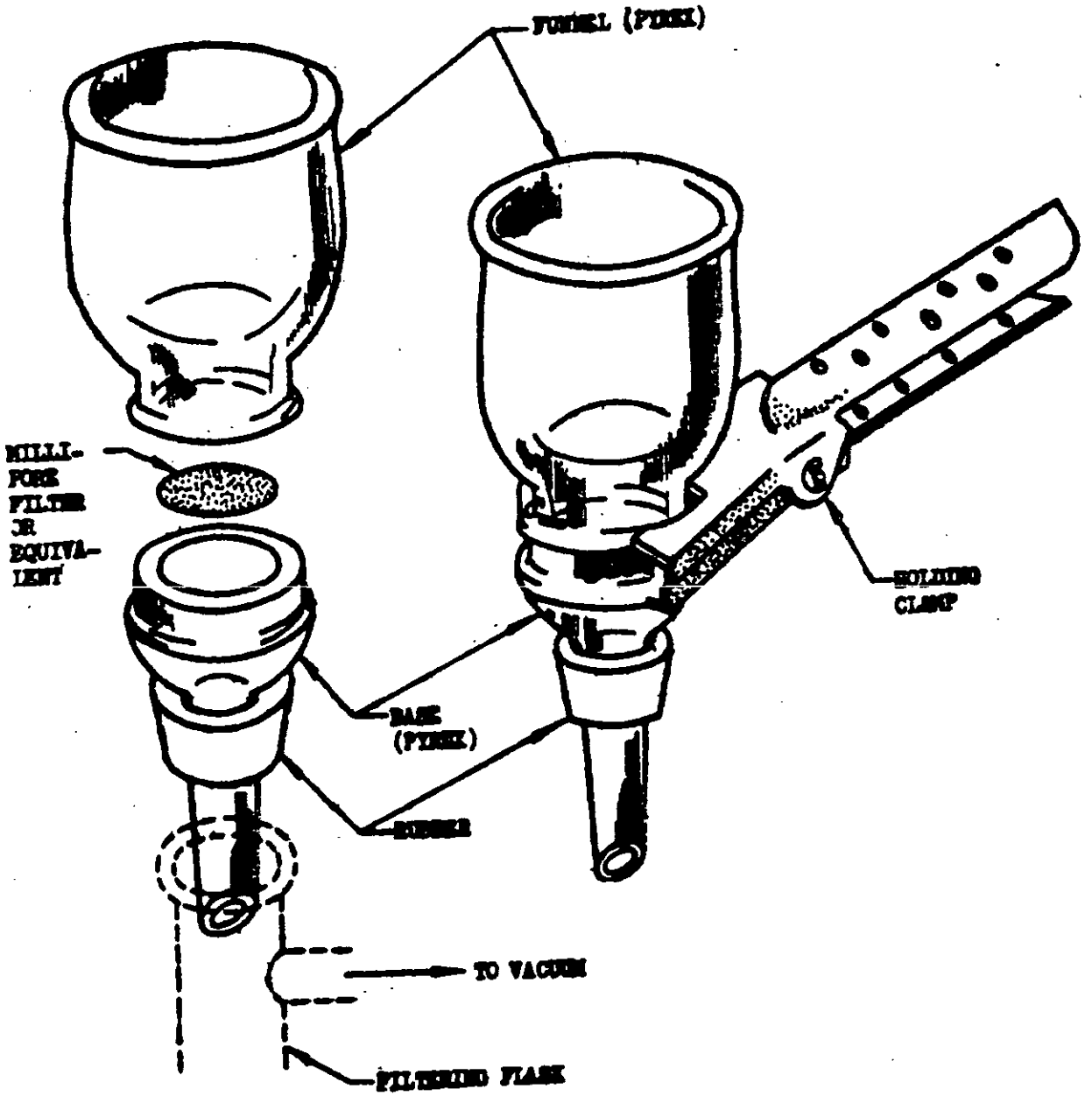


FIGURE 5. Diagram of Effluent Filtration Setup

The difference between the membrane filter weights before and after the above procedure is the weight of contaminant passing through the test filter, B in the formula specified in 4.6.2.3.1.

4.6.2.3.1 System add and blank values - The test specified in 4.6.2.3, with the filter element removed shall be repeated four times for four separate contaminant-add values (A in the following formula). Hydraulic fluid cleaned to a level that conforms with 4.6.2.2 shall be used for each test. The contaminant collected shall be the add value and shall be used in the calculation of degree of efficiency. It shall be the average of these four runs. None of the four add values shall be less than 95 percent by weight of the contaminant introduced. To insure cleanliness of the system and the filter assembly, a system blank value shall be obtained by repeating 4.6.2.3(a) thru (c) with the filter element installed and no contaminant added. This blank value shall be the value C in the following efficiency formula and shall be less than 0.0007 gram.

$$\text{Percent removal} = \frac{A - (B-C)}{A} \times 100$$

Where:

A = (add value) = Amount of test contaminant passed through the system when there is no filter element in the filter housing.

