

INCH - POUND

MIL-F-24402E(SH)

3 April 1990

SUPERSEDING

MIL-F-24402D(SH)

12 April 1982

(See 6.8)

MILITARY SPECIFICATION

FILTERS (HYDRAULIC), FILTER ELEMENTS (HIGH EFFICIENCY),
AND FILTER DIFFERENTIAL PRESSURE INDICATORS,
GENERAL SPECIFICATION FOR

This specification is approved for use by the Naval Sea Systems Command, Department of the Navy, and is available for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers hydraulic filter housings, filter elements, and associated differential pressure indicators for use in ship hydraulic control systems with an operating pressure up to 3,000 pounds per square inch (**1b/in²**).

1.2 Classification. Filter housings, filter elements, and differential pressure indicators shall be of the envelope sizes specified in the applicable specification sheet (see 3.1) and shall be designated as shown in the applicable specification sheets

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation (see 6.2).

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Naval Sea Systems Command, SEA 5523, Department of the Navy, Washington, DC 20362-5101 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

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SPECIFICATIONS

FEDERAL

- PPP-F-320 - Fiberboard; Corrugated and Solid, Sheet Stock (Container Grade), and Cut Shapes.

MILITARY

- MIL-V-3 - Valves, Fittings, and Flanges (Except for Systems Indicated Herein); Packaging of.
- MIL-P-116 - Preservation, Methods of.
- MIL-S-901 - Shock Tests, H.I. (High-Impact) Shipboard Machinery, Equipment, and Systems, Requirements for.
- MS3102 - Connector, Receptacle, Electric, Box Mounting, Solder Contacts, AN Type.
- MIL-H-5606 - Hydraulic Fluid, Petroleum Base: Aircraft, Missile, and Ordnance.
- MIL-L-17331 - Lubricating Oil, Steam Turbine and Gear, Moderate Service.
- MIL-L-19140 - Lumber and Plywood, Fire-Retardant Treated.
- MIL-H-19457 - Hydraulic Fluid, Fire-Resistant, Non-Neurotoxic.
- MIL-H-22072 - Hydraulic Fluid, Catapult, NATO Code Number H-579.
- MIL-F-24402/1 - Filter Housings, Hydraulic Single Element.
- MIL-F-24402/2 - Filter Housings, Hydraulic, Duplex.
- MIL-F-24402/3 - Filter Housings, Hydraulic, Three Elements.
- MIL-F-24402/4 - Filter Elements Hydraulic. Disposable.
- MIL-F-24402/5 - Filter Indicators, "Differential Pressure, Hydraulic.
- MIL-F-27656 - Filter Unit, Fluid, Pressure MXU-408/M, Absolute 5 Micron, Hydraulic.

STANDARDS

MILITARY

- DOD-STD-100 - Engineering Drawing Practices.
- MIL-STD-167-1 - Mechanical Vibrations of Shipboard Equipment (Type I - Environmental and Type II - Internally Excited).
- MIL-STD-278 - Welding and Casting Standard.
- MIL-STD-1651 - Insert Arrangements for MIL-C-5015, MIL-C-22992 (Classes C, J, and R), and MIL-C-83723 (Series II) Electrical Connectors.
- MIL-STD-2073-1 - DOD Materiel Procedures for Development and Application of Packaging Requirements.
- MIL-STD-2073-2 - Packaging Requirement Codes,
- MIL-STD-2193 - Hydraulic System Components, Ship Metric.

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Naval Publications and Forms Center, (Attn: NPODS), 5801 Tabor Avenue, Philadelphia, PA 19120-5099.)

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2.2 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DOD adopted are those listed in the issue of the DODISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS are the issues of the documents cited in the solicitation (see 6.2).

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

Y32.10 - Graphic Symbols for Fluid Power Diagrams. (DoD adopted)

(Application for copies should be addressed to the American National Standards Institute, 1430 Broadway, New York, NY 10018.)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

D 3951 - Standard Practice for Commercial Packaging. (DoD adopted)

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.)

NATIONAL FLUID POWER ASSOCIATION (NFPA)

T2.6.1 - Method for Verifying the Fatigue and Static Pressure Ratings of the Pressure Containing Envelope of a Metal Fluid Power Component.

(Application for copies should be addressed to the National Fluid Power Association Inc., 3333 North Mayfair Road Milwaukee. WI 53222.)

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE)

ARP 901 - Bubble-Point Test Method.

(Application for copies should be addressed to the Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA 15096.)

(Non-government standards and other publications are normally available from the organizations that prepare or distribute the documents. These documents also may be available in or through libraries or other information services.)

2.3 Order of precedence. In the event of a conflict between the text of this document and the references cited herein (except for related specification sheets), the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Specification sheets. The individual item requirements shall be as specified herein and in accordance with the applicable specification sheet. In the event of any conflict between the requirements of this specification and the specification sheet, the latter shall govern.

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3.2 Qualification. The filter assemblies, filter elements, and differential pressure indicators furnished under this specification shall be products which are authorized by the qualifying activity for listing on the applicable qualified products list at the time of award of contract (see 4.3 and 6.3).

3.3 Materials. Materials and coatings shall conform with the material requirements specified in MIL-STD-2193. Where threaded connections are used between the filter bowl and housing, the thread design and materials shall be selected to prevent galling. The bowl and head shall be constructed of dissimilar materials which do not gall when in contact or of similar materials which have a hardness difference of not less than 45 Brinell points. Plating or coating threads to achieve hardness difference shall not be permitted.

3.3.1 Recovered materials. Unless otherwise specified herein, all equipment, material, and articles incorporated in the products covered by this specification shall be new and may be fabricated using materials produced from recovered materials to the maximum extent practicable without jeopardizing the intended use. The term "recovered materials" means materials which have been collected or recovered from solid waste and reprocessed to become a source of raw materials, as opposed to virgin raw materials. None of the above shall be interpreted to mean that the use of used or rebuilt products is allowed under this specification unless otherwise specifically specified.

3.3.2 Compatibility. Filter assemblies and differential pressure indicators shall be compatible with the fluids identified in the compatibility requirements in MIL-STD-2193.

3.3.2.1 Filter element compatibility. Filter element materials shall be compatible with hydraulic fluids containing up to 5 percent water, which shall not result in degradation of element performance. The hydraulic fluids are identified in the compatibility requirements in MIL-STD-2193.

3.3.3 Filter element media. If the filter element is of the type wherein resinous or other material is used for elimination of imperfections, not more than 2 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 (see 4.7.2.1). After repair, the minimum bubble point on production elements shall be 90 percent of the minimum bubble point of the qualification test element with the lowest bubble point, but shall be not less than 4.5 inches.

3.4 Construction. Unless otherwise specified herein, the design, parts, and construction of filter housings, filter elements, and differential pressure indicators shall conform to the construction requirements specified herein, in MIL-STD-2193, and in the applicable specification sheets.

3.4.1 Filter assemblies. Filter assemblies (filter element and housing) shall be of the full-flow type, with flow through the filter element being from outside-in. Filter assemblies shall be constructed so that fluid entering the filter housing cannot impinge directly upon the filter element medium. The filter assemblies shall be such that the filter elements cannot be installed reversed.

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The filter assemblies shall permit the removal of the filter element within the element removal clearance envelope shown on the applicable specification sheets, without disconnecting fittings or disturbing mountings. Filter assemblies shall meet all requirements with the maximum element diameter permitted for the size element used in the assembly.

3.4.1.1 Mounting. The equipment shall include provisions for solid mounting of the filter assemblies. The mounting provisions shall meet the shock requirements of 3.5.1. The mounting shall withstand the wrench loads required for making tube connections and replacing filter elements.

3.4.1.2 Components. The components comprising the filter assemblies such as check valves, differential pressure indicators, and relief valves, shall permit repair or replacement of the components without having to replace the filter housing or manifold. Internal valves shall have replaceable seats.

3.4.1.3 Interchangeability. In no case shall parts be physically interchangeable or reversible unless such parts are also interchangeable or reversible with regard to function, performance, and strength.

3.4.2 Filter housings. The filter housings shall meet the flowrates specified in the applicable specification sheets. These flowrates are based on the use of fluid in accordance with MIL-L-17331.

3.4.2.1 Filter housing bowls. Filter housing bowls shall utilize threaded connections between the filter bowl and housing. The entering ends of the bowl and housing threads shall incorporate a blunt start in which the partial thread at the entering end is removed to prevent crossing of threads during assembly. Filter housings shall be provided with square wrench flats to facilitate bowl removal during filter element replacement. The threaded filter bowls shall be provided with not less than 2-inch wide knurling completely around the bowl circumference.

3.4.2.2 Drain plug. Filter housings shall be equipped with a drain plug. The positioning of the drain plug shall permit maximum drainage of oil from the assembly during filter element replacement.

3.4.2.3 Loads. Filter housings shall withstand the structural loads imposed by the tests (see 4.3). In addition, the filter housing shall be of such strength and rigidity as to withstand the wrench loads required for making tube connections and replacing filter elements.

3.4.3 Filter elements. Filter elements shall be constructed with an outer wrap of metal screen or perforated metal to protect the filter media pack from damage during handling.

3.4.4 Protective and control devices.

3.4.4.1 Differential pressure indicators. Filter assemblies shall be equipped with differential pressure indicators. The indicators shall conform to the envelope and male gland dimensions shown on the specification sheet for differential pressure indicators and shall be mounted to the filter assembly using

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the porting detail shown on figure 1. The filter housing shall permit the mounting of any indicator in not less than two of four 90-degree orientations. Three-element filter assemblies (see the applicable specification sheet) shall have an indicator installed which can be rotated 180 degrees to permit viewing from either side of the assembly.

3.4.4.1.1 Mechanical differential pressure indicators. Mechanical differential pressure indicators shall actuate, by raising a red indicator, at a filter element differential pressure value specified in the applicable specification sheet. The indicator shall have a surge lockout to prevent actuation for not less than 5 seconds for differential pressures equal to or less than a value specified in the applicable specification sheet. The indicator shall not inadvertently actuate under the vibration of a 20 gravity shock load. Once actuated, the red indicator shall be constructed so that it can be manually reset at 3,000 **lb/in²** operating pressure without the assistance of any tool.

