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An American National Standard

Standard Specification for Filters Used in Air or Nitrogen Systems[1]

This standard is issued under the fixed designation F 1791; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This specification covers the design, construction, test, and performance requirements for air or nitrogen system filters, referred to hereinafter as filters. These filters are intended to be installed in-line to protect equipment from particular contamination.

1.2 The values stated in this specification in inch-pounds units are to be regarded as the standard. The SI equivalent shown in parentheses are provided for information only.

2. Referenced Documents

2.1 *ASTM Standards:*

F 992 Specification for Valve Label Plates[2]

2.2 *American Society of Mechanical Engineers (ASME):*

B1.1 United Screw Threads (UN and UNR Thread Form)[3]

B1.20.1 Pipe Threads, General Purpose (Inch)[3]

B16.11 Forged Steel Fittings, Socket-Welding and Threaded[3]

B16.25 Buttwelding Ends[3]

B16.34 Flanged, Threaded, and Welded End[3]

2.3 *Society of Automotive Engineers (SAE):*

ARP 901 Aerospace Recommended Practice—Bubble-Point Test Method[4]

2.4 *Military Standards and Specifications:*

MIL-STD-167-1 Mechanical Vibrations of Shipboard Equipment (Type I—Environmental and Type II—Internally Excited)[5]

MIL-STD-740-1 Airborne Sound Measurements and Acceptance Criteria of Shipboard Equipment[5]

MS16142 Boss, Gasket Seal Straight Thread Tube Fitting, Standard Dimensions for[5]

MIL-S-901 Shock Tests, H.I. (High-Impact); Shipboard Machinery, Equipment and Systems, Requirements for[5]

MIL-F-1183 Fittings, Pipe, Cast Bronze, Silver-Brazing, General Specifications for[5]

2.5 *Naval SEA Systems Command (NAVSEA): Government Drawings:*

NAVSEA 803-1385884 Unions, Fittings and Adapters Butt and Socket Welding 6000 PSI, WOG, NPS[5]

NAVSEA 803-1385943 Unions, Silver Brazing 3000 PSI, WOG, NPS, for UT Inspection[5]

NAVSEA 803-1385946 Unions, Bronze Silver Brazing, WOG for UT Inspection[5]

3. Terminology

3.1 *Definitions:*

3.1.1 *absolute contaminant removal rating*—the smallest size of contaminant as defined in ARP 901 that the filter will retain with 100 % efficiency by weight.

3.1.2 *bubble point*—the pressure differential across a submerged filter element required to produce a visible and steady stream of air bubbles. Correlation between bubble point and contaminant removal capability provides an economical means to test for contaminant removal capability on a production basis. The bubble point indicates the maximum pore size of the filter media under static conditions.

3.1.3 *bubble-tight*—no visible leakage over a 3-min period using either water submersion or the application of bubble fluid for detection.

3.1.4 *clean filter element pressure drop*—the pressure drop across the filter element when it is new or uncontaminated.

3.1.5 *cleanable filter element*—a filter element that, after being contaminated to its dirt-holding capacity (contaminated filter element pressure drop), can be restored by cleaning to operational condition and with a pressure drop not exceeding the required clean filter element pressure drop.

3.1.6 *contaminant removal rating*—this is a measure of the size of contaminants that the filter can remove from the flow stream.

3.1.7 *contaminated filter element pressure drop*—the pressure drop across the filter element when it is contaminated to the point where cleaning or replacement is required.

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[2] *Annual Book of ASTM Standards*, Vol 01.07.

[3] Available from American Society of Mechanical Engineers, Headquarters, Three Park Ave., New York, NY 10016–5990. (Telephone: 212–591–7722, Fax: 212–591–7676, Telex: 710–591–5267.

[4] Available from Society of Automotive Engineers, 400 Commonwealth Dr., Warrendale, PA 15096.

[5] Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS.

3.1.8 *differential pressure indicator actuation pressure*—the pressure drop across the filter element at which the differential pressure indicator actuates.

3.1.9 *disposable filter element*—a filter element that, after being contaminated to its dirt-holding capacity (contaminated filter element pressure drop), cannot be restored to operational conditions and thereafter should be replaced.

3.1.10 *external leakage*—leakage that escapes to atmosphere.

3.1.11 *filter element bypass full-flow differential pressure*—the pressure drop across the filter element at which the filter bypass is passing the full-flow rating of the filter.

