

INCH-POUND

MIL-DTL-24402F(SH)

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SUPERSEDING

MIL-F-24402E(SH)

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DETAIL SPECIFICATION

FILTERS (HYDRAULIC), FILTER ELEMENTS, 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 (lb/in²).

1.2 Classification. Filter housings and differential pressure indicators are of the envelope sizes specified in the applicable specification sheet (see 3.1) and are designated as shown in the applicable specification sheet.

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements of documents cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-S-901	-	Shock Tests, H.I. (High-Impact) Shipboard Machinery, Equipment, and Systems, Requirements for
MIL-PRF-17331	-	Lubricating Oil, Steam Turbine and Gear, Moderate Service
MIL-DTL-24402/1	-	Filter Housings, Hydraulic, Single-Element
MIL-DTL-24402/2	-	Filter Housings, Hydraulic, Duplex
MIL-DTL-24402/3	-	Filter Housings, Hydraulic, Three Elements
MIL-DTL-24402/5	-	Filter Indicators, Differential Pressure, Hydraulic

Comments, suggestions, or questions on this document should be addressed to Commander, Naval Sea Systems Command, ATTN: SEA 05S, 1333 Isaac Hull Avenue, SE, Stop 5160, Washington Navy Yard DC 20376-5160 or emailed to CommandStandards@navy.mil, with the subject line "Document Comment". Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at <https://assist.dla.mil>.

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DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-167-1	-	Mechanical Vibrations of Shipboard Equipment (Type I - Environmental and Type II - Internally Excited)
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-2193	-	Ship Hydraulic System Components

(Copies of these documents are available online at <http://quicksearch.dla.mil>.)

2.2.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

NAVAL SEA SYSTEMS COMMAND (NAVSEA) PUBLICATIONS

S9074-AR-GIB-010/278	-	Requirements for Fabrication Welding and Inspection, and Casting Inspection and Repair for Machinery, Piping, and Pressure Vessels
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(Copies of this document are available from online at <https://nll.ahf.nmci.navy.mil>, may be requested by phone at 215-697-2626, or may be requested by email at nllhelpdesk@navy.mil. This publication can be located by searching the Navy Publications Index for the TMIN without the suffix.)

2.3 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

NATIONAL FLUID POWER ASSOCIATION (NFPA)

NFPA T2.6.1	-	Fluid Power Components - Method for Verifying the Fatigue and Establishing the Burst Pressure Ratings of the Pressure Containing Envelope of a Metal Fluid Power Component
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(Copies of this document are available from www.nfpa.com.)

SAE INTERNATIONAL

SAE-AS1290	-	Graphic Symbols for Aircraft Hydraulic and Pneumatic Systems
SAE-AS34521	-	Connector, Receptacle, Electric, Box Mounting, Rear Release, Crimp Contact, AN Type With
SAE-J2321	-	Ship Systems and Equipment -- General Specification for Filter Elements -- Hydraulic and Lube Oil Service
SAE-J2321/2	-	Disposable Hydraulic Filter Element - 190 L/min Flow, 21 MPa Collapse Pressure, Filtration Ratio = 75 at 7 µm
SAE-J2321/3	-	Disposable Hydraulic Filter Elements - 21 MPa Collapse Pressure, Filtration Ratio = 75 at 10 µm, 75 to 175 L/Min

(Copies of these documents are available from www.sae.org.)

2.4 Order of precedence. Unless otherwise noted herein or in the contract, 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.

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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.

3.2 Qualification. The filter assemblies and differential pressure indicators furnished under this specification shall be products that are authorized by the qualifying activity for listing on the applicable qualified products list before contract award (see 4.2 and 6.3).

3.3 Filter elements. Filter elements for use in the filter assemblies furnished under this specification shall be in accordance with SAE-J2321 and SAE-J2321/2 for Size B elements or SAE-J2321/3 for Size C elements (see the applicable specification sheet).

3.4 Materials. Materials and coatings shall conform to 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. Threads shall not be plated or coated to achieve hardness difference.

3.4.1 Recycled, recovered, environmentally preferable, or biobased materials. Recycled, recovered, environmentally preferable, or biobased materials should be used to the maximum extent possible, provided that the material meets or exceeds the operational and maintenance requirements, and promotes economically advantageous life cycle costs.

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

3.5 Construction. Unless otherwise specified (see 6.2), the design, parts, and construction of filter housings and differential pressure indicators shall conform to the construction requirements specified herein, in MIL-STD-2193, and in the applicable specification sheet. Plated socket head cap screws shall not be utilized.

3.5.1 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. Filter assemblies shall prevent installation of the filter element in a reverse orientation.