3.4.4.1.2 Electrical differential pressure indicators. Electrical differential pressure indicators shall actuate by raising a red indicator and making electrical contacts simultaneously at a filter element differential pressure value specified in the applicable specification sheet. The electrical connector shall conform to class, size, insert arrangement, and style requirements of MS3102 as identified by part or identifying number (PIN); MS3102R-10SL-3P. The electrical rating on the single-pole, double-throw switch shall be 5 amperes at 110 volts alternating current (Vat), 28 volts direct current (Vdc) (resistive), and 3 amperes at 100 Vac, 28 Vdc (inductive). The switch shall be constructed with a removable 2-watt, 6800-ohm resistor installed internally across the normally open contacts, for possible use in a supervised monitoring system. Electrical connector pins A and B, in accordance with MIL-STD-1651, arrangement 3, shall be connected to the normally open contacts. The indicator shall have a surge lockout to prevent actuation for not less than 5 seconds for differential pressure equal to or less than a value specified in the applicable specification sheet. The indicator shall not inadvertently actuate under the vibration of a 20 gravity shock load. Once actuated, the red indicator shall be constructed so that it can be manually reset at 3,000 **lb/in²** operating pressure without assistance of any tool.

3.4.4.1.3 Gauge-type differential pressure indicators. Gauge-type differential pressure indicators shall have a differential pressure range as specified in the applicable specification sheet. The indicators shall be marked in **10-lb/in²** graduations with identifying numbers every 20 **lb/in²**. Gauges shall not be redlined. Gauges shall withstand forward and reverse differential pressures of up to 3,000 **lb/in²** without any zero shift or loss of accuracy. Accuracy shall be within plus or minus 11 **lb/in²**.

3.4.4.2 Bleed valve. Each filtration circuit of each filter assembly shall include a safety bleed valve to vent system pressure from the filter bowls, thus allowing safe disassembly.

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3.4.4.3 Bypass-relief valve. Filter assemblies designated type R (see the applicable specification sheet) shall have a relief valve to automatically bypass hydraulic fluid, in the event of excessive flow restriction through the filter elements. The relief valve shall be set in accordance with the setting specified in the applicable specification sheet. The relief valve shall be integral to the filter housing.

3.4.4.4 Selector valves. Three-way, three-position, directional-control valves shall be incorporated into duplex filter assemblies. Valve levers or handles shall be provided with a latch or other mechanism to prevent inadvertent operation. Flow shall not be shut off when shifting from one position to another. With dummy elements installed and with a flow of at least one-half of the housing's rated flow, the differential pressure across the filter assembly during shifting shall be not greater than 50 lb/in². The maximum torque required to change valve positions under test flow conditions shall be not greater than 40 foot-pounds.

3.4.4.5 Check valves. Duplex filter assemblies shall use check valves to prevent the reverse flow of fluid through the filtration circuits. Maximum cracking differential pressure shall be 8 lb/in². Leakage, with the filter bowls removed and measured at differential pressures of 5 and 3,000 lb/in², shall be not greater than 2 milliliters (mL) per minute in each flow passage after completion of pressure cycle testing (see 4.7.1.9).

3.4.5 Welding and allied processes. Welding and allied processes shall be in accordance with MIL-STD-278 for the filter housing pressure vessel or structural welds, as applicable.

3.5 Performance. Filter assemblies, filter housings, differential pressure indicators, and filter elements shall perform as specified when subjected to the examination and tests specified in 4.3 and 4.4.

3.5.1 Shock. Filter assemblies and differential pressure indicators shall meet the shock requirements of MIL-S-901 for grade A, class I equipment.

3.5.2 Fatigue impulse. When required by the applicable specification sheet, the filter assemblies and differential pressure indicators shall withstand, without failure, 10 million impulse pressure cycles in accordance with NFPA T2.6.1.

3.5.3 Proof pressure. Filter assemblies and differential pressure indicators shall withstand a proof pressure as specified in the applicable specification sheet without evidence of permanent deformation, malfunction, or external leakage.

3.5.4 Housing pressure drop. The pressure drop through the filter housing at maximum rated flow, with dummy elements installed, shall be not greater than the value specified in the applicable specification sheet. The dummy elements may be constructed to minimize element flow loss, but the element end caps shall be solid, except for the normal hole in the element outlet, and shall comply with the maximum envelope dimensions specified for the appropriate filter elements.

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3.5.5 Burst pressure. Filter assemblies shall withstand a burst pressure as specified in the applicable specification sheet. The filter assemblies shall not rupture under this pressure. The burst pressure test is required for those filter assemblies which are not subjected to the fatigue impulse test specified in 4.7.1.2 (see MIL-F-24402/1 and MIL-F-24402/3).

3.5.6 Filtration. The filter element shall exhibit the following performance values (see 4.7.2.2 through 4.7.2.5.1).

- (a) Filtration efficiency. A filtration efficiency (contaminants removal) equal to or greater than the value specified in the applicable specification sheet.
- (b) Dirt holding capacity. A capacity equal to or greater than the value specified in the applicable specification sheet at the specified pressure drop.
- (c) Clean element pressure drop. At rated flow of fluid in accordance with MIL-L-17331, a clean element pressure drop equal to or less than the value specified in the applicable specification sheet.

3.5.7 Collapse pressure. The filter element collapse pressure shall be equal to or greater than the value specified in the applicable specification sheet (see 4.7.2.5.2).

3.5.8 Reverse flow. The filter element shall withstand, without damage, reverse flow and differential pressure surges as specified in the applicable specification sheet (see 4.7.2.5 3).

3.5.9 Media migration. There shall be no media migration from the filter element when subjected to the vibration test specified in 4.7.2.7.2.

3.5.10 Flow fatigue. The filter element shall withstand, without damage, the number of flow fatigue pressure cycles specified in the applicable specification sheet (see 4.7.2.6).

3.5.11 Vibration. The differential pressure indicators furnished under this specification shall meet the requirements of MIL-STD-167-1, type I environmental vibration up to and including 50 hertz (Hz) (see 4.7,1.3).

3.6 Identification.

3.6.1 Filter housing. Each filter assembly shall be clearly and permanently identified by an attached identification plate containing the following information (except for the ANSI fluid symbol, which may be put on a separate plate alone):

- (a) Number and date of this specification.
- (b) Filter assembly specification part number (see the applicable specification sheet).
- (c) Manufacturer's part or drawing number.
- (d) Manufacturer's name or trademark.

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- (e) ANSI fluid symbol (see ANSI Y32.10).
- (f) Relief valve setting, where applicable.
- (g) Replacement filter element specification part number (see the applicable specification sheet).

3.6.1.1 Selector valve positions. On duplex filter assemblies, the three positions of the selector valve shall be clearly marked to indicate the filtration circuit selected.

3.6.1.2 Ports. Inlet and outlet ports shall be clearly and permanently marked IN and OUT, respectively. Drain and vent ports shall be clearly and permanently marked DRAIN and VENT, respectively.

3.6.1.3 Filter bowls. The threaded filter bowls shall be clearly and permanently marked "Hand Tighten Only."

3.6.1.4 Aluminum components. Pressure-containing aluminum components of the filter assemblies shall be permanently marked on the part with the alloy and temper of the aluminum. Military standard hardware and aluminum parts internal to the filter assembly are exempt from this marking requirement.

3.6.2 Filter element. Each filter element shall be clearly and permanently identified on the closed end. The following information shall be provided:

- (a) Filter element specification part number (see the applicable specification sheet)
- (b) Manufacturer's part or drawing number.
- (c) Manufacturer's name or trademark.
- (d) Noncleanable

3.6.3 Differential pressure indicator. Each differential pressure indicator shall be clearly and permanently identified by an attached identification plate containing the following information:

- (a) Differential pressure indicator specification part number (see the applicable specification sheet).
- (b) Manufacturer's part or drawing number.
- (c) Manufacturer's name or trademark.
- (d) Actuating pressure with tolerances (for indicators furnished with mechanical or electrical indicators).

3.6.4 Special marking. Each assembly shall incorporate appropriate caution or warning plates as necessary, to assure lubrication and assembly procedures which will prevent galling of threads during element replacement.

3.7 Workmanship. Dimensions and tolerances shall be as specified herein and on the applicable specification sheet. If the tolerances specified are not stringent enough, suggest tightening the requirement specified.

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4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements (examinations and tests) as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own 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 this specification where such inspections are deemed necessary to ensure supplies and services conform to prescribed requirements.

4.1.1 Responsibility for compliance. All items shall meet all requirements of sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of the manufacturing operations, is an acceptable practice to ascertain conformance to requirements, however, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to accept defective material.

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

- (a) Qualification inspection (see 4.3).
- (b) Quality conformance inspection (see 4.4).

4.3 Qualification inspection. Qualification inspection shall be conducted at a laboratory satisfactory to the Naval Sea Systems Command (NAVSEA). Qualification inspection shall consist of the examination and tests specified in table I. Tests shall be performed in the sequence shown in table I. Failure of any test shall be cause for rejection.

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TABLE I . Qualification inspection.

Examination and tests	Requirement	Test method
<u>Filter housings</u>		
Examination	3.4.1, 3.4.1.1, 3.4.1.2, 3.4.1.3, 3.4.2.1, 3.4.2.2, 3.4.4.2 through 3.4.4.5, 3.6.1, 3.6.1.1 through 3.6.1.4, 3.6.4, and 3.7	4.6
Filter element removal	3.4.1	4.7.1.11
Shock	3.5.1	4.7.1.1
Housing pressure drop	3.5.4	4.7.1.5
Fatigue impulse <u>1/</u>	3.5.2	4.7.1.2
Proof pressure <u>1/</u>	3.5.3	4.7.1.4
Relief valve operation	3.4.4.3	4.7.1.7.1
Selector valve operation and leakage	3.4.4.4	4.7.1.8.1
Check valve leakage <u>1/</u>	3.4 4.5	4.7.1.9.1
Burst pressure <u>1/</u>	3.5.5	4.7.1.10
<u>Differential pressure indicators</u>		
Examination	3.4 1.3, 3 4.4. 3 6 3. and 3 7	4.6
Shock	3.5.1	4.7.1.1
Vibration	3.5.11	4.7.1.3
Fatigue impulse <u>1/</u>	3.5.2	4.7.1.2
Proof pressure <u>1/</u>	3.5.3	4.7.1.4
Operation	3.4.4	4.7.1.6
<u>Elements only</u>		
Element no. 1		
Examination	3.3.3, 3.4.1.3, 3.4.3, 3.6.2, and 3.7	4.6
Bubble point	3.3.3	4.7.2.1
Degree of filtration <u>1/</u>	3.5.6(a) and (b)	4.7.2.2 through 4.7.2.4
Bubble point	3.3.3	4.7.2.1
Flow fatigue <u>1/</u>	3.5.10	4.7.2.6
Bubble point	3.3.3	4.7.2.1

See footnote at end of table.