B = (contaminant value) = Amount of test contaminant passed through the test filter assembly (element installed).

C = (blank value) = Amount of contaminant attributed to the test system and test filter assembly when no test contaminant has been added.

4.6.2.3.2 Efficiency - The filter assembly shall remove 99.5 percent by weight of the contaminant-add value as determined by the formula in 4.6.2.3.1.

4.6.2.4 Flow fatigue - Filter elements shall be installed in filter housings and shall be subjected to pressure-flow cycles with hydraulic fluid at a minimum flow of 6 gpm and at 275° ± 5°F. A cycle shall consist of increasing the differential pressure across the filter element from zero to the maximum specified and back to zero by first increasing, then decreasing, the flow through the test filter element, which has been loaded with A-C fine test dust, carbonyl iron E and APM F-9 beads.

4.6.2.4.1 The cycling rate shall not exceed 300 cpm. The number of cycles at each differential pressure shall be as follows:

(a) 90,000 cycles at 60 psi pressure drop

(b) 8,000 cycles at 80 psi pressure drop

(c) 2,000 cycles at 120 psi pressure drop

(d) 100 cycles at 5,000 psi pressure drop

There shall be no evidence of damage as a result of this test.

4.6.2.4.2 Particles released (passed) - Near the completion of each series of tests (a, b, c, and d above), a 2,000 ml sample of effluent fluid shall be collected while maintaining the specified differential pressure. The fluid sample shall be passed through an absolute 0.80-micron type AA Millipore or equivalent. The disk shall be scanned in accordance with ARP-598. Any test contaminant found larger than 3 microns shall be cause for rejection.

4.6.2.5 Maximum particle passed - A filtration test shall be conducted as follows:

(a) A degree of filtration test shall be conducted in accordance with the procedure specified in 4.6.2.3 (a) through (i) except that the contaminant shall be APM F-9 beads and carbonyl iron E in the amounts specified in Table V. The particle size distribution for carbonyl iron E shall conform to Figure 6.

(b) The effluent shall be passed through an absolute 0.8-micron membrane disk Type AA Millipore filter paper, or equal.

(c) The entire disk shall be scanned in accordance with ARP-598. The largest bead or carbonyl iron E particle shall be no greater than 3 micron.

NOTE: In order to produce an absolute test result, the test set-up downstream of the filter element and all glassware should not have been used previously with carbonyl iron E or glass beads.