The filter assemblies shall permit the removal of the filter element within the element removal clearance envelope shown on the applicable specification sheet, 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.

3.5.1.1 Mounting. The equipment shall include provisions for solid mounting of the filter assemblies. The mounting provisions shall meet the shock requirements of 3.6.1. The mounting shall withstand the wrench loads required for making tube connections and replacing filter elements.

3.5.1.2 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.

3.5.1.3 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.

3.5.2 Filter housings. The filter housings shall meet the flow rates specified in the applicable specification sheet. These flow rates are based on the use of fluid in accordance with MIL-PRF-17331.

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3.5.2.1 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 housing bowls 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.

3.5.2.2 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.

3.5.2.3 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.

3.5.3 Protective and control devices.

3.5.3.1 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 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.

3.5.3.1.1 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.

3.5.3.1.2 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 SAE-AS34521 as identified by part or identifying number (PIN) MS3452W-10SL-3P. The electrical rating on the single-pole, double-throw switch shall be 5 amperes at 110 volts alternating current (VAC), 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, 6,800-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.

3.5.3.1.3 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 ± 11 lb/in². When specified (see 6.2), a calibration procedure shall be provided. Gauges shall have a protective shield to safeguard gauge from impact damage.

3.5.3.2 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.

3.5.3.3 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.

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3.5.3.4 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.

3.5.3.5 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 0.07 ounces (2 milliliters [mL]) per minute in each flow passage after completion of pressure cycle testing (see 4.6.1.9).

3.5.4 Welding and allied processes. Welding and allied processes shall be in accordance with S9074-AR-GIB-010/278 for the filter housing pressure vessel or structural welds, as applicable.

3.6 Performance. Filter assemblies, filter housings, and differential pressure indicators shall perform as specified when subjected to the examination and tests specified in 4.2 and 4.3.

3.6.1 Shock. Filter assemblies and differential pressure indicators shall meet the shock requirements of MIL-S-901 for Grade A, Class I equipment.

3.6.2 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.

3.6.3 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.

3.6.4 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.

3.6.5 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 4.6.1.2 (see MIL-DTL-24402/1 and MIL-DTL-24402/3).

3.6.6 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 4.6.1.3).

3.7 Identification.

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

- a. Number and date of this specification.
- b. Filter assembly specification PIN (see the applicable specification sheet).
- c. Manufacturer's part or drawing number.
- d. Manufacturer's name or trademark.
- e. Fluid symbol (see SAE-AS1290).
- f. Relief valve setting, where applicable.
- g. Replacement filter element specification PIN (see the applicable specification sheet).

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

3.7.1.2 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.

3.7.1.3 Filter bowls. The threaded filter bowls shall be clearly and permanently marked “Hand Tighten Only.”

3.7.1.4 Aluminum components. Pressure-containing aluminum components of the filter assemblies shall be permanently marked 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.

3.7.2 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 PIN (see the applicable specification sheet).
- b. Manufacturer’s part or drawing number.
- c. Manufacturer’s name or trademark.

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

3.8 Workmanship. Dimensions and tolerances shall be as specified herein and on the applicable specification sheet. Unless otherwise specified (see 6.2), filter housings shall be free from visual cracks, machined surface anomalies, alloy inclusions, discontinuities, and asperities.

4. VERIFICATION

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

- a. Qualification inspection (see 4.2).
- b. Conformance inspection (see 4.3).

4.2 Qualification inspection. Qualification inspection shall be conducted at a laboratory acceptable 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
Filter housings		
Examination	3.5.1, 3.5.1.1, 3.5.1.2, 3.5.1.3, 3.5.2.1, 3.5.2.2, 3.5.3.2 through 3.5.3.5, 3.7.1, 3.7.1.1 through 3.7.1.4, 3.7.3, and 3.8	4.5
Filter element removal	3.5.1	4.6.1.11
Shock	3.6.1	4.6.1.1
Housing pressure drop	3.6.4	4.6.1.5
Fatigue impulse ^{1/}	3.6.2	4.6.1.2
Proof pressure ^{1/}	3.6.3	4.6.1.4
Relief valve operation	3.5.3.3	4.6.1.7.1
Selector valve operation and leakage	3.5.3.4	4.6.1.8.1
Check valve leakage	3.5.3.5	4.6.1.9.1
Burst pressure ^{1/}	3.6.5	4.6.1.10
Differential pressure indicators		
Examination	3.5.1.3, 3.5.3.1, 3.7.2, and 3.8	4.5
Shock	3.6.1	4.6.1.1
Vibration	3.6.6	4.6.1.3
Fatigue impulse ^{1/}	3.6.2	4.6.1.2
Proof pressure ^{1/}	3.6.3	4.6.1.4
Operation	3.5.3.1	4.6.1.6
NOTE:		
^{1/} Fluid temperature and viscosity specified in 4.4 do not apply.		