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TABLE I. Qualification inspection - Continued.

Examination and tests	Requirement	Test method
Element no. 2		
Examination	3.3.3, 3.4.1.3, 3.4.3, 3.6.2, and 3.7	4.6
Bubble point	3.3.3	4.7.2.1
Pressure drop	3.5.6(c)	4.7.2.5.1
Collapse pressure <u>1</u> /	3.5.7	4.7.2.5.2
Bubble point	3.3.3	4.7.2.1 and 4.7.2.5.2
Element no. 3		
Examination	3.3.3, 3.4.1.3, 3.4.3, 3.6.2, and 3.7	4.6
Bubble point	3.3.3	4.7.2.1
Media migration	3.5.9	4.7.2.7
Bubble point	3.3.3	4.7.2.1
Reverse flow	3.5.8	4.7.2.5.3
Bubble point	3.3.3	4.7.2.1
Element nos 4, 5, and 6		
Examination	3.3.3, 3.4.1.3, 3.4.3, 3.6.2, and 3.7	4.6
Bubble point	3.3.3	4.7.2.1
Compatibility	3.3.2 and 3.3.2.1	4.7.2.8
Bubble point	3.3.3	4.7.2.1
Additional tests	4.7.2.8.1	As required

1/ Fluid temperature and viscosity specified in 4.5.1 do not apply. Fluid in accordance with MIL-H-5606 may be used.

4.3.1 Test specimens. Test specimens shall be identified with the manufacturer's part number. In addition, each test specimen filter element shall be marked with an individual serial number for identification.

4.3.1.1 Filter housings and differential pressure indicators. Qualification tests shall be performed on one specimen of each assembly and indicator for which qualification is desired. After completion of testing, each specimen shall be permanently stamped to identify it as unsuitable for service.

4.3.1.2 Filter elements. Qualification test specimens of filter elements shall consist of one set of six elements for each size for which qualification is desired.

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4.3.1.3 Assembly drawings. Assembly drawings shall be furnished with each new filter assembly, filter element, and pressure indicator submitted for qualification tests. Prior to authorization for qualification testing, two sets of assembly drawings, in accordance with DOD-STD-100, shall be furnished with each new model filter assembly and filter element submitted for qualification tests. Assembly drawings shall show a cutaway section of details in their normal assembly positions and shall carry part numbers of details and subassemblies. The following data shall be furnished on, or together with, the assembly drawings:

- (a) Outline dimensions of the complete assembly.
- (b) Dimensional location of ports, port sizes, and port identification markings.
- (c) Dimensional location and size of mounting holes.
- (d) Cross-sectional views showing internal flow paths.
- (e) Bill of material, listing specifications, grade, and condition, or other data needed to identify the materials proposed.
- (f) Complete dismantling procedure and description of tools needed.
- (g) Any special installation or operating instruction considered necessary.
- (h) Unless such information is provided in the qualification test report, filter element drawings shall include a cross-sectional view with each individual component identified. (Proprietary information, such as the number of square inches of media or composition of media, is not required.)

4.3.2 Retention of qualification. Retention of qualification for filter elements shall be dependent on a 5-year verification of continued compliance with the requirements of this specification. Filter efficiency and dirt holding capacity and pressure drop tests specified in 4.7.2.3 and 4.7.2.5.1 shall be performed to verify the continued compliance with the specification requirements.

4.3.3 Qualification by similarity. Qualification on the basis of similarity will be considered by the qualifying activity as specified in 4.3.3.1 through 4.3.3.3.

4.3.3.1 Filter assemblies.

4.3.3.1.1 Assemblies without bypass relief. Qualification approval without additional testing will be considered for an assembly which does not have a bypass relief based on the qualification approval of a similar assembly that does have a bypass relief.

4.3.3.1.2 Assemblies with bypass relief. Qualification approval for an assembly with a bypass relief will be considered based on the qualification approval of a similar assembly without bypass relief upon completion of additional tests as specified by the qualifying activity.

4.3.3.1.3 Assemblies with different indicators. Qualification approval for an assembly with a different form of differential pressure indicator may be extended from the original assembly qualification provided the additional form of differential pressure indicator has passed qualification tests.

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4.3.3.1.4 Assembly consisting of qualified components. Qualification approval without additional testing will be considered for an assembly that is formed by combining previously qualified components.

4.3.3.2 Elements. Tests for one size element may be accepted as applicable to another size element when more than one size element is being tested concurrently. This acceptance based on similarity shall be subject to the following restrictions:

- (a) Identical type media are used in the elements,
- (b) Generally, acceptance by similarity will be limited to media migration and fluid compatibility.
- (c) When more than two sizes of element are being tested concurrently, flow fatigue and degree of filtration for all sizes may be based on testing of the smallest and largest size elements.
- (d) Acceptance based on similarity is at the discretion of the engineering representative of the qualifying activity witnessing the tests.

4.3.3.3 Differential Pressure indicators. Fatigue impulse tests may be extended from qualified assemblies for which the only differences are the actuation pressure and operating pressure range.

4.4 Quality conformance inspection, Quality conformance inspection shall consist of the following:

- (a) Individual inspection (see 4.4.1).
- (b) Sampling (see 4.4.2).

4.4.1 Individual inspection. The individual inspection, specified in table II, shall be conducted on each filter housing and differential pressure indicator in the sequence shown in table II. Any filter housing or differential pressure indicator containing a defect shall be rejected.

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TABLE II. Quality conformance inspection.

Individual inspection			
Item	Examination and tests	Requirement	Test method
Filter housings	Examination	3.4.1, 3.4.1.1, 3.4.1.2, 3.4.1.3, 3.4.2.1, 3.4.2.2, 3.4.4.2 through 3.4.4.5, 3.6.1, 3.6.1.1 through 3.6.1.4, 3.6.4 and 3.7	4.6
	Proof pressure <u>1/</u> <u>2/</u>	3.5.3	4.7.1.4
	Relief valve operation <u>1/</u>	3.4.4.3	4.7.1.7.2
	Selector valve operation and leakage	3.4.4.4	4.7.1.8.2
	Check valve leakage <u>1/</u>	3.4.4.5	4.7.1.9.2
Differential pressure indicators	Examination	3.4.1.3, 3.4.4, 3.6.3, and 3.7	4.6
	Proof pressure <u>1/</u> <u>2/</u>	3.5.3	4.7.1.4
	Operation	3.4.4	4.7.1.4
Sampling			
Filter elements	Examination	3.3.3, 3.4.1.3, 3.4.3, 3.6.2, and 3.7	4.6
	Bubble point	3.3.3	4.7.2.1.3
	Pressure point <u>3/</u>	3.5.6(c)	4.7.2.5.1

1/ Fluid temperature and viscosity specified in 4.5.1 do not apply. Fluid in accordance with MIL-H-5606 may be used.

2/ Proof pressure test shall be conducted prior to all other tests.

3/ Where test fluid other than MIL-L-17331 is used for testing, the test data shall be comparison converted to MIL-L-17331.

4.4.2 Sampling for filter elements. Sampling for quality conformance inspection shall be as specified (see 4.4.2.1 and 4.4.2.2).

4.4.2.1 Inspection lot. An inspection lot shall consist of finished filter elements which are of the same material, type, size, fabricated by the same process, and produced as one continuous run or order, or part thereof and submitted for acceptance inspection at the same time.

4.4.2.2 Sampling for examination and tests. A random sample, selected from each lot in accordance with the sampling plans of table III, shall be inspected in accordance with table II. Any defect in the filter element or a failure of the test shall be cause for rejection of the filter element.

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TABLE III. Sampling plan for filter elements,

Lot size	Sample size
1 - 50	All
51 - 500	50
501 - 1200	80
1201 - 3200	125
3201 - 10,000	200
10,001 - 35,000	315
35,001 - Over	500

4.5 Test conditions.

4.5.1 Test fluid and fluid temperature. Unless otherwise specified (see tables I and II), the hydraulic fluid used for all tests shall conform to MIL-L-17331. Where MIL-L-17331 fluid is used for testing, the fluid temperature shall be that temperature at which the actual fluid viscosity is 100 centistokes, and the temperature shall be maintained to plus or minus 1 degree Celsius (°C). Viscosity data used to determine test temperature (approximately 37°C) shall be included in the qualification test report.

4.6 Examination. The filter housings, differential pressure indicators, and filter elements shall be examined to determine compliance with the requirements specified herein with respect to design, visible defects, dimensions, marking, and workmanship.

4.7 Test methods.

4.7.1 Filter housings and differential Pressure indicators. Unless otherwise specified herein, all tests shall be conducted with filter elements installed.

4.7.1.1 Shock. Filter assemblies and differential pressure indicators shall be subjected to a shock test as specified in MIL-S-901 for grade A, class I equipment. There shall be no evidence of damage, malfunction, or external leakage at the conclusion of the test or during subsequent tests (see 4.7.1.2 through 4.7.1.10).

4.7.1.2 Fatigue impulse. For filter assemblies and differential pressure indicators with a fatigue pressure rating, the fatigue pressure rating shall be verified as specified in NFPA T2.6.1. The cyclic test pressure to be used shall be determined by multiplying the rated fatigue pressure by applicable test duration and variability factors specified in NFPA T2.6.1 to obtain a 90 percent assurance level based on a 90 percent confidence level. A photograph showing the actual impulse curve, as indicated by oscilloscope (or equivalent method), shall be included in the qualification test report.

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4.7.1.3 Vibration. Differential pressure indicators shall be subjected to a vibration test as specified in MIL-STD-167-1, type I. For this test, inlet pressure shall be between 2,700 and 3,000 lb/in^2 , and the outlet shall be unpressurized. There shall be no evidence of damage, malfunction, or external leakage at the conclusion of the vibration test or during subsequent tests. As an alternative to MIL-STD-167-1, type I requirements, the vibration requirements may be met by vibrating the indicators in each of the three principal directions in accordance with the time, frequencies, and amplitudes specified in 4.7.2.7.2, followed by a 1-hour endurance test in each direction at the highest resonant frequency noted. If no resonant frequency is noted, the endurance test shall be conducted at 50 Hz.

4.7.1.4 Proof pressure. A proof pressure as specified in 3.5.3 shall be applied to the filter housing and differential pressure indicators and held for 2 minutes. For qualification, this test shall be performed after the completion of shock and fatigue impulse tests.