3.1.12 *filter element bypass reseat differential pressure*—the pressure drop across the filter element at which the filter bypass reseats after passing the full-flow rating of the filter.

3.1.13 *filter element bypass set differential pressure*—the pressure drop across the filter element at which the filter bypass opens.

3.1.14 *filter element collapse strength*—the maximum pressure drop or differential across the filter element that the element must withstand without collapse, damage, or impairment of performance capabilities.

3.1.15 *filter element contaminant-holding capacity*—also commonly termed "dirt capacity." The amount of a contaminant, expressed in weight, that the element can hold when its resistance to flow causes a pressure drop equal to the contaminated filter element pressure drop.

3.1.16 *filter element pressure drop*—the pressure drop across the filter element.

3.1.17 *filter housing pressure drop*—the pressure drop accounted for by the filter housing.

3.1.18 *filter pressure drop*—the pressure drop across the entire filter (element and housing) at any given flow rate of the service fluid (air or nitrogen).

3.1.19 *flow capacity*—the maximum flow rate that the filter is required to pass.

3.1.20 *hydrostatic shell test pressure*—the hydrostatic test pressure that the filter is required to withstand without damage. The filter must be capable of meeting all performance requirements after the shell test pressure has been removed.

3.1.21 *media migration*—any material released into the flow stream by the filter media and its materials of construction. This term refers to the tendency of the filter media or "built-in" contamination, such as, welding scale, metal particles, or air-borne dust combined with the media during its manufacture, to leave the filter and shed or migrate into the flow stream.

3.1.22 *nominal contaminant removal rating*—the smallest size of contaminant as defined in ARP 901 that the filter will retain with 98 % efficiency by weight.

3.1.23 *operating pressure*—the pressure within the filter during service.

3.1.24 *pressure ratings*—the pressure rating of the filter shall be defined in the documents listed in Table 1. The pressure rating for a filter is the maximum allowable working (service) pressure at 100°F (38°C).

TABLE 1 Filter Inlet and Outlet End Connections

Type of End Connection	Pressure Rating	Applicable Documents for Dimensional Details of End Connections
Butt-welded	ASME B16.34 Class 150, 300, 400, 600, 900, 1500, 2500, or 4500	ASME B16.25
Socket-welded	ASME B16.34 Class 150, 300, 400, 600, 900, 1500, 2500, or 4500	ASME B16.11
Threaded (tapered pipe thread)	ASME B16.34 Class 150, 300, 400, 600, 900, 1500, or 2500	ASME B1.20.1 and ASME B16.11
Union-end,[A] silver-brazed	MIL-F-1183 (O-ring type) 400 lb/in.^{2} (2.758 MPa)	MIL-F-1183 (O-ring type) 400 lb/in.^{2} (2.758 MPa)
Union-end,[A] silver-brazed	803-1385946 1500 lb/in.^{2} (10.342 MPa)	803-1385946 1500 lb/in.^{2} (10.342 MPa)
Union-end,[A] silver-brazed	803-1385943 3000 lb/in.^{2} (20.684 MPa)	803-1385943 3000 lb/in.^{2} (20.684 MPa)
Union-end,[A] butt/socket weld	803-1385884 6000 lb/in.^{2} (41.369 MPa)	803-1385884 6000 lb/in.^{2} (41.369 MPa)
Other, as specified	as specified	as specified

[A]For union inlet and outlet connections, only the pertinent dimensions listed in the applicable documents (military specification or NAVESA requirements) shall apply. The filter shall be supplied with the thread pieces only, without the tail pieces and union nuts.

4. Classification

4.1 Filters shall be of the following types, compositions, styles, pressure ratings, sizes, end connections, and contamination removal ratings, as specified in Section 5.

4.1.1 *Filter Element Type*:

4.1.1.1 Type 1—Disposable.

4.1.1.2 Type 2—Cleanable.

4.1.2 *Filter Element Bypass Composition*:

4.1.2.1 Composition A: with bypass.

4.1.2.2 Composition B: without bypass.

4.1.3 *Filter Element Differential Indicator Style*:

4.1.3.1 Style I: with differential pressure indicator.

4.1.3.2 Style II: without differential pressure indicator.

4.2 *Pressure Ratings*—Filters shall have pressure ratings selected from those listed in Table 1 and specified in Section 5. The pressure rating selected shall be the same for both the filter inlet and outlet.