4.2.1 Test specimens. Test specimens shall be identified with the manufacturer's part number.

4.2.1.1 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.

4.2.2 Qualification by similarity. Qualification on the basis of similarity will be considered by the qualifying activity as specified in 4.2.2.1 through 4.2.2.2.

4.2.2.1 Filter assemblies.

4.2.2.1.1 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.

4.2.2.1.2 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.

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4.2.2.1.3 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.

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

4.2.2.2 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.

4.3 Conformance inspection. Conformance inspection shall consist of the examinations and tests specified in [table II](#). Conformance inspection 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.

TABLE II. Conformance inspection.

Individual inspection		
Examination and tests	Requirement	Test method
Filter housings		
Examination	3.5.1, 3.5.1.1, 3.5.1.2, 3.5.1.3, 3.5.2.1, 3.5.2.2, 3.5.3.2 through 3.5.3.5, 3.7.1, 3.7.1.1 through 3.7.1.4, 3.7.3 and 3.8	4.5
Proof pressure ^{1/} , ^{2/}	3.6.3	4.6.1.4
Relief valve operation ^{1/}	3.5.3.3	4.6.1.7.2
Selector valve operation and leakage	3.5.3.4	4.6.1.8.2
Check valve leakage ^{1/}	3.5.3.5	4.6.1.9.2
Differential pressure indicators		
Examination	3.5.1.3, 3.5.3.1, 3.7.2 and 3.8	4.5
Proof pressure ^{1/} , ^{2/}	3.6.3	4.6.1.4
Operation	3.5.3.1	4.6.1.9
NOTES:		
^{1/} Fluid temperature and viscosity specified in 4.4 do not apply. When test fluid other than MIL-PRF-17331 is used for leakage tests, increased leakage rates are only permitted when specifically approved by the qualifying activity.		
^{2/} Proof pressure test shall be conducted prior to all other tests.		

4.4 Test conditions. Unless otherwise specified (see 6.2 and [tables I](#) and [II](#)), the hydraulic fluid used for all tests shall conform to MIL-PRF-17331. Where MIL-PRF-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 $\pm 1.8^\circ\text{F}$ (1°C).

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

4.6 Test methods.

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

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4.6.1.1 **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 4.6.1.2 through 4.6.1.10).

4.6.1.2 **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.

4.6.1.3 **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/in², 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 [table III](#), 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 hertz.

TABLE III. Vibratory displacement single amplitude.

Frequency range (Hz)	Table amplitude ^{1/} (inch, minimum)	Time (minutes)
4 to 15	0.05	2
16 to 25	0.04	1
26 to 33	0.03	1
36 to 40	0.02	1
41 to 50	0.01	1
NOTE: ^{1/} For Government-conducted tests, the maximum amplitude shall not exceed the minimum required amplitude by more than 20 percent.		

4.6.1.4 **Proof pressure.** A proof pressure, as specified in 3.6.3, 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.

4.6.1.5 **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 sheet. Rated flow for each filter housing shall be as specified in the applicable specification sheet.

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4.6.1.6 Differential pressure indicator operation.

4.6.1.6.1 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-DTL-24402/5. This test shall be repeated with the outlet pressurized to 50 and 3,000 lb/in². 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 3,000 lb/in², and that the actuators can be manually depressed to the normal reset position under these conditions. With the outlet pressurized to 50 and 3,000 lb/in², a differential pressure of a value, as specified in MIL-DTL-24402/5, of 5 seconds duration shall not cause the indicator to actuate.

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

4.6.1.6.2 Electrical-type port. For qualification testing, the electrical differential pressure indicators shall be tested for operation in accordance with 4.6.1.6.1. During operational tests, it shall be verified that the electrical contacts trip in conjunction with the actuation and reset of the red indicator (see 3.5.3.1.2). For 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.

4.6.1.6.3 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/in². Differential pressure shall be maintained at 3,000 lb/in² 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 3.5.3.1.3. The gauge shall be tested in both the ascending and descending pressure modes of operation at 20-lb/in² intervals from the lowest to highest pressure range, inclusive. An indicator response time of less than 20 seconds for a 50-lb/in² change in pressure shall be demonstrated. For 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.

4.6.1.7 Relief valve operation.

4.6.1.7.1 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 (see 6.8.1). 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.

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 the maximum specified value.

c. Minimum reseal pressure (see 6.8.2). 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.