4.7.1.5 Housing pressure drop. This test shall be conducted with a dummy element installed as specified in 3.5.4. Using the test fluid, the maximum pressure drop between the inlet and outlet of the filter housing at rated flow shall not exceed the value specified in the applicable specification sheets. Rated flow for each filter housing shall be as specified in the applicable specification sheet.

4.7.1.6 Differential pressure indicators' operation.

4.7.1.6.1 Gauge-type indicator. For gauge-type differential pressure indicators, the gauge shall be subjected to forward and reverse differential pressures up to 3,000 lb/in^2 . Differential pressure shall be maintained at 3,000 lb/in^2 for 1 minute. After all tests, including shock, fatigue impulse, vibration, and proof pressure, the gauge shall read within the specified accuracy in the differential pressure range specified in 3.4.4.1.3. The gauge shall be tested in both the ascending and descending pressure modes of operation at 20- lb/in^2 intervals from the lowest to highest pressure range, inclusive. An indicator response time of less than 20 seconds for a 50- lb/in^2 change in pressure shall be demonstrated. For quality conformance, the accuracy of each indicator shall be verified at a pressure interval of 25 percent of gauge pressure range, starting from the lowest to highest pressure range in both ascending and descending pressure modes.

4.7.1.6.2 Mechanical-type indicator. With the outlet unpressurized, the inlet pressure shall be increased slowly until the pressure indicator actuates. The actuation pressure shall be higher than the outlet pressure by the value specified in MIL-F-24402/5. This test shall be repeated with the outlet pressurized to 50 and 3000 lb/in^2 . After actuation, it shall be demonstrated that the indicator will remain actuated when the inlet pressure is reduced to zero with outlet pressures of 0, 50, and 3000 lb/in^2 , and that the actuators can be manually depressed to the normal reset position under these conditions. With the outlet pressurized to 50 and 3000 lb/in^2 , a differential pressure of a value as specified in MIL-F-24402/5 of 5 seconds duration shall not cause the indicator to actuate.

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The above qualification tests shall be performed after completion of shock, fatigue impulse, vibration, and proof pressure tests. For quality conformance, the actuation pressure of each indicator shall be verified to be higher than the outlet pressure by the value specified in MIL-F-24402/5. This test may be conducted with the outlet port unpressurized.

4.7.1.6.3 Electrical-type port. For qualification testing, the electrical differential pressure indicators shall be tested for operation in accordance with 4.7.1.6.2. During operational tests, it shall be verified that the electrical contacts trip in conjunction with the actuation and reset of the red indicator (see 3.4.4.1.2). For quality conformance, the actuation pressure for both the red indicator and electrical switch of each indicator shall be verified to be higher, by the value specified in the applicable specification sheet, than the outlet pressure.

4.7.1.7 Relief valve operation.

4.7.1.7.1 Relief valve (qualification). Filter assemblies with an integral relief valve shall be tested for relief valve operation. For this test, dummy elements which stop flow shall be installed. Relief valve performance requirements shall be in accordance with the applicable specification sheet. Test procedures shall be as follows:

- (a) Cracking pressure. Relief valve cracking differential pressure shall be determined by applying pressure at the inlet port of the filter assembly with a power-driven pump. Starting at 80 percent of the minimum cracking pressure, pressure shall be increased in increments not to exceed 5 percent of cracking pressure. At each pressure increment, leakage shall be measured for not less than 1 minute. The cracking pressure is that pressure at which the leakage exceeds the minimum value identified on the applicable specification sheet.
- (b) Full flow. The pressure differential across the valve shall be increased until rated flow is obtained or until the maximum allowed full flow differential pressure is exceeded, (See the applicable specification sheet for rated flow, maximum full flow differential pressure, and test fluid.) Rated flow shall occur at a differential pressure less than maximum specified value.
- (c) Minimum reseal. With the bypass relief valve flowing at least 10 percent of rated flow, the inlet pressure shall be reduced below the cracking pressure in increments not to exceed 5 percent of the minimum cracking pressure. At each pressure increment, leakage shall be measured for not less than 1 minute. The pressure shall be reduced until the leakage is less than that permitted by the applicable specification sheet. This pressure shall be considered the relief valve reseal pressure.

4.7.1.7.2 Relief valve, quality conformance). Filter assemblies with an integral relief valve shall be tested as specified in 4.7.1.7.1 to verify the cracking pressure and minimum reseal requirements specified for quality conformance on the applicable specification sheet. For quality conformance, the

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cracking pressure test may be conducted at the maximum permitted pressure and the reseal test at the minimum permitted pressure without testing at incremental pressures.

4.7.1.8 Selector valve operation and leakage (duplex filter assemblies only).

4.7.1.8.1 Selector valve (qualification). The torque or force to operate the selector valve shall be measured for all positions. Seal tightness shall be checked at 3,000 **lb/in²** differential pressure for the positions in which one filter bowl is isolated. The selector valve shall then be operated for 200 cycles with a flow not less than one-half the housing rated flow (see the applicable specification sheet). During shifting of the selector valve from one position to another, flow shall not be cut off, and the differential pressure across the filter assembly shall not exceed 50 **lb/in²** with dummy elements installed. After 200 cycles, the torque and leakage tests shall be repeated. The torque before and after the cycling test shall be not greater than 40 foot-pounds. Leakage measured with the bowl of the isolated filter removed shall be not greater than 6 mL per minute for the isolated flow paths, either before or after the cycling test, and shall not increase by more than 50 percent, as a result of the cycling test.

4.7.1.8.2 Selector valve (quality conformance). Valve operating torque and selector valve leakage shall be checked as specified in 4.7.1.6.1 and shall meet the requirements specified in 3.4.4.4. The cycling test specified in 4.7.1.8.1 is not required unless the required operating torque of the qualification unit increased by more than 10 percent during testing, and the operating torque of the individual inspection unit is higher than for the qualification unit.

4.7.1.9 Check valve cracking pressure and leakage (duplex filter assemblies only).

4.7.1.9.1 Check valve (qualification). Cyclic testing shall be conducted with the selector valve aligned so that only one filter bowl is on-line. With the filter outlet at 3,000 **lb/in²** minimum and with a flow of one-half the rated flow of the assembly, the filter inlet shall be subjected to 5,000 repetitions of rapid decompression and rapid repressurization. At the completion of testing, cracking pressure and internal leakage shall be determined for both check valves. Maximum cracking differential shall be 8 **lb/in²**. Internal leakage in the flow-checked direction shall be measured at a differential pressure of 5 and 3,000 **lb/in²**. Leakage measured with both filter bowls removed shall be not greater than 2 mL per minute in each flow passage. The leakage shall be measured over a period of 5 minutes. When determining leakage, fluid shall be not cooler than that temperature required to maintain a fluid viscosity not greater than 100 centistokes. If both installed check valves are not identical in design and construction, the cyclic test shall be repeated with the other bowl on-line. Replacement of check valve internals prior to this repeat test is allowed. Cracking pressure and leakage determinations shall be repeated and shall meet the above requirements.

4.7.1.9.2 Check valve (quality conformance). Check valve cracking pressure and leakage shall be checked as specified in 4.7.1.9.1 and shall meet the requirements specified in 3.4.4.5. Leakage shall be measured over a period of not less than 1 minute. The cycling test specified in 4.7.1.9.1 is not required.

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4.7.1.10 Burst pressure. A burst pressure, as specified in 3.5.5, shall be applied to the filter housing. The actual burst pressure shall be recorded,

4.7.1.11 Filter element removal. The filter elements shall be removed from the filter housing within the clearance envelope as specified in 3.4.1. There shall be no interference with the housing.

4.7.2 Filter elements.

4.7.2.1 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 that specified in ARP 901. The fluid level shall be maintained at approximately 1/2 inch above the top of the filter element. Unless otherwise specified herein, the bubble point test procedure shall be in accordance with ARP 901. The manometer reading in inches of water corresponding to the first bubble shall be recorded. The standard referee test liquid shall be reagent grade isopropanol (isopropyl alcohol) having a surface tension of 21.15 ± 0.10 dynes per centimeter at 25°C. However, the test liquid may be commercial grades of isopropanol, proprietary solvent No. 3 (U.S. Industrial Chemicals) or other brands of denatured ethanol used by the manufacturer for bubble point testing of production elements. The test fluid and its surface tension shall be identified. For test liquids other than isopropanol, the bubble point pressure shall be corrected for surface tension in accordance with ARP 901 and the standard bubble point reported in the qualification test report. The bubble point test shall be accomplished within 10 minutes of the immersion of the filter element.

4.7.2.1.1 Test point values. The initial bubble point value of the 6 qualification test elements of each size shall be determined prior to further testing. The minimum initial bubble point pressure for each production element shall be established based on the bubble points of the qualification test elements. The minimum bubble point established shall be 90 percent of the minimum bubble point of the qualification test element with the lowest bubble point, but shall be not less than 4.5 inches.

4.7.2.1.2 Test elements. Normally, the degree of filtration test (see 4.7.2.4) shall be performed on the element with the lowest bubble point, and the pressure drop and collapse test (see 4.7.2.5) shall be performed on the element with the highest bubble point in the test liquid. Where bubble points are determined after a specific qualification test, the bubble point prior to and after the test shall be conducted in the fluid used for the specific test. Variation in the selection of elements for specific test or sequence of tests may be made at the discretion of NAVSEA or its representative.

4.7.2.1.3 Bubble point (quality conformance). Unless otherwise specified herein, for quality conformance, the filter element, containing no fluid, shall be bubble point tested in accordance with ARP 901. The liquid 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. For the bubble point of production

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elements, the minimum initial bubble point shall be determined as specified in 4.7.2.1.1. If the surface tension of the production test liquid is different from that of the liquid used for qualification, the minimum bubble point shall be calculated based on the standard bubble point reported in the qualification test report using the criteria specified in 4.7.2.1.1 and corrected for surface tension in accordance with ARP 901.

4.7.2.2 Determination of test fluid cleanliness. A determination of test fluid cleanliness shall be made. The procedure shall be as follows:

- (a) Flush 2,000 mL of the prefiltered fluid through the contaminant mixing chamber (see figure 2) and the filter test housing at a rate of 20 to 40 gallons per minute and collect the fluid in a clean container.
- (b) The weight of the contaminant collected will be the blank value (B) used in calculating the efficiency. (For tests conducted by the Government, the blank value (B) shall not exceed 0.002 gram.)