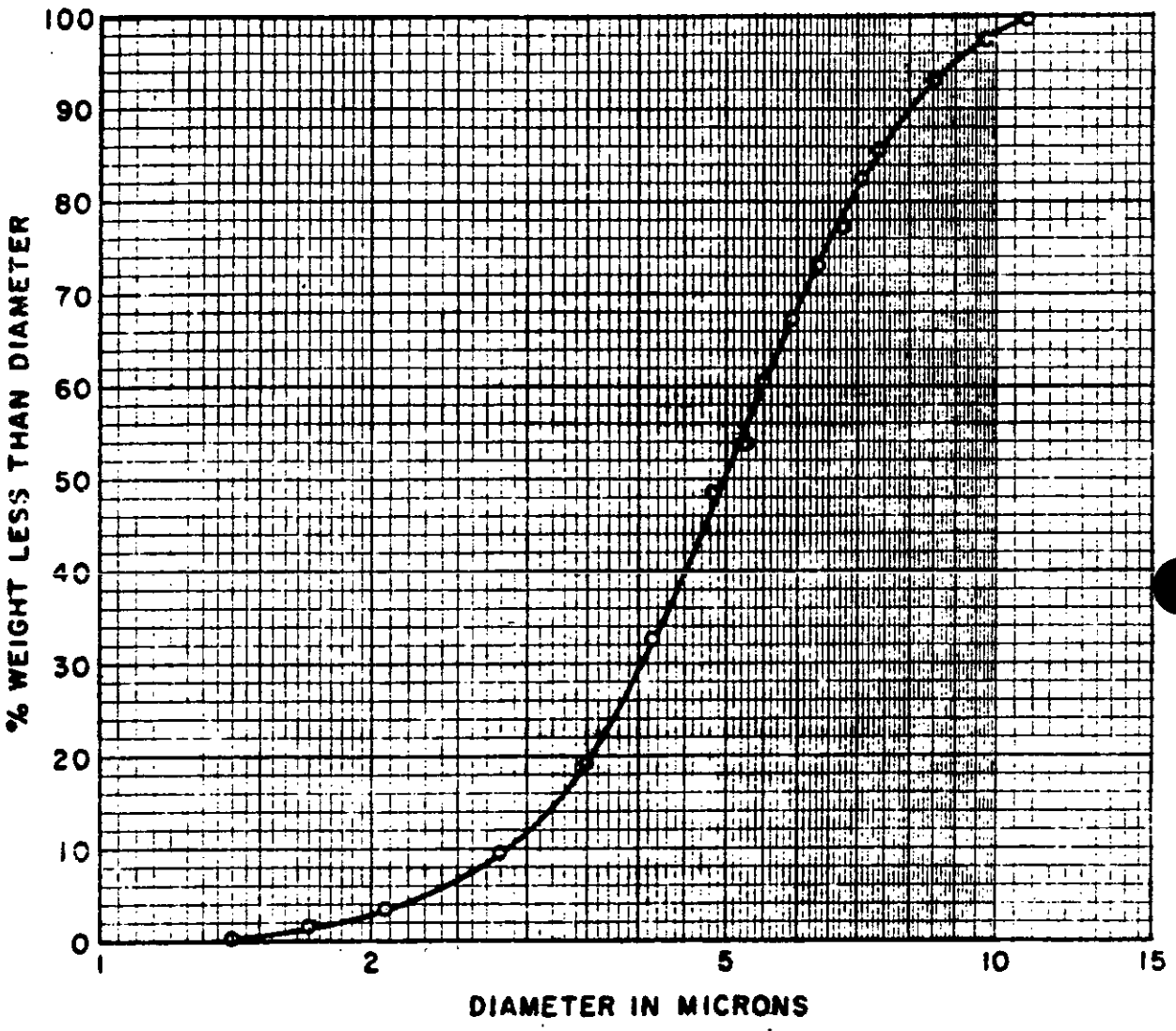


FIGURE 6. Particle Size Distribution, Carbonyl Iron E

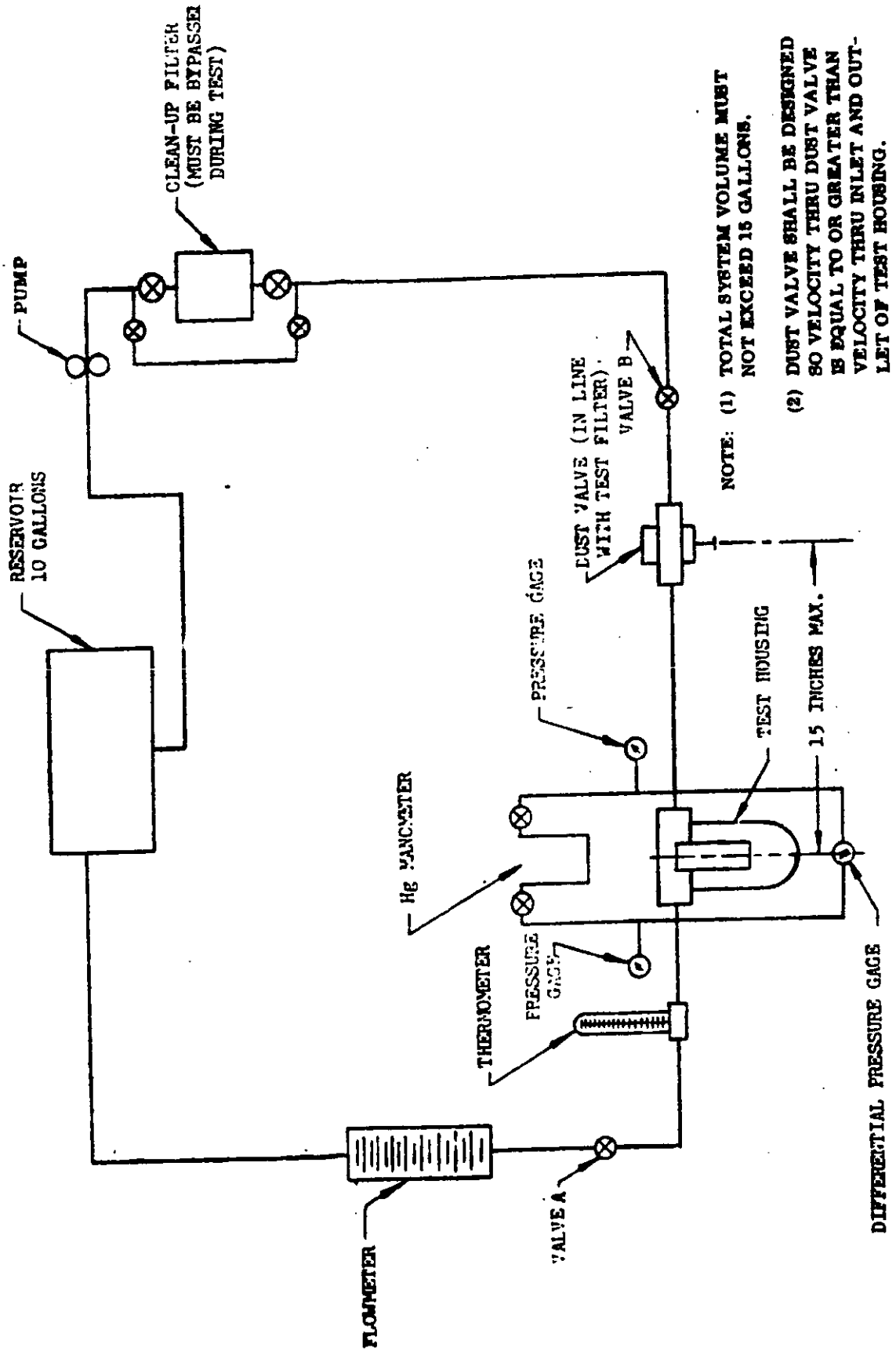


FIGURE 7. Typical Setup for Determining Pressure Buildup and Collapse Pressure Characteristics

4.6.2.6 Fluid degradation test - The cleanup filter shall be removed from the setup shown on Figure 7. The reservoir and circuit shall be filled with unfiltered hydraulic fluid. Two 1-quart samples of the unfiltered fluid shall be collected. The fluid shall then be circulated through the circuit at rated flow for 1 hour and two 1-quart samples of the effluent taken. Test dust shall be added at the dust valve until the differential pressure across the filter reaches 100 psi. Two 1-quart samples of the effluent shall then be collected. One of each of the three samples of fluid shall be properly identified and shall be submitted to all the tests of MIL-H-5606. The three remaining samples shall be properly identified and forwarded to the procuring activity. Any change to the composition of the hydraulic fluid as a result of passing through the filter shall be cause for rejection.

4.6.2.7 Pressure buildup and collapse test - A pressure buildup and collapse test shall be conducted as follows:

(a) The test fluid used in the system shown on Figure 7 shall be precleaned by flowing through the cleanup filter to the level specified in paragraph 4.6.2.2. The cleanup filter shall be bypassed throughout the remainder of this test.

(b) The element under test shall be installed in the housing.

(c) The pump shall be started, valves A and B opened, and rated flow attained.