4.3 *Size*—Filter sizes shall be ¼ NPS (13.5 mm), ½ NPS (21.3 mm), ¾ NPS (26.9 mm), 1 NPS (33.7 mm), 1¼ NPS (42.4 mm), 1½ NPS (48.3 mm), and 2 NPS (60.3 mm) or as specified in Section 5 (see Table 2).

4.4 *End Connections*—Filters shall have inlet and outlet end connections selected from those listed in Table 1 and specified in Section 5. Inlet and outlet connections shall be identical.

TABLE 2 Filter Performance Characteristics

Filter Size, NPS	Minimum Dirt-Holding Capacity Grams AC Coarse
¼ (13.5 mm)	6.0
½ (21.3 mm)	6.0
¾ (26.9)	10.0
1 (33.7 mm)	12.0
1¼ (42.4 mm)	12.0
1½ (48.3 mm)	14.0
2 (60.3 mm)	16.0
As specified	as specified

4.5 *Contamination Removal Ratings*—Filters shall have contamination removal ratings selected from the following three categories: 20 µm nominal/50 µm absolute, 5 µm nominal/18 µm absolute, and 0.4 µm nominal/5 µm absolute. The contamination rating selected shall be specified in Section 5.

5. Ordering Information

5.1 Ordering documentation for filters under the specification shall include the following information, as required, to describe the equipment adequately.

5.1.1 ASTM designation and year of issue,

5.1.2 Title, number, and date of this specification,

5.1.3 Filter element type (see 4.1.1),

5.1.4 Filter element bypass composition (see 4.1.2),

5.1.5 Filter element differential pressure indicator style (see 4.1.3),

5.1.6 Filter pressure rating (see 4.2),

5.1.7 Size (see 4.3),

5.1.8 End connections (see 4.4),

5.1.9 Contaminant removal rating, absolute/nominal (see 4.5),

5.1.10 Maximum filter operating pressure,

5.1.11 Flow capacity required (see 7.1, S1.3),

5.1.12 Supplementary requirements, if any (S1.0 through S4.0), and

5.1.13 Maximum vibration frequency and amplitude, if other than specified (see S1.8).

6. Filter Design and Construction

6.1 Filters shall incorporate the design features specified in 6.1.1-6.1.6.

6.1.1 *Materials of Construction*—Materials shall be 300 series corrosion-resistant steel (SS304, 304L, 316, or 316L), or other materials selected to provide compatibility with the line medium, weldability, and corrosion resistance without requiring painting, coating, or plating. The filter body and the filter bowl shall be weld repairable. Materials for contacting parts shall be selected to minimize electrolytic corrosion and galling.

6.1.2 *Design Construction Requirements*:

6.1.2.1 *General Construction*—The filter shall have a bolted flanged body and filter bowl to expedite removal of the filter element for cleaning or replacement.

6.1.2.2 *Collapse Strength*—The filter element shall be capable of withstanding a differential pressure equal to the maximum inlet pressure rating without structural degradation.

6.1.2.3 *Automatic Bypass*—When specified (see 5.1.4), the filter assembly shall incorporate an automatic bypass feature to bypass system fluid automatically around the filter element in the event of excessive flow restriction through the filter element. The automatic bypass shall be set in accordance with Table 3 and shall have a capacity equal to or greater than that of a clean filter assembly.

6.1.2.4 *Filter Element Installation*—Positive means shall prevent any play or looseness of the filter element in service and prevent cocking or misalignment during installation.

6.1.2.5 *Filter Element Flow Direction*—The filter element flow direction shall be from the outside to the inside surface of the element.

TABLE 3 Filter Pressure Drop Requirements

NOTE 1—Percentages shown above shall read as percent of the operating pressure of the filter (see 3.1.23 and 5.1.10).