4.6.1.7.2 Relief valve (conformance). Filter assemblies with an integral relief valve shall be tested as specified in 4.6.1.7.1 to verify the cracking pressure and minimum reseal requirements specified for conformance on the applicable specification sheet. For conformance, the 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.

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

4.6.1.8.1 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 0.2 ounces (6 milliliters) 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.

4.6.1.8.2 Selector valve (conformance). Valve operating torque and selector valve leakage shall be checked as specified in 4.6.1.8.1 and shall meet the requirements specified in 3.5.3.4. The cycling test specified in 4.6.1.8.1 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.

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

4.6.1.9.1 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 0.07 ounces (2 milliliters) 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 the 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.

4.6.1.9.2 Check valve (conformance). Check valve cracking pressure and leakage shall be checked as specified in 4.6.1.9.1 and shall meet the requirements specified in 3.5.3.5. Leakage shall be measured over a period of not less than 1 minute. The cycling test specified in 4.6.1.9.1 is not required.

4.6.1.10 Burst pressure. A burst pressure, as specified in the applicable specification sheet, shall be applied to the filter housing in accordance with NFPA T2.6.1. The actual burst pressure shall be recorded.

4.6.1.11 Filter element removal. The filter elements shall be removed from the filter housing within the clearance envelope as specified in 3.5.1. There shall be no interference with the housing.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When packaging of materiel is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activities within the Military Service or Defense Agency, or within the military service's system commands. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

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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 flow rates.

6.2 Acquisition requirements. Acquisition documents should specify the following:

- a. Title, number, and date of this specification.
- b. Title, number, and date of the applicable specification sheet.
- c. The specific issue of individual documents referenced (see 2.2 and 2.3).
- d. Applicable specification sheet PIN.
- e. Construction requirements, if other than specified (see 3.5).
- f. Gauge-type differential pressure indicator calibration requirements (see 3.5.3.1.3).
- g. Workmanship requirements, if other than specified (see 3.8).
- h. Test fluid and fluid temperature requirements, if other than specified (see 4.4).
- i. Packaging requirements (see 5.1).
- j. Provisioning requirements (see 6.4).
- k. Assembly drawing requirements (see 6.5).
- l. Indicators for logistic support requirements (see 6.6).
- m. Fastener torque requirements (see applicable specification sheet).

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 QPL 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 orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from Commander, Naval Sea Systems Command, ATTN: SEA 05S, 1333 Isaac Hull Avenue, SE, Stop 5160, Washington Navy Yard DC 20376-5160 or emailed to CommandStandards@navy.mil. An online listing of products qualified to this specification may be found in the Qualified Products Database (QPD) at <https://assist.dla.mil>.

6.3.1 Provisions governing qualification. Copies of SD-6, "Provisions Governing Qualification," are available online at <http://quicksearch.dla.mil/> or <https://assist.dla.mil>.

6.4 Provisioning. Provisioning Technical Documentation (PTD), spare parts, and repair parts should be furnished as specified in the contract (see 6.2). 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.

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6.5 Assembly drawings. The requirement for assembly drawings should be considered when this specification is applied on a contract (see 6.2). If assembly drawings are required, two sets of assembly drawings, in accordance with ASME Y14.100, should be furnished with each new model filter assembly submitted for qualification tests. Assembly drawings should show a cutaway section of details in their normal assembly positions and should carry part numbers of details and subassemblies. The following data should 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.

6.6 Indicators for logistic support. When the differential pressure indicators are procured as separate items (see 6.2), an instruction sheet should be packed with each indicator and should contain, at a minimum, the following statement: "Installation information. For mounting fastener material and torque requirements, see applicable filter assembly drawing or S9086-S4-STM-010, Naval Ships' Technical Manual Chapter 556 Hydraulic Equipment (Power Transmission and Control), Section titled "Filtration". The length of the fastener for mounting this indicator is (indicate length which will provide an engagement between $1\frac{1}{4}$ and $1\frac{1}{2}$ times the diameter of the fastener)."

6.7 Cushioning and wrapping materials. Materials that have properties for resistance to fire and are acceptable for use within unit packs and shipping containers for Navy acquisitions are:

Material	Specification
Plastic film, flexible, cellular	PPP-C-795, Class 3 - fire-retardant
Bound fiber	PPP-C-1120, Type III or IV, Class C
Fibrous glass	MIL-C-17435
Polystyrene foam	MIL-P-19644, Type II
Rubber, cellular synthetic	MIL-PRF-20092, Class 5
Polyurethane foam	MIL-PRF-26514
Foam-in-place packaging materials; general specification for	MIL-PRF-83671
Foam, combustion retardant, for cushioning supply items aboard navy ships	MIL-F-87090

6.8 Definitions.

6.8.1 Relief valve cracking pressure. Relief valve cracking pressure is the pressure at which the relief valve internal leakage exceeds the minimum value identified on the applicable specification sheet for internal leakage.