(d) Standardized fine air cleaner (A-C) test dust shall be added in increments as specified in Table V at 4-minute intervals through the dust valve, in slurry. Test dust shall have the following composition:

Size of Particle	Percent by Weight of Total
0 to 5 microns	39 ± 2
5 to 10 microns	18 ± 3
10 to 20 microns	16 ± 3
20 to 40 microns	18 ± 3
Over 40 microns	9 ± 3

(e) Two minutes after each dust addition, pressure differential and flow and temperature shall be recorded. Dust shall be added until the minimum weight of dust specified in Table V is added. The differential pressure across the filter assembly shall not exceed 100 psid. The pump shall not be stopped during the test. Additional dust and carbonyl iron E, (1-12

microns) in equal quantities shall be added until a differential pressure of 5,000 psid is obtained across the element. The dirt capacity to 5,000 psid shall be recorded. The effluent shall be sampled and tested in accordance with 4.6.2.5 (b) and (c) as the differential reaches 100, 150, 1,000, 2,000, 3,000, and 5,000 psid. The samples collected shall show a maximum carbonyl iron E particle of 3 microns. For quality conformance tests, the test shall be stopped at 100 psid.

4.6.2.8 Cold start - The filter element shall be installed in a housing filled with oil and subjected to a temperature of -65°F for 72 hours. The element shall then be subjected to 10 flow cycles at 3,000 psid pressure across the element with fluid held at -65°F or lower. The flow shall not exceed 150 percent of rated flow and shall be a minimum of 0.5 gpm. Each flow cycle shall be 15 ± 5 seconds in duration. There shall be no evidence of filter media damage as evidenced by satisfactory completion of the bubble point, media migration, largest particle passed and pressure buildup and collapse tests.