Filter Pressure Drop					
Maximum Allowable Clean Element (see 7.1.5)	ΔP Indicator Actuation (see 7.1.5)	Maximum Allowable Contaminated Element (see 7.1.5)	Filter Element Bypass (see S1.0)		
			Set	Full Flow	Reseat
2.5 %	4.75 to 5.25 %	6.25 %	7.25 to 8 %	8.25 to 9.25 %	6.25 to 7 %

Example:
Operating pressure: 1000 psi (6895 kPa)
Maximum allowable clean element pressure drop: 25 psi (172 kPa)
ΔP indicator actuation: 47.5 to 52.5 psi (327 to 346 kPa)
Maximum allowable contaminated element pressure drop: 62.5 psi (431 kPa)
Filter element bypass set pressure drop: 72.5 to 80 psi (500 to 552 kPa)
Filter element bypass full-flow pressure drop: 82.5 to 92.5 psi (569 to 638 kPa)
Filter element bypass reseat pressure drop: 62.5 to 70 psi (431 to 483 kPa)

6.1.2.6 *Cleanability*—Cleanable filter elements shall be cleanable and reusable by means of scrubbing and washing the outside surface with detergent and tap water and blowing through with compressed air not exceeding 30-psig (207-kPa gage pressure). Once cleaned, the element shall be capable of meeting the requirements for a new element. Cleanable filter elements shall not be adversely affected by immersion in water and shall be capable of meeting the above criteria for not less than five cleaning and reuse cycles.

6.1.2.7 *Differential Pressure Indicator*—When specified (see 5.1.5), the filter body shall incorporate a nonelectrical, "pop up" differential pressure indicator which senses the pressure drop across the element and actuates in accordance with Table 3. Once actuated, a red indicator button shall remain up until manually reset.

6.1.2.8 *O-Ring Locations*—O-rings in face-seal applications shall have the grooves located in the lower members to simplify assembly.

6.1.2.9 *Pressure Envelope*—The hydrostatic shell test pressures shall be 1.5 times the filter rated pressure at 100°F (38°C).

6.1.2.10 *Connections*—The inlet and outlet end connections of the filter shall be as specified in Table 1. Any exposed threads shall be protected by plastic caps for shipping.

6.1.2.11 *Port Configuration*—The filter body shall have in-line inlet and outlet end connections for installation into the piping system.

6.1.2.12 *Pressure Lines*—All pressure lines in the filter shall be internally ported.

6.1.2.13 *Accessibility*—The filter shall be fully and easily accessible for cleaning or repair without removal of the filter body from the line.

6.1.2.14 *Threads*—Threads shall be as specified in ASME B1.1. Where necessary, provisions shall be incorporated to prevent the accidental loosening of threaded parts. The design shall be such that standard wrenches can be used on all external bolting. Lock-wire shall not be used.

6.1.2.15 *Interchangeability*—The entire filter, including all associated piece parts, shall have part number identity and shall be replaceable from stock or the manufacturer on a nonselective and random basis. Parts having the same manufacturer's

part number shall be directly interchangeable with each other with respect to installation (physical) and performance (function). Physically interchangeable assemblies, components, and parts are those that are capable of being readily installed, removed, or replaced without alteration, misalignment, or damage to parts being installed or adjoining parts. Fabrication operations such as cutting, filing, drilling, reaming, hammering, bending, prying, or forcing shall not be required.

6.1.2.16 *Nonmetallic Element Interchangeability*—Nonmetallic elements, including but not limited to, cushions and O-rings, shall be treated as separately identified and readily replaceable parts.

6.1.2.17 *Pressure Gage Ports*—The filter shall be provided with threaded gage connection ports to permit attachment of pressure gages for sensing the inlet and outlet pressures. The gage connections shall be located to measure the pressure differential across the filter element accurately.

6.1.2.18 *Springs*—Any spring incorporated in the filter shall not be compressed solid during operation. Spring ends shall be squared and ground. Engagement or disengagement of parts against spring compression shall not be required.

6.1.3 *Maintainability*—The filter shall permit direct access for disassembly, repair, and reassembly of the filter element and all internal working parts and subassemblies when mounted for operation in the system. Maintenance shall require standard tools to the maximum extent possible. Any special tools required for maintenance shall be identified and shall be supplied as part of the filter.

6.1.4 *Reversibility*—The filter element, and all other parts in the filter, shall not be physically reversible unless they are also functionally reversible to preclude incorrect assembly.

6.1.5 *Adjustments*—There shall be no adjustments required in the filter during or after assembly other than the set points of a differential pressure indicator or an automatic bypass valve or both, where applicable.

6.1.6 *Reliability*—Except for cleaning or replacement of the filter element, periodic maintenance of the filter or any of its components shall not be required. There shall be no postassembly lubrication required.

7. Performance

7.1 Filters shall meet the performance requirements of 7.1.1-7.1.8.

7.1.1 *Contaminant Removal Rating*—The filter shall be capable of the levels of contaminant removal specified in the ordering information (see 4.5 and Section 5).