4.7.2.3 Efficiency. The filter element shall remove 97 percent by weight of the specified contaminant add value, as determined by the, following efficiency formula:

$$\text{Percent removal} = \frac{(A-B + 0.002) \cdot C}{(A-B + 0.002)} \times 100$$

where

- A = (add value) - Amount of test contaminant passed through system when there is no filter element in the housing. Add value cannot exceed weight of contaminant added.
- B = (blank value) - Amount of contaminant attributed to the test system and filter test assembly when no test contaminant has been added.
- C = (contaminant value) - Amount of test contaminants passed through test assembly with element installed.

4.7.2.3.1 Determination of system add value for Government conducted tests. When tests are conducted at a Government facility or by the Government for verification, the test specified in 4.7.2.4 shall be conducted two times without the filter element installed. The add value (A) used in calculating efficiency shall be the average of the two runs, and the contaminant collected in each of the runs shall be not less than 95 percent by weight of the contaminant introduced.

4.7.2.3.2 Determination of system add value for tests conducted by the filter manufacturer or his designated facilities. The test specified in 4.7.2.4 shall be conducted two times without the filter element installed. The add value (A) to be used in calculating efficiency shall be the weight of the contaminant collected for the run in which the minimum contaminant was collected and shall be

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not less than 90 percent by weight of the contaminant introduced. In lieu of two runs, an add value (A) of 90 percent may be used based on a single run in which the add value exceeded 95 percent by weight of the contaminant introduced.

4.7.2.4 Degree of filtration, 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. A degree of filtration circuit, similar to that shown on figure 2 with an in-line assembly to contain the test element, shall be used. Test procedure shall be as follows:

- (a) A setup shall be made as shown on figure 2 without installing the filter element in the test housing.
- (b) Flush 2,000 mL of prefiltered hydraulic fluid through the contaminant mixing chamber and the filter housing at a rate of 20 to 40 gallons per minute, and discard. This operation shall be repeated.
- (c) The hydraulic fluid shall be checked in accordance with 4.7.2.2.
- (d) Valve B (see figure 2) shall be closed.
- (e) Add 2,000 mL of previously filtered hydraulic fluid through plug valve A (see figure 2). The element shall be installed in the filter housing.
- (f) A 25 mL slurry containing the amount of contaminant specified in the specification, sheet for filter elements shall be added to the hydraulic fluid through a small funnel inserted in the plug valve A. The contaminant shall be APM F-9 beads. Additional fluid shall be used as necessary to wash down the funnel.
- (g) The contaminant shall be distributed uniformly by churning the hydraulic fluid with an agitator for 3 minutes.
- (h) Plug valve 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 flow.
- (i) Valve B shall be opened and air pressure shall force the hydraulic fluid, containing the contaminant, through the sample filter assembly at a rate of 20 to 40 gallons per minute. This filtrate shall be collected in a clean 5,000 mL container. Using a wash bottle, 750 mL of prefiltered solvent compatible with the filter membrane shall then be washed through the contaminant mixing chamber and test filter assembly. The wash fluid shall be collected in the same 5,000 mL container.
- (j) Hydraulic fluid and wash fluid passed through the test filter shall be filtered through a membrane filter disc, 47 millimeters (mm) diameter, absolute 0.8 micrometer, type AA Millipore, or equal, which has been previously washed with prefiltered solvent, dried to a constant weight by heating for 30 minutes at 50°C, cooled for 30 minutes in a desiccator, and weighed to 0.10 milligram (mg) accuracy,
- (k) The 5,000 mL container shall be washed with not less than 1,000 mL of prefiltered solvent. This wash shall also be passed through the filter membrane using a vacuum (not less than 25 inches of mercury).

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- (1) The membrane filter disc and assembly shall be washed down with prefiltered solvent as necessary to ensure that all contaminants are trapped on the filter disc.
- (m) With solvent washing completed and all wash fluid passed through the filter disc, it shall be dried to a constant weight and weighed to 0.10 mg accuracy.

4.7.2.4.1 Membrane filter weights. The difference between the membrane filter weights before and after the procedure specified in 4.7.2.4 is the weight of contaminant passing through test filter B in the formula specified in 4.7.2.3.

4.7.2.5 Pressure build-up and collapse pressure.

4.7.2.5.1 Filter element pressure drop. With the element in a test housing, standardized air cleaner (A-C) fine test dust shall be added immediately upstream of the filter element at 4-minute intervals. An acceptable pressure build-up and collapse test setup, with cleanup devices installed, is shown on figure 3. The amount of dust added at each interval shall be as specified in the specification sheet for filter elements. The temperature of the test fluid shall be maintained as specified in 4.5.1. Pressure differential, flowrate, and temperature shall be recorded 2 minutes after each dust addition. The pressure differential at test flow (see applicable specification sheet) shall be not greater than the value specified in the applicable specification sheet for a clean element and shall be not greater than the value specified in the applicable specification sheet after the specified amount of dust has been added. Additional dust shall be added until either a differential pressure of 150 lb/in² is obtained across the element at test flow or until twice the minimum weight of test dust has been added. Fluid flow shall not be interrupted during pressure build-up testing. Add intervals, amount of dust added, and pressures shall be included in the qualification test report. Curves showing the differential pressure across the element versus weight added in grams of A-C fine test dust shall be included in the qualification test report. Cleanup filters are allowed in the test stand during pressure build-up testing at the contractor's facilities. When testing is conducted by the Government, cleanup element efficiency shall be equal to or better than that required for MIL-F-27656 elements.

4.7.2.5.2 Filter element collapse pressure. Standardized A-C fine or A-C coarse test dust shall be added to the filter elements following the pressure drop test until a differential pressure across the element of not less than 2,000 lb/in² is obtained and held for 2 minutes. Additional test dust shall be added until a differential pressure as specified in the applicable specification sheet is reached and held for 2 minutes. The filter elements shall not collapse. The initial bubble point after testing shall be not less than 3 inches of water, when tested in either the element test fluid or proprietary solvent No. 3 (see 4.7.2.1).

4.7.2.5.3 Filter element reverse flow test. With at least 20 gallons per minute flow in the reverse direction from the element collapse test (see 4.7.2.5.2), the element shall be loaded with A-C fine or A-C coarse test dust until a differential pressure as specified in the applicable specification sheet is obtained across the element. The elements shall withstand the reverse flow

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differential pressure without structural damage. The initial bubble point of the element after reverse flow testing shall be not less than 80 percent of the initial bubble point of the element prior to reverse flow testing. Flow may be adjusted as necessary to maintain the differential pressure for not less than 3 minutes.

4.7.2.6 Flow fatigue. Filter elements shall be subjected to pressure flow cycles with hydraulic fluid. A cycle shall consist of increasing the differential pressure across the filter element from zero to the pressure specified below and back to zero by first increasing, then decreasing, the flow through the test filter element which has been loaded with A-C fine or A-C coarse dust, or equivalent. The cycling rate shall not exceed 300 cycles per minute. The number of cycles at each differential pressure shall be as follows:

- (a) 45,000 cycles at 100 **lb/in²** pressure drop
- (b) 5,000 cycles at 300 **lb/in²** pressure drop

There shall be no evidence of damage as a result of this test, and after testing, the element initial bubble point shall be not less than 80 percent of the initial bubble point of the element prior to testing,

4.7.2.7 Media migration and vibration analysis of filter elements.

4.7.2.7.1 Preparation for analysis. The test element shall be installed in a filter housing or in a special test housing with blanking connections installed. The housing shall be filled with prefiltered hydraulic test fluid.

4.7.2.7.2 Vibration test. The filter housing head shall be secured to the testing machine so that the vibration input is centrally aligned along the longitudinal axis of the filter element. The equipment shall be vibrated from 4 Hz (or lowest attainable frequency) to 50 Hz in discrete frequency intervals of 1 Hz, at the amplitudes shown in table IV. At each frequency, the vibration shall be maintained for times shown in table IV. An acceptable alternative will be a continuous sweep from 4 to 50 Hz over a period of not less than 1 hour at the amplitudes shown in table IV.

TABLE IV. Vibratory displacement single amplitude.

Frequency range (Hz)	Table amplitude <u>1/</u> (inch - minimum)	Time (minutes)
4 to 15	0.05	2
16 to 25	0.04	1
26 to 33	0.03	1
34 to 40	0.02	1
41 to 50	0.01	1

1/ For Government-conducted tests, the maximum amplitude shall not exceed the minimum required amplitude by more than 20 percent.

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4.7.2.7.3 Media migration analysis. The port blanks shall be removed, and the filter element and filter housing shall be flushed with 3,000 mL minimum of prefiltered fluid and the effluent collected. The effluent shall be filtered through a membrane filter disk, 47 mm diameter, absolute 0.8 micrometer, type AA Millipore, or equal, which has been previously washed with prefiltered solvent. The membrane from this analysis and the membrane retained from the degree of filtration test (see 4.7.2.4) shall be examined for evidence of filter media migration. There shall be no media migration identifiable as coming from the filter element medium.

4.7.2.8 Compatibility of elements with fluids. Filter element numbers 4, 5, and 6 shall be tested for compatibility with fluids that conform to MIL-H-19457, MIL-H-22072, and MIL-L-17331. One patch (four required; each approximately 2 by 4 inches) of the filtration media shall also be tested for compatibility with each of the above fluids. An untested fourth patch shall be retained for microscopic comparison with the immersed patches upon completion of the tests. Test patches shall be taken from a single representative specimen of filtration media (approximately 8 by 4 inches). Each test fluid shall be thoroughly mixed with 5 percent water prior to testing and stirred approximately every 24 hours thereafter, weekends excepted. During the test, water and oil may be added as necessary to make up evaporation losses. Elements and test patches shall be completely immersed in appropriate test fluids as designated above, for 195 hours at 85 to 90°C. After immersion and decreasing of the elements and patches, there shall not be any visible evidence of degradation or corrosion. Element bubble points shall be not less than 85 percent nor more than 120 percent of the bubble point at the beginning of the test. The above portion of the compatibility test shall be scheduled for completion so that examination can be accomplished in the same time frame as the other qualification tests. Patches shall be compared to the untested specimen under a microscope, and visible differences noted. Skin contact with and inhalation of MIL-H-19457 and MIL-H-22072 fluids and vapors shall be avoided.

4.7.2.8.1 Optional testing. After the fluid compatibility tests, filter element numbers 4, 5, and 6 may be subjected to any of the tests listed for filter element numbers 1, 2, or 3 and shall satisfactorily pass those tests. Tests to be conducted and elements to be selected shall be at the discretion of NAVSEA or its representative. Elements not tested further will be retained by NAVSEA for future reference.