4.6.2.9 Media migration and vibration tests - The filter housing containing no element shall be mounted on a test stand and flushed at rated flow with oil precleaned to the level specified in 4.6.2.2. The filter unit, filled to the top of the element with fluid, shall be maintained at 300°F for 100 hours.

4.6.2.9.1 Vibration test - The filter unit shall be cooled to room temperature (70° to 90°F) and vibrated in three mutually perpendicular planes, while mounted in normal position (bowl at the bottom). The frequency of vibration shall be varied from 50 to 500 Hz, with one pass of scanning to be at least 15 minutes, at an acceleration of 10g in each plane with any resonating frequencies noted. The filter unit shall be vibrated for 1 hour at each of these resonating frequencies. If no resonance is encountered, the vibrating frequency shall be 500 Hz for one hour at an acceleration of 10g in each plane. The differential pressure indicator shall not actuate during this test. Following the migration analysis test paragraph 4.6.2.9.2, the differential pressure indicator shall be tested for and meet the operational requirements of paragraphs 4.6.1.4.1 and 4.6.1.4.2.

4.6.2.9.2 Migration analysis tests - The filter assembly shall be taken from the vibration test and without loss of oil installed inverted in a test set-up similar to that shown in Figure 3. A degree of filtration test shall be conducted without contaminant, paragraph 4.6.2.3(d) through (o). The analysis membrane shall be microscopically examined using the procedure specified in ARP-598. The membrane filter used for this test shall be of contrasting color

to the filter element medium and the microscope shall be of adequate magnification. There shall be no migration identifiable as coming from the filter media. The weight of the contaminant collected shall not exceed the value listed in Table V.

4.7 Preservation, packaging, and marking - Preparation for delivery shall be examined for conformance to section 5.

5. PREPARATION FOR DELIVERY

5.1 Packaging - (See 6.2)

5.1.1 Level A - One each filter unit or element shall be packaged in accordance with method II of MIL-P-116. All openings of the filter unit or element shall be sealed with closures conforming to MIL-C-5501. The filter unit or element shall be wrapped in grade A barrier material conforming to MIL-B-121 and placed in a container conforming to PPP-B-636.

5.1.2 Level C - The filter or element shall be packaged in accordance with standard commercial practice.

5.2 Packing - (See 6.2)

5.2.1 Insofar as practical, shipping containers shall be of uniform size and shape and of minimum cube and tare weight. Each shipping container shall contain only one filter unit, or one element when shipping only filter elements.

5.2.2 Level A - Unless otherwise specified, shipping containers shall be nailed wooden or wooden-cleated plywood boxes conforming to PPP-B-621 or PPP-B-601 (overseas type).

5.2.3 Level C - Unless otherwise specified, the unit package shall be packed in substantial commercial shipping containers constructed 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 containers shall conform to the requirements of consolidated freight classification rules in effect at the time of shipment.

5.3 Marking for shipments - In addition to any special marking required by the contract or order, interior packages and exterior shipping containers shall be marked in accordance with MIL-STD-129 and shall include the following:

Specification sheet part number
Month and year of manufacture
Style and size

6. NOTES

6.1 Intended use - The filter assemblies covered by this specification are intended for use in aircraft hydraulic test equipment and ground support equipment and operating with hydraulic fluid conforming to MIL-H-5606 at nominal operating pressures of 5000 psi and 275°F.

6.2 Ordering data - Procurement documents should specify the following:

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

(b) Specification sheet part numbers (see 1.2). (Adapter M81836/5 is required when filter elements are used in MIL-F-27656 type filter housings.)

(c) Style (see 1.2).

(d) Applicable levels of packaging, and packing (see 5.1 and 5.2).

(e) Special marking, if required (see 5.3).

6.3 Qualification - With respect to products requiring qualification, awards will be made only for such products as have, prior to the time set for opening of bids, 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. The attention of the suppliers is called to this requirement, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification, in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. The activity responsible for the Qualified Products List is the Naval Air Systems Command, Attn: AIR-53441C, Department of the Navy, Washington, D. C. 20360.

Preparing activity:
Navy - AS
(DoD Project No. 4920-N288)

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Naval Air Systems Command
Washington, D.C. 20360

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SPECIFICATION ANALYSIS SHEET

Form Approved
Budget Bureau No. 119-R004

INSTRUCTIONS

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 the minimum amount of delay and at the least cost. Comments and the return of this form will be appreciated. Fold on dotted lines on reverse side, staple in corner, and send to preparing activity (as indicated on reverse hereof).

SPECIFICATION
MIL-D-81609B(AS) DETECTING SET, MAGNETIC AN/ASQ-81(V)

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)

SUBMITTED BY (Printed or typed name and activity)	DATE

DD, FORM 1 APR 62, 1426

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