7.1.2 *Flow Capacity*—The flow capacity of the filter shall be as specified in 5.1.11 in standard cubic feet per minute (cubic metre per second) [at 60°F (16°C) and 14.7 psia (101 kPa absolute)]. The filter shall meet the specified maximum flow capacity, or any intermediate capacity, and shall operate while providing the specified filter contaminant removal rating. If an automatic bypass is specified (see 5.1.4), it shall also meet the flow capacity requirements of the filter.

7.1.3 *External Leakage*—Filter external leakage shall be bubble-tight at operating pressure conditions over a 3-min period.

7.1.4 *Filter Element Contaminant-Holding Capacity*—Solid particulate contaminant (dirt) holding capacity shall be as specified in Table 2.

7.1.5 *Pressure Drop*—The maximum allowable filter element clean and contaminated pressure drops shall be as specified in Table 3.

7.1.6 *Differential Pressure (ΔP) Indicator Actuation Pressure*—The pressure drop across the filter element at which the differential pressure indicator, where applicable, actuates shall be as specified in Table 3.

7.1.7 *Filter Element Bypass Set, Full-Flow, and Reseat Differential Pressures*—The set, full-flow, and reseat differential pressures of an automatic filter element bypass, where applicable, shall be as specified in Table 3.

7.1.8 *Media Migration*—There shall be no media migration.

8. Tests Required

8.1 Each filter shall pass the tests outlined in 8.1.1-8.1.4.

8.1.1 *Visual Examination*—The filter shall be examined visually to determine conformance with the ordering data and workmanship without disassembly.

8.1.2 *Hydrostatic Shell Test*—The filter shall be hydrostatically tested by applying pressure equal to 1.5 times the 100°F (38°C) rated pressure to the inlet and outlet ports, respectively, to check the structural integrity of the filter. The filter element may be removed for this test. Pressure shall be applied for a minimum of 3 min. Air or nitrogen gas may be used in lieu of water providing appropriate safety precautions are taken to minimize the risk associated with the use of a compressible gas. Thers shall be no external leakage, permanent distortion, or structural failure.

8.1.3 *External Leakage Test*—Air shall be applied at rated pressure to the filter. External leakage shall be checked using bubble fluid or by submerging the filter in water. There shall be no visible external leakage over a 3-min period.

8.1.4 *Bubble Point Test*—The filter element shall be tested to determine the initial bubble point. The bubble point test shall be performed in accordance with the procedure specified in ARP 901. To ensure the correct nominal contaminant removal rating and absolute contaminant removal rating, acceptance criterion shall have been previously established for the particular filter design being tested by an empirical correlation of the results of bubble point testing with actual particle retention testing as outlined in ARP 901.

9. Marking

9.1 *Identification Plate*—An identification plate of corrosion-resistant metal in accordance with Specification F 992; Types I, II, III, or IV shall be permanently attached to the filter and shall include the following information (some or all information may instead be stamped or etched directly on the filter body):

9.1.1 Manufacturer's name,

9.1.2 ASTM designation and year of issue,

9.1.3 Operating conditions (inlet pressure and flow capacity),

9.1.4 Manufacturer's model/part number,

9.1.5 Pressure rating,

9.1.6 Contamination removal rating (nominal/absolute in micrometre),

9.1.7 Replacement element part number,

9.1.8 Flow direction, if applicable.

10. Quality Assurance System

10.1 The manufacturer shall establish and maintain a quality assurance system that will ensure all the requirements of this specification are satisfied. This system shall also ensure that all filters will perform in a similar manner to those representative filters subjected to original testing.

10.2 A written description of the quality assurance system the manufacturer will use shall be available for review and acceptance by the inspection authority.

10.3 The purchaser reserves the right to witness the production tests and inspect the filters in the manufacturer's plant to the extent specified on the purchase order.

SUPPLEMENTARY REQUIREMENTS

One or more of the following supplementary requirements S1.0, S2.0, S3.0, or S4.0 shall be applied only when specified by the purchaser in the inquiry, contract, or order. Details of those supplementary requirements shall be agreed upon in writing by the manufacturer and purchaser. Supplementary requirements shall in no way negate any requirements of the specification itself.