4.8 Inspection of packaging. Sample packages and packs, and the inspection of the presentation, packing, and marking for shipment and storage shall be in accordance with the requirements of section 5 and the documents specified therein.

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5. PACKAGING

(The packaging requirements specified herein apply only for direct Government acquisition. For the extent of applicability of the packaging or preparation for delivery requirements of referenced documents listed in section 2, see 6.5.)

5.1 General.5.1.1 Navy fire-retardant requirements.

- (a) Treated lumber and plywood. When specified (see 6.2), all lumber and plywood including laminated veneer material used in shipping containers and pallet construction, members, blocking, bracing, and reinforcing shall be fire-retardant treated material conforming to MIL-L-19140 as follows:

Levels A and B - Type II - weather resistant.
Category 1 - general use.

Level C - Type I - non-weather resistant.
Category 1 - general use.

- (b) Fiberboard. Fiberboard used in the construction of class-domestic, non-weather resistant fiberboard and cleated fiberboard boxes including interior packaging forms shall meet the flamespread and the specific optic density requirements of PPP-F-320.
- (c) Cushioning and wrapping materials. The use of excelsior, newspaper, shredded paper (all types), and similar hydroscopic or non-neutral materials and all types of loose fill materials for packaging applications such as cushioning, fill, stuffing, and dunnage is prohibited. Materials selected for cushioning and wrapping shall have properties (characteristics) for resistance to fire (see 6.6). Cushioning or wrapping materials, as applicable, shall be provided to prevent item and package damage and to prevent free movement of the container contents.

5.1.2 Filter elements. Upon completion of filter assembly (see 3.4.1) testing, filter elements shall be removed and replaced with new elements

5.2 Presentation. Presentation shall be level A, C, or Commercial as specified (see 6.2).

5.2.1 Level A.

5.2.1.1 Cleaning and drying. All materials shall be cleaned and dried prior to the application of the method of unit protection. Unless otherwise specified (see 6.2), the selection of the cleaning process and drying procedure shall be at the contractor's option and shall be in accordance with the requirements of MIL-P-116.

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5.2.1.2 Unit packs. Methods of presentation (unit packs) shall be in accordance with the requirements of MIL-P-116 and as specified herein. Unless otherwise specified (see 6.2), the selection of a sub-method, under the method of preservation, shall be at the contractor's option.

5.2.1.2.1 Filter assembly. Each filter assembly (see 3.4.1), shall be unit protected in accordance with method II. Desiccant shall conform to type II or III. Sub-method IIa unit protection, overpacked in a wood or plywood constructed box or crate, shall be provided with an externally mounted humidity indicator device and the container provided with an inspection port for visual viewing of the humidity indicator change device installed in the opaque barrier material. If a transparent barrier material bag is used, the humidity indicator may be of the three spot, impregnated area card type.

5.2.1.2.2 Pressure indicator. Each indicator not attached to the filter assembly shall be unit protected in accordance with method IA. Unit containers, except where specifically required under the selected sub-method, shall be of the weather or water-resistant folding, set-up or metal edged paperboard or fiberboard construction conforming to table I, appendix F of MIL-STD-2073-1. Unless otherwise specified (see 6.2) or herein, container options shall be at the contractor's option. Container closure shall be as specified in the applicable container specification or appendix thereto, except that method V shall apply for weather resistant fiberboard containers.

5.2.1.2.3 Filter elements. Each filter element shall be unit protected in accordance with the requirements as specified above for "pressure indicators".

5.2.2 Level C.

5.2.2.1 Filter assembly. Each filter assembly shall be unit protected in accordance with method IA.

5.2.2.2 Pressure indicators. Each indicator shall be unit protected as specified under level A except that (a) sub-method IC shall apply, (b) unit containers shall be of the non-weather resistant construction and, (c) fiberboard containers shall be of the class-domestic/fire retardant with method I closure using pressure sensitive adhesive tape.

5.2.2.3 Filter elements. Each filter element shall be unit protected in accordance with the requirements as specified above for "pressure indicators".

5.2.3 Commercial. Commercial packaging (cleaning, preservation, cushioning, and unit pack) shall be in accordance with ASTM D 3951.

5.3 Packing. Packing shall be level A, B, C, or commercial as specified (see 6.2).

5.3.1 General requirements for levels A, B, and C. Containers selected (see 5.3.2) shall be of minimum weight and cube consistent with protection required, and of uniform size. Cushioning, anchoring, blocking and bracing of shipping container contents shall be in accordance with table V of MIL-STD-2073-2 code AD, AE or PI as specified (see 6.2) for the procurement of delivery destinations as follows:

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- (a) Code AD for domestic shipments and storage.
- (b) Codes AE or PI for shipboard destinations and stowage.

5.3.2 Levels A, B, and C containers. Filter assemblies, indicators and filter elements preserved as specified (see 5.2) shall be packed in exterior shipping containers for the level of packing specified (see 5.3), in accordance with table VII, exterior shipping container requirements, of MIL-STD-2073-1, appendix C, and herein. Unless otherwise specified (see 6.2), container selection and options shall be at the contractor's option.

5.3.2.1 Caseliners, closure and gross weight.

5.3.2.1.1 Caseliners. When specified (see 6.2), level A shipping containers containing items preserved commercial (see 5.2.3) shall be provided with waterproof caseliners in accordance with MIL-STD-2073-1.

5.3.2.1.2 Closure. Container closure, reinforcing, or banding shall be in accordance with the applicable container specification or appendix thereto except that weather-resistant fiberboard boxes shall be closed in accordance with method V and reinforced with non-metallic or tape banding and domestic or fire retardant fiberboard boxes shall be closed in accordance with method I using pressure sensitive tape.

5.3.2.1.3 Weight. Wood, plywood, and cleated type containers exceeding 200 pounds gross weight shall be modified by the addition of skids in accordance with MIL-STD-2073-1 and the applicable container specification or appendix thereto.

5.3.3 Commercial. Filter assemblies, indicators and filter elements preserved as specified (see 5.2) shall be packed for shipment in accordance with ASTM D 3951 and herein.

5.3.3.1 Container modification. Shipping containers exceeding 200 pounds gross weight shall be provided with a minimum of two, 3- by 4-inch nominal wood skids laid flat, or a skid- or sill-type base which will support the material and facilitate handling by mechanical equipment during shipment and storage.

5.4 Marking.

5.4.1 Levels A, B, C, and commercial. In addition to any special marking required (see 6.2) interior (unit) packs and shipping containers shall be marked including bar coding for shipment, stowage, and storage in accordance with MIL-STD-2073-1, appendix F.

5.5 Valves. The packaging (preservation, packing and marking) requirements of valves shall be in accordance with MIL-V-3 for the level (A, C, or commercial) of preservation; level (A, B, C, or commercial) of packing, marking, including packaging acquisition options therein as specified (see 6.2). In addition, the requirements of 5.1.1 apply.

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- (a) Code AD for domestic shipments and storage.
- (b) Codes AE or P1 for shipboard destinations and stowage.

5.3.2 Levels A, B, and C containers. Filter assemblies, indicators and filter elements preserved as specified (see 5.2) shall be packed in exterior shipping containers for the level of packing specified (see 5.3) , in accordance with table VII, exterior shipping container requirements, of MIL-STD-2073-1, appendix C, and herein. Unless otherwise specified (see 6.2), container selection and options shall be at the contractor's option.

5.3.2.1 Caseliners, closure and gross weight.

5.3.2.1.1 Caseliners. When specified (see 6.2), level A shipping containers containing items preserved commercial (see 5.2.3) shall be provided with waterproof caseliners in accordance with MIL-STD-2073-1.

5.3.2.1.2 Closure. Container closure, reinforcing, or banding shall be in accordance with the applicable container specification or appendix thereto except that weather-resistant fiberboard boxes shall be closed in accordance with method V and reinforced with non-metallic or tape banding and domestic or fire retardant fiberboard boxes shall be closed in accordance with method I using pressure sensitive tape.

5.3.2.1.3 Weight. Wood, plywood, and cleated type containers exceeding 200 pounds gross weight shall be modified by the addition of skids in accordance with MIL-STD-2073-1 and the applicable container specification or appendix thereto.

5.3.3 Commercial. Filter assemblies, indicators and filter elements preserved as specified (see 5.2) shall be packed for shipment in accordance with ASTM D 3951 and herein.

5.3.3.1 Container modification. Shipping containers exceeding 200 pounds gross weight shall be provided with a minimum of two, 3- by 4-inch nominal wood skids laid flat, or a skid- or sill-type base which will support the material and facilitate handling by mechanical equipment during shipment and storage.

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6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. The filter assemblies, filter elements, and differential pressure indicators covered by this specification are intended for use in submarine and surface ship petroleum base, water glycol, and triaryl phosphate ester fluid hydraulic systems. For application to systems using other than these fluids, users are cautioned to ensure compatibility with filter assemblies and elements herein. When fluids of lower viscosities are used, the filter assemblies may be suitable for higher flowrates.

6.2 Acquisition requirements. Acquisition documents must specify the following:

- (a) Title, number, and date of this specification.
- (b) Title, number, and date of the applicable specification sheet.
- (c) Issue of DODISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced {see 2.1.1 and 2.2}.
- (d) Specification part number.
- (e) When fire-retardant material is required (see 5.1.1).
- (f) Level of preservation and level of packing required (see 5.2, 5.3, and 5.5).
- (g) Selection of the cleaning process and drying procedure if other than contractor's option (see 5.2.1.1).
- (h) Sub-method selection if other than contractor's option (see 5.2.1.2).
- (i) Containers selection and options thereof if other than contractor's option (see 5.2.1.2.2 and 5.3.2).
- (j) Code required (see 5.3.1).
- (k) When caseliners are required (see 5.3.2.1.1).
- (l) Special marking required (see 5.4).

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in Qualified Products List No, 24402 whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or purchase orders for the products covered by this specification. The activity responsible for the Qualified Products List is the Naval Sea Systems Command, SEA 55Z3, Department of the Navy, Washington, DC 20362-5101, and information pertaining to qualification of products may be obtained from that activity. Application for qualification tests must be made in accordance with "Provisions Governing Qualification SD-6" (see 6.3.1).

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6.3.1 Copies of "Provisions Governing Qualification SD-6" may be obtained upon application to Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120.

6.4 Provisioning. Provisioning Technical Documentation (PTD), spare parts, and repair parts should be furnished as specified in the contract.

6.4.1 When ordering spare parts or repair parts for the equipment covered by this specification, the contract should state that such spare parts and repair parts should meet the same requirements and quality assurance provisions as the parts used in the manufacture of the equipment. Packaging for such parts should also be specified.