6.8.2 Relief valve minimum reseal pressure. Relief valve minimum reseal pressure is the pressure at which the relief valve internal leakage drops below the minimum value identified on the applicable specification sheet for internal leakage.

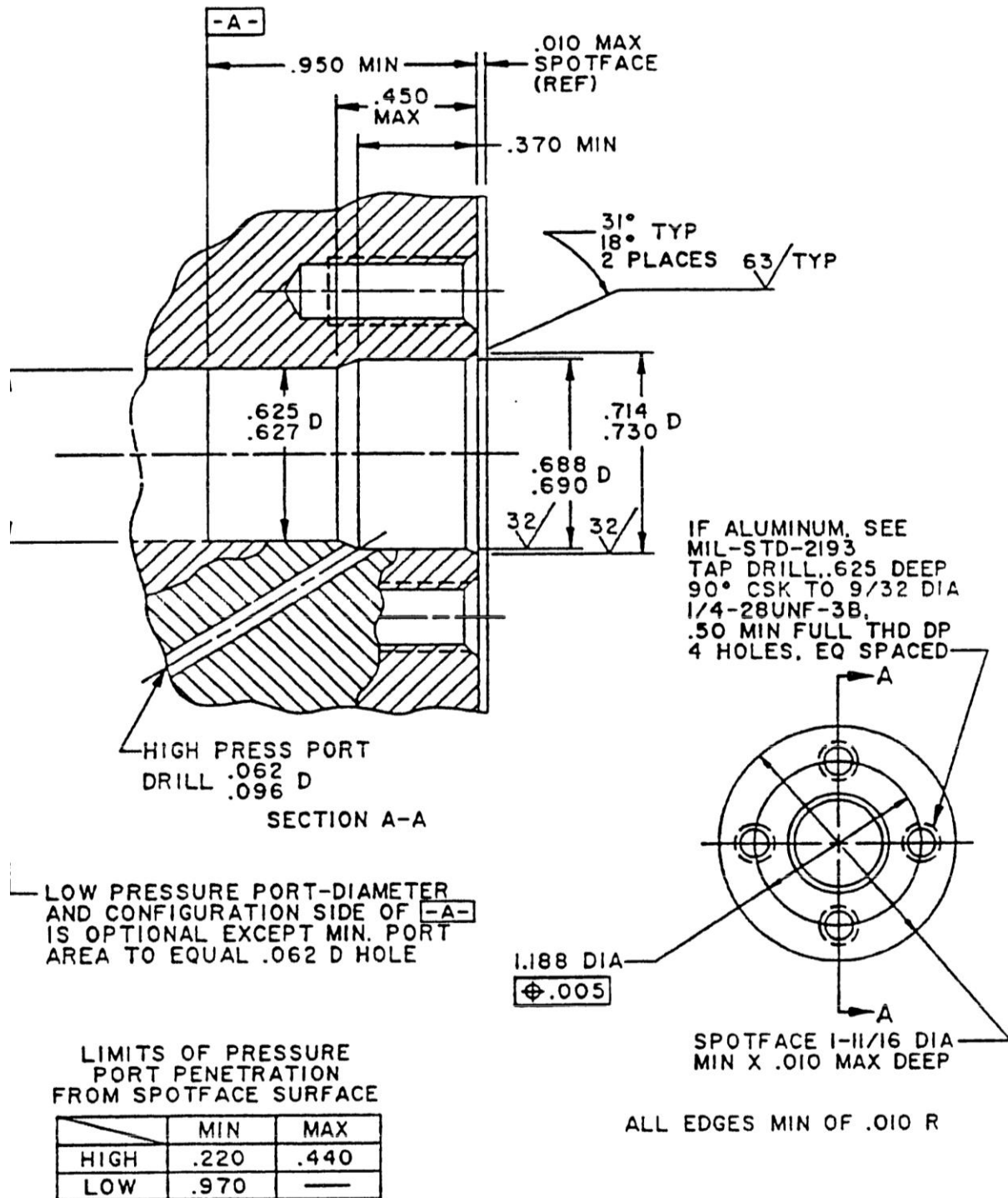
6.9 Subject term (key word) listing.

Filter housing

Hydraulic component

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

FIGURE 1. Differential pressure indicator port.

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Preparing activity:
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NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at <https://assist.dla.mil>.