S1. Supplemental Tests

S1.1 Supplemental tests shall be conducted at a facility satisfactory to the customer and shall consist of the examinations and tests selected from those specified in S1.2 through S1.11 and delineated in the ordering data. The tests may be conducted on representative filter sizes and pressure classes to qualify all sizes and pressure classes of filters, provided the filters are of the same type and design. Evidence of prior approval of these tests is acceptable.

S1.2 *Element Collapse Test*—Apply a pressure differential across the filter element equal to the pressure rating specified in Section 5 for 3 min. There shall be no structural damage to the filter element.

S1.3 *Cleanability Test*—The filter shall be subjected to sufficient contamination so that flow requirements cannot be met. It shall then be cleaned by the methods specified (see 6.1.2.6) to demonstrate cleanability. After cleaning, the element shall be capable of meeting the applicable flow and pressure drop criteria (see S1.5).

S1.4 *Flow Capacity/Clean Filter Element Pressure Drop Test*—Apply an inlet pressure equal to the maximum operating pressure of the filter (see 3.1.23 and 5.1.11). Flow shall be increased to the flow capacity of the filter. Pressure drop shall not exceed the allowable clean filter element pressure drop specified in Table 3. If the clean filter element pressure drop has been previously determined at a different inlet pressure, this test may be waived where calculations or previous testing are provided which verify an acceptable clean filter element pressure drop at the maximum operating pressure.

S1.5 *Differential Pressure Indicator Actuation Pressure Test*—Differential pressure across the filter element shall be increased until the differential pressure indicator actuates. The actuation pressure shall be as specified in Table 3. Once actuated, the red button shall remain in the up position until manually reset.

S1.6 *Automatic Bypass Valve Set Differential Pressure Test*—Differential pressure across the filter element shall be further increased until the automatic bypass valve opens. Differential pressure shall be further increased until the automatic bypass valve is fully open. Differential pressure shall then decreased until the automatic bypass valve reseats. The automatic bypass valve shall lift initially, then lift to pass the full-flow capacity, and reseat within the limits specified in Table 3. There shall be evidence of operational instability or damage.

S1.7 *Seat Tightness Test*—The differential pressure across the automatic bypass valve shall be increased to 95 % of its set pressure. The automatic bypass valve shall be bubble-tight (no visible evidence of leakage over a 3-min period using bubble fluid for detection or submerging a line from the outlet under water).

S1.8 *Shock Test*—The filter shall be subjected to and meet the high-impact shock tests for Grade A, Class I as specified in MIL-S-901 pressurized with water, air, or nitrogen to the maximum operating pressure. There shall be no structural damage to the filter. There shall be no degradation to the performance capability of the filters.

S1.9 *Vibration Test*—The filter shall be vibration tested in accordance with Type I of MIL-STD-167-1 pressurized with air or nitrogen to the maximum operating pressure. At frequencies up to and including 33 Hz (unless otherwise specified in the ordering information, Section 5), there shall be no resonance in the range of frequency tested. There shall be no structural damage or degradation to the performance capability of the filter.

S1.10 *Noise Test*—The filter shall be tested for airborne noise in accordance with MIL-STD-740-1. The noise (sound pressure level) shall not exceed 85 dBa observed at 1-m distance from the filter.

S1.11 *Posttest Examination*—The filter shall be disassembled and examined for any evidence of excessive wear, degradation, or impending damage or breakage.

S2. Technical Data Requirements

S2.1 *Drawings*—Assembly drawings or catalog sheets of the filter that clearly depict design shall be provided. The following shall also be included as part of, or in addition to, the drawing or catalog content:

S2.1.1 Bill of material listing specification, grade, condition, and any other data required to identify fully the properties

of the materials proposed. This shall include identifications, material and size designations, shore hardness, and any other data necessary to identify the parts fully.

S2.1.2 In cases in which standard commercial or military parts are or can be used, these shall be appropriately identified.

S2.1.3 Outline dimensions, disassembly space, location, and size of end connections and mounts.

S2.1.4 Estimated weight and center of gravity (vertical, longitudinal, and transverse).

S2.1.5 Recommended assembly torques or equivalent procedures for making up all joints and threaded assemblies.

S2.1.6 The following information shall be included: (1) pressure rating, (2) contaminant removal rating, (3) clean pressure drop at filter-rated flow capacity, (4) differential pressure indicator setting (Style I filters), and (5) automatic bypass valve setting (Composition A filters).