6.5 sub-contracted material and parts. The packaging requirements of referenced documents listed in section 2 do not apply when material and parts are acquired by the contractor for incorporation into the equipment and lose their separate identity when the equipment is shipped.

6.6 Cushioning and wrapping materials (see 5.1.1(c)). Materials that have properties for resistance to fire and are acceptable for use within unit packs and shipping containers for Navy acquisitions are:

<u>Material</u>	<u>Specification</u>
Paper, kraft, treated (fire-resistant)	A-A-1894
Paper, kraft, wrapping	UU-P-268, type II, grade C or D
Plastic film, flexible, cellular	PPP-C-795, class 3 - fire-retardant
Polystyrene expanded, resilient	PPP-C-850, grade SE
Plastic, open cell, cushioning	PPP-C-1842, type I, style B
Bound fiber	PPP-C-1120, type III or IV, class C
Rubber, latex foam	MIL-R-5001, grade A
Rubber, cellular	MIL-R-6130, grade A
Fibrous glass	MIL-C-17435
Polystyrene foam	MIL-P-19644, type II
Rubber, cellular synthetic	MIL-R-20092, class 5
Polyurethane foam	MIL-P-26514
Polyurethane foam, flexible, open cell	MIL-F-81334
Foam-in-place packaging materials; general specification for	MIL-F-83671
Foam, combustion retardant, for cushioning supply items aboard navy ships	MIL-F-87090 (SA)

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6.7 Subject term key word) listing.

Rubble point
Degree of filtration
Flow fatigue
Media migration

6.8 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

Preparing activity:
Navy - SH
(Project 4330-N057)

MIL-F-24402E(SII)

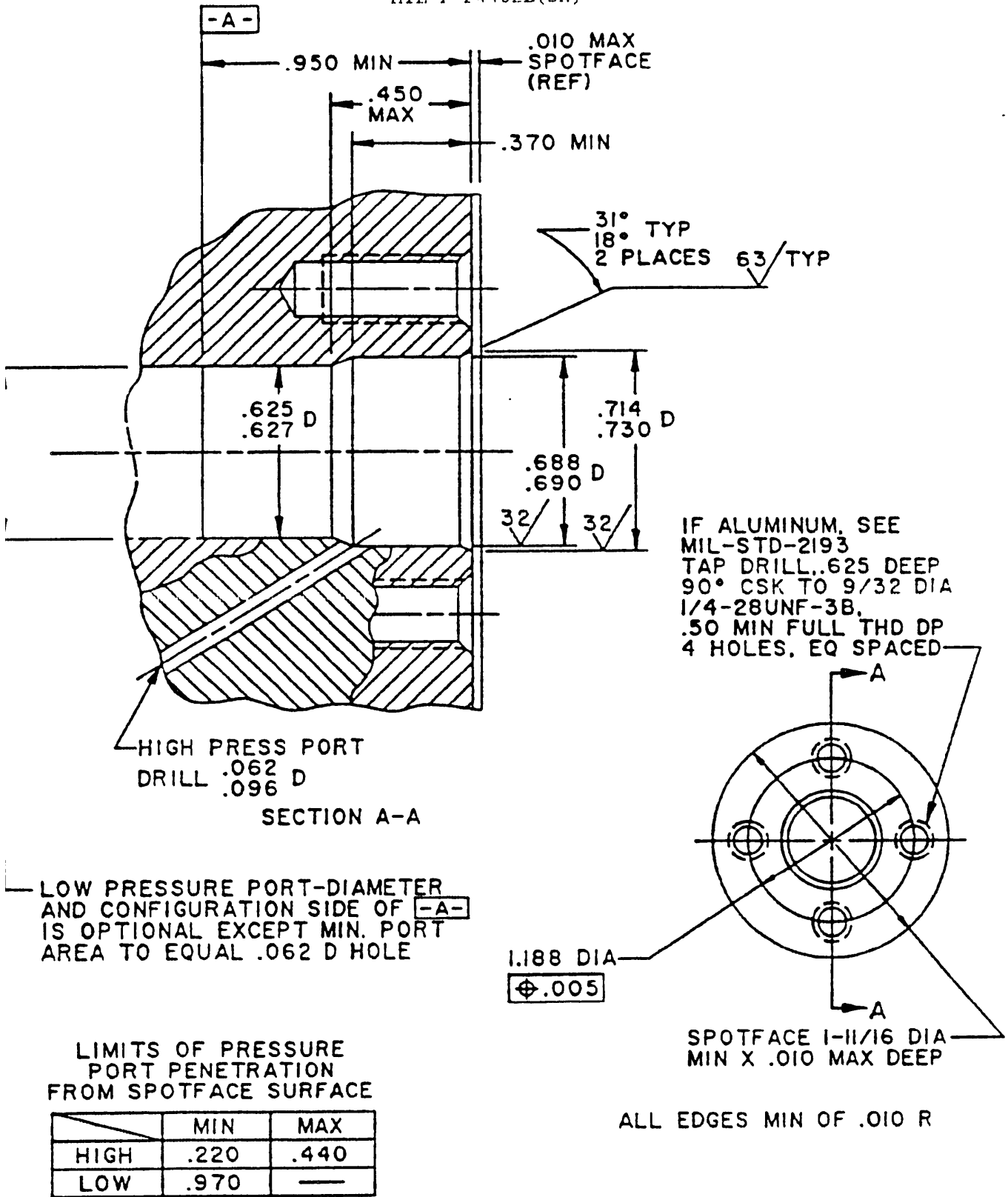


FIGURE 1. Differential pressure indicator port.

MIL-F-24402E(SII)

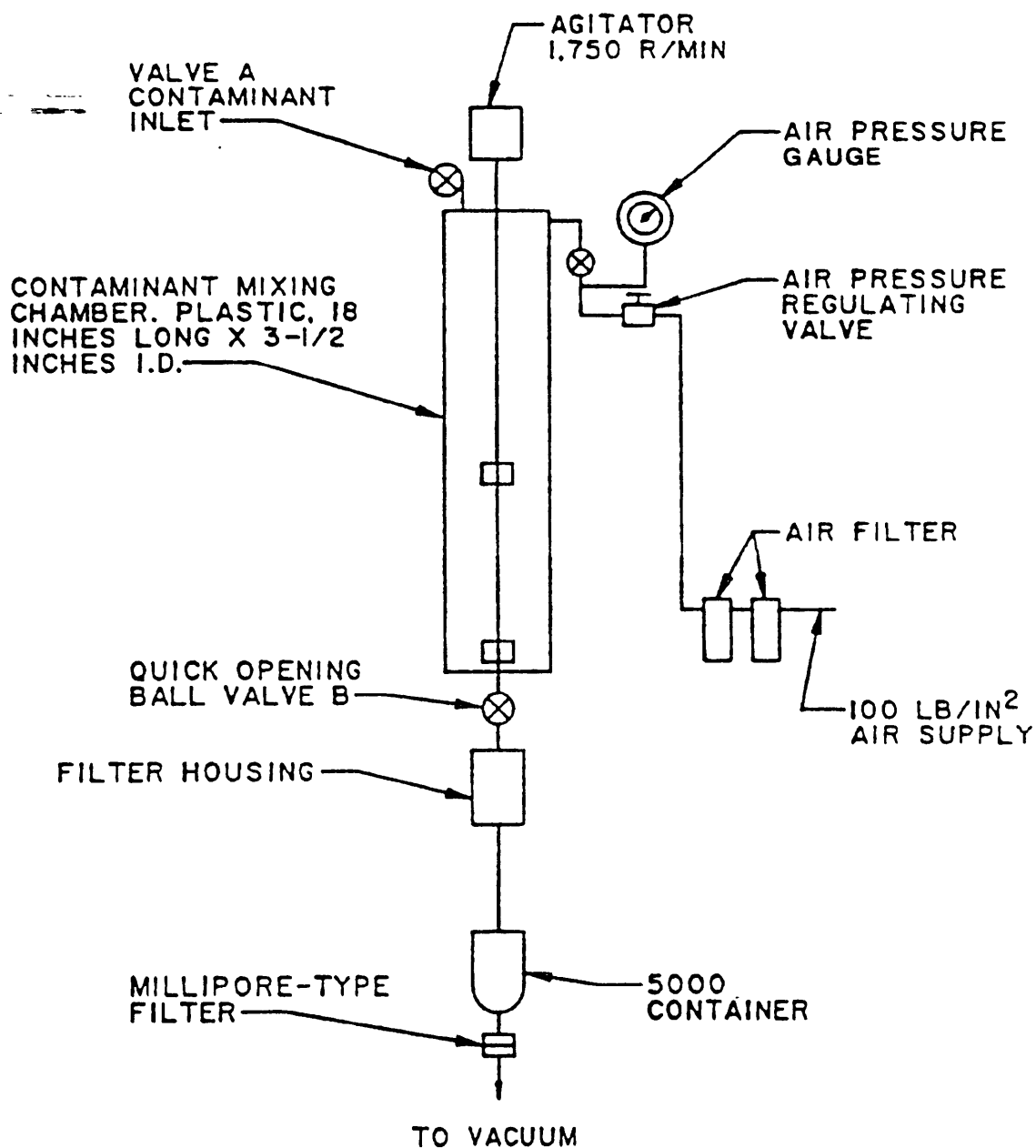


FIGURE 2. Typical apparatus for determining filtration efficiency.