S2.2 *Technical Manuals*—Technical manuals shall provide a description, installation procedures, operation and maintenance instructions, and illustrated parts breakdown for the filter, organized as follows:

S2.2.1 *Chapter 1*—General information and safety precautions.

S2.2.2 *Chapter 2*—Operation.

S2.2.3 *Chapter 3*—Functional description.

S2.2.4 *Chapter 4*—Scheduled maintenance.

S2.2.5 *Chapter 5*—Troubleshooting.

S2.2.6 *Chapter 6*—Corrective maintenance.

S2.2.7 *Chapter 7*—Parts list.

S2.2.8 *Chapter 8*—Installation.

S2.3 In addition, the following shall be included as part of the technical manual contents:

S2.3.1 The assembly drawings for the filter, supplemented by additional illustrations where necessary to illustrate operation and maintenance adequately. These additional illustrations may consist of blowouts or partial or full sections and may eliminate extraneous lines and details to clarify the interaction of parts.

S2.3.2 Table listing wrench sizes and assembly torques (or other equivalent procedures) for making up all joints and threaded assemblies.

S2.3.3 Detailed disassembly and reassembly procedures. In addition to a section providing procedures for the complete disassembly and reassembly of the filter, maintenance and troubleshooting sections shall contain, or refer to, only the limited disassembly and reassembly required to accomplish each particular operation. This is intended to reduce the possibility of unnecessary disassembly and unnecessary disturbance of adjustments when performing specific or limited maintenance or troubleshooting operations.

S2.3.4 Adjustment procedures for the differential pressure indicator and the automatic bypass valve (where applicable).

S3. Quality Assurance

S3.1 *Scope of Work*—The written description of the quality assurance system shall include the scope and locations of the work to which the system is applicable.

S3.2 *Authority and Responsibility*—The authority and responsibility of those in charge of the quality assurance system shall be clearly established.

S3.3 *Organization*—An organizational chart showing the relationship between management and the engineering, purchasing, manufacturing, construction, inspection, and quality control groups is required. The purpose of this chart is to identify and associate the various organizational groups with the particular functions for which they are responsible. These requirements are not intended to encroach on the manufacturer's right to establish and, from time to time, to alter whatever form of organization the manufacturer considers appropriate for its work. Persons performing quality control functions shall have a sufficiently well-defined responsibility and the authority and the organized freedom to identify quality control problems and to initiate, recommend, and provide solutions.

S3.4 *Review of Quality Assurance System*—The manufacturer shall ensure and demonstrate the continuous effectiveness of the quality assurance system.

S3.5 *Drawings, Design Calculations, and Specification Control*—The manufacturer's quality assurance system shall include provisions to ensure that the latest applicable drawings, design calculations, specifications, and instructions, including all authorized changes, are used for manufacture, examination, inspection, and testing.

S3.6 *Purchase Control*—The manufacturer shall ensure that all purchased material and services conform to specified requirements and that all purchase orders give full details of the material and services ordered.

S3.7 *Material Control*—The manufacturer shall include a system for material control that ensures the material received is properly identified and that any required documentation is present, identified to the material, and verifies compliance to the specified requirements. The material control system shall ensure that only the intended material is used in manufacturer. The manufacturer shall maintain control of material during the manufacturing process by a system that identifies status of material throughout all stages of manufacture.

S3.8 *Manufacturing Control*—The manufacturer shall ensure that manufacturing operations are carried out under controlled conditions using documented work instructions. The manufacturer shall provide for inspection, where appropriate, for each operation that affects quality or shall arrange an appropriate monitoring operation.

S3.9 *Quality Control Plan*—The manufacturer's quality control plan shall describe the fabrication operations, including examinations and inspections.

S3.10 *Welding*—The quality control system shall include provisions for ensuring that welding conforms to specified requirements. Welders shall be qualified to the appropriate standards and the qualification records shall be made to the inspection authority if required.

S3.11 *Nondestructive Examination*—Provisions shall be made to use nondestructive examination, as necessary, to ensure that material and components comply with the specified requirements. Nondestructive examinations shall be authorized by their employer or qualified by a recognized national body or both, and their authorizations/qualification records shall be made available to the inspection authority if required.

S3.12 *Nonconforming Items*—The manufacturer shall establish procedures for controlling items not in conformance with the specified requirements.

S3.13 *Heat Treatment*—The manufacturer shall provide controls to ensure that all required heat treatments have been applied. Means should be provided by which heat treatment requirements can be verified.