MIL-F-24402E(SH)

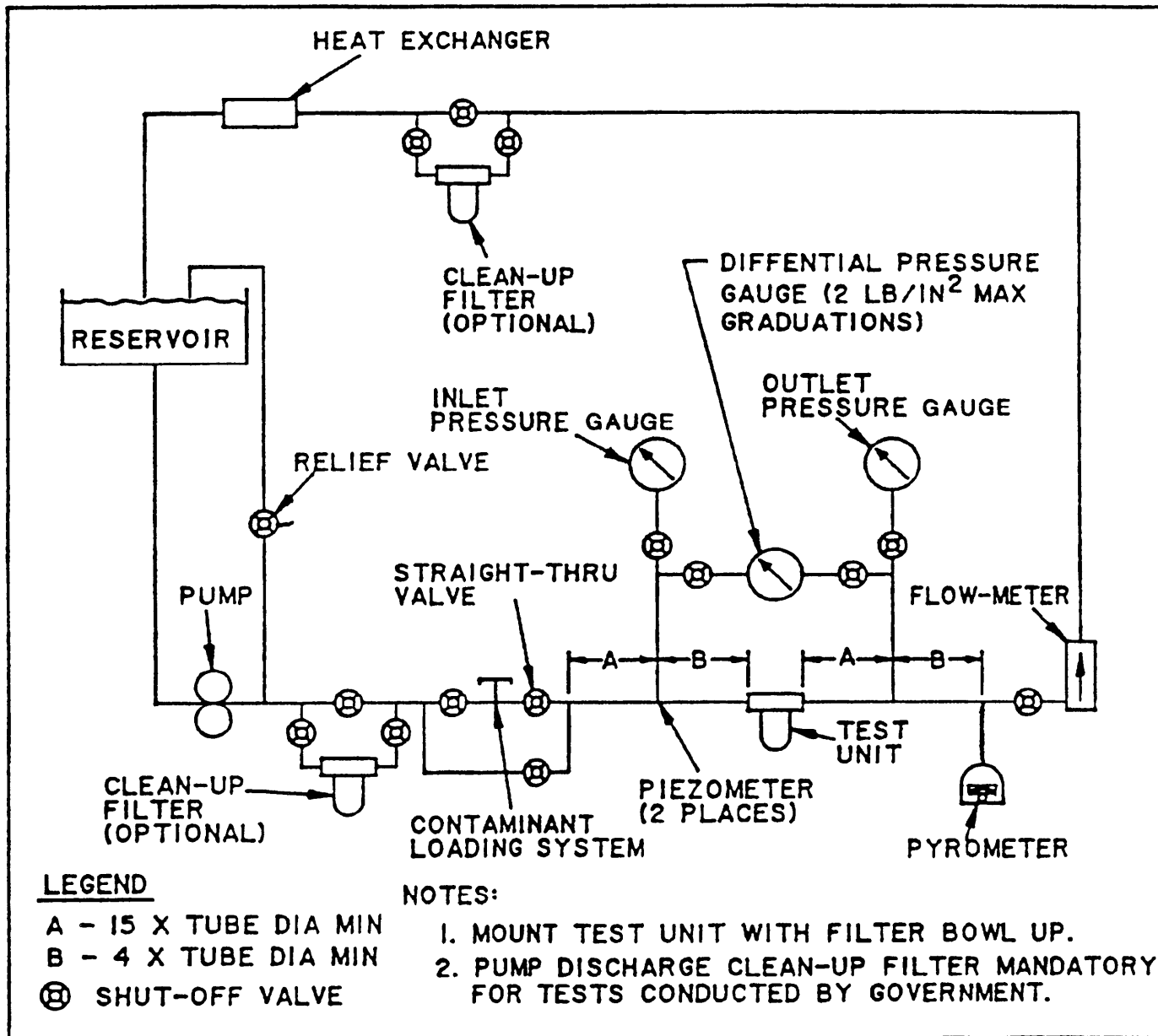


FIGURE 3. Typical piping schematic for pressure build-up and collapse test.

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions Reverse Side)

1. DOCUMENT NUMBER MIL-F-24402E(SH)	2. DOCUMENT TITLE FILTERS (HYDRAULIC), FILTER ELEMENTS (HIGH EFFICIENCY), AND FILTER DIFFERENTIAL PRESSURE INDICATORS, GEN SPEC P
--	---

3a. NAME OF SUBMITTING ORGANIZATION

4 TYPE OF ORGANIZATION (Mark one)

VENDOR

USER

MANUFACTURER

OTHER (Specify) _____

b. ADDRESS (Street, City, State, ZIP Code)

5. PROBLEM AREAS

a. Paragraph Number and Wording

b. Recommended Wording

c. Reason/Rationale for Recommendation

6. REMARKS

7a. NAME OF SUBMITTER (Last, First, MI) - Optional

b. WORK TELEPHONE NUMBER (Include Area Code) - Optional

c. MAILING ADDRESS (Street, City, State, ZIP Code) - Optional

8. DATE OF SUBMISSION (YYMMDD)

(TO DETACH THIS FORM, CUT ALONG THIS LINE.)

INCH-POUND

MIL-F-24402E(SH)
AMENDMENT 2
26 May 1995
SUPERSEDING
AMENDMENT 1
7 July 1992

MILITARY SPECIFICATION

FILTER (HYDRAULIC), FILTER ELEMENTS (HIGH EFFICIENCY), AND
FILTER DIFFERENTIAL PRESSURE INDICATORS,
GENERAL SPECIFICATION FOR

This amendment forms a part of MIL-F-24402E(SH), Dated 3 April 1990, and is approved for use by the Naval Sea Systems Command, Department of the Navy and is available for use by all Department and Agencies of the Department of Defense.

PAGE 2

Add the following specifications to the Military Specifications Listing:

MIL-F-24704 - Flanges, Four Bolt Square, Hydraulic, General Specification for.
MIL-F-24704/4 - Flanges, Four Bolt Square, Blind For Hydraulic Systems.
MIL-F-24704/5 - Flanges, Four Bolt, Insert Sleeves For Hydraulic Systems.

PAGE 3

* Add the following standard to the American Society For Testing And Materials (ASTM) :

A 342 - Standard Test Methods for Permeability of Feebly Magnetic Materials.

PAGE 4

* 3.4: Add the following:

" The aluminum parts of the filter elements are exempted from anodizing requirements. Plated socket head cap screws shall not be utilized".

AMSC FSC 4330
DISTRIBUTION STATEMENT A. Approved for public release: distribution is unlimited.

MIL-F-24402E(SH)
AMENDMENT 2

PAGE 4

* Add the following new paragraph:

"3.3.4 Filter element magnetic permeability. The size B and size C filter elements shall have a relative magnetic permeability of less than 2.0 when tested in accordance with ASTM-A432."

PAGE 5

3.4.2.1, Line 5: Delete " housings " and substitute "housing bowls".

PAGE 9

3.6.3: Delete item "(d)" in its entirety.

PAGE 11

Table I:

(a). Delete footnote 1/ from the check valve leakage test.

* (b). Add the following test after "Examination" under "Element no. 1":

Examination and tests	Requirement	Test method
<u>Element only</u>		
Element no. 1		
Examination	3.3.3, 3.4.1.3, 3.4.3, 3.6.2, and 3.7	4.6
Magnetic permeability	3.3.4	4.7.2.9

PAGE 15

Table II, Sampling: Delete "Pressure point 3/" and substitute "Clean element pressure drop 3/".

Table II, **Footnote 1/** : Delete and substitute "Fluid, temperature, and viscosity specified in 4.5.1 do not apply. For leakage tests with other than MIL-L-17331 fluid, an increased leakage is permitted only when specifically approved by the qualifying activity."

4.4.2 Delete "and 4.4.2.2" and substitute "through 4.4.2.3".

4.4.2.1 and 4.4.2.2: Delete and add the following paragraphs.

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AMENDMENT 2

"4.4.2.1 Sampling for examination and tests. For the purpose of sampling, filter elements shall be grouped into lots not exceeding 501 pieces. A lot is defined as elements produced at one facility, fabricated by the same process, which are of same material, size, type and part number."

"4.4.2.2 Examination and bubble point test. As a minimum the manufacturer shall select a sample quantity from each lot of filter elements in accordance with table III and inspect them in accordance with table II. If one or more defectes are found in any sample, the entire lot shall be rejected. The manufacturer has the option of screening 1002 of the rejected lot for the defective characteristic(s) or providing a new lot which shall be inspected in accordance with the sampling plan contained herein."

"4.4.2.3 Clean element pressure drop test. As a minimum the manufacturer shall select a sample quantity from each lot of filter elements in accordance with table III and inspect them in accordance with table II. Failure of the test shall be cause for rejection of the element lot."

PAGE 16

Table III: Delete and substitute:

"TABLE III. Sampling plan for filter elements.

Lot size	Sample	Size
	Examination and bubble point	Clean element pressure drop
1 - 29	All	1
30 - 501	29	1

PAGE 23

4.7.2.5: Add the following:

"An acceptable pressure build-up and collapse test setup, with cleanup device installed, is shown on figure 3."

4.7.2.5.1: Delete and substitute:

"4.7.2.5.1 Clean element pressure drop and Pressure buildup.

(a) Clean element pressure drop. With the full flow dummy element installed in a test housing, the housing shall be installed in the forward flow direction. A test flow (see table I of MIL-F-24402/4) shall be established at the temperature determined to obtain 100 cst oil viscosity, and the differential pressure shall be recorded. This is the tare value. The dummy element shall be removed and replaced with the test element. A test flow (see table I of MIL-F-244402/4) shall be established at the temperature used for the tare value. The recorded differential pressure is gross value. Difference between the tare and gross value is the pressure drop of the clean element. The clean element pressure drop shall be no greater than the value specified in the applicable specification sheet.

3 of 4

MIL-F-24402E(SH)
AMENDMENT 2

(b) Pressure buildup. With the element in a test housing, standardized air cleaner (A-C) test dust shall be added immediately upstream of the filter element at 4-minute interval. The amount of dust added at each interval shall be as specified in the specification sheet for filter elements. The temperature of the test fluid shall be maintained as specified in 4.5.1. Pressure differential, flow rate, and temperature shall be recorded 2 minutes after each dust addition. The pressure differential at test flow (see table I of MIL-F-24402/4) shall be not greater than the value specified in the applicable specification sheet after the specified amount of dust has been added. Additional dust shall be added until either a differential pressure of 150 **lb/in²** is obtained across the element at test flow or until twice the minimum weight of test dust has been added. Fluid flow shall not be interrupted during pressure build-up testing. Add intervals, amount of dust added, and pressure shall be included in the qualification test report. Curve showing the differential pressure across the element versus weight added in gram of A-C fine test dust shall be included in the qualification test report. Cleanup filters are allowed in the test stand during pressure build-up testing at the contractor's facilities. When testing is conducted by the Government, cleanup element efficiency shall be equal to or better than that required for MIL-F-27656 elements."

PAGE 25

* Add the following new paragraph:

"4.7.2.9 Magnetic permeability. The filter element shall be subjected to a magnetic permeability test as specified in ASTM-A432. Nonconformance to the requirement of 3.3.4 shall constitute failure of this test."

PAGE 26

5.1.2: Delete in its entirety.

PAGE 27

5.2.2.1: At the end of sentence, Add "of MIL-P-116"

NOTE: The margins of this amendment are marked with an asterisk or vertical lines to indicate where changes (additions, modifications, corrections, deletions) from the previous amendment were made. This was done as a convenience only and Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the last previous amendment.

Preparing activity
NAVY - SH
(Project 4330-N002)