S3.14 *Inspection Status*—The manufacturer shall maintain a system for identifying the inspection status of material during all stages of manufacture and shall be able to distinguish between inspected and non-inspected material.

S3.15 *Calibration of Measurement and Test Equipment*—The manufacturer shall provide, control, calibrate, and maintain inspection, measuring, and test equipment to be used in verifying conformance to the specified requirements. Such calibration shall be traceable to a national standard and calibration records shall be maintained.

S3.16 *Records Maintenance*—The manufacturer shall have a system for the maintenance of inspection records, radiographs, and manufacturer's data reports that describe the achievement of the required quality and the effective operation of the quality system.

S3.17 *Sample Forms*—The forms used in the quality control system and any detailed procedures for their use shall be available for review. The written description of the quality assurance system shall make reference to these forms.

S3.18 *Inspection Authority*—The manufacturer shall make available to the inspection authority at the manufacturer's plant a current copy of the written description of the quality assurance system. The manufacturer's quality assurance system shall provide for the inspection authority at the manufacturer's plant to have access to all drawings, calculations, specifications, procedures, process sheets, repair procedures, records, test results, and any other documents as necessary for the inspection authority to perform its duties in accordance with this supplementary requirement. The manufacturer may provide for such access by furnishing the inspection authority with originals or copies of such documents.

S4. Special Material, Design, and Performance Considerations

S4.1 *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 that 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 specified.

S4.2 Pipe threads shall not be used in the filter.

S4.3 Filter performance shall not be adversely affected by the following ambient conditions:

S4.3.1 *Temperature:* 40°F (4°C) to 120°F (49°C).

S4.3.2 *Moisture Content:* Exposure to atmosphere containing salt-laden moisture.

S4.4 *Gage Connections*—The threaded gauge connection (see 6.1.2.17) shall be ¼-in. (13.5-mm) size in accordance with MS 16142.

S4.5 General requirements for filters intended for the protection of air-reducing manifolds. Filters intended for the protection of air-reducing manifolds shall incorporate the following functional elements shown below:

S4.5.1 Particulate contaminant removal.

S4.5.2 Automatic bypass valve.

S4.5.3 Differential pressure indicator.

APPENDIX

(Nonmandatory Information)

X1. GUIDELINES FOR THE SELECTION AND INSTALLATION OF FILTERS

X1.1 *Scope*—This appendix provides general guidelines for the selection and installation of filters in air or nitrogen systems, and therefore, its use does not in any way relieve the user of his final responsibility in the selection and installation of filters.

X1.2 *Contamination Removal Rating (also commonly termed: "filter rating" or "micrometre rating")*—The finer the contamination removal rating specified, the more frequently it will be necessary to clean (or replace) the filter element. Therefore, only the actual desired level of filtration required by a particular application, and as shown by design analysis or operating experience, should be specified.

X1.3 *Filter Element Bypass*—A filter element bypass should be specified for any application where a partial or full blockage of fluid flow is not acceptable. Some or all of the fluid flow under such circumstances will be unfiltered. Where a constant supply of filtered fluid is necessary, a multiple-filter approach should be considered. An adjustable filter element bypass allows setting (within the limits of adjustment provided) the pressure drop at which bypass of flow initiates.

X1.4 *Permanent Versus Disposal Elements*—Permanent filter elements are designed to provide specified performance repeatedly up to a specified number of cleaning from a contaminated condition. Disposable filter elements require replacement with a new like element each time they reach a contaminated condition. Permanent elements can reduce inventory requirements. Disposable elements can reduce initial costs and maintenance requirements.

X1.5 *Contaminant-Holding Capacity*—To a certain extent, contaminant-holding capacity is proportional to the flow

capacity-pressure drop capabilities of a filter element. Different filter mediums, however, hold contaminants in different ways, giving different contaminant-holding capacities for any given initial (clean) flow capacity-pressure drop capability, and therefore, it is necessary to specify contaminant-holding capacity as a separate parameter.

X1.6 *Differential Pressure Indicator*—A filter element differential pressure indicator warns of a high contamination level before it reaches the point at which the flow of filtered fluid is no longer adequate to meet system requirements or a bypass will begin to open. An adjustable filter element differential pressure indicator allows setting (within the limits of adjustment provided) the pressure drop at which the indicator actuates.