METRIC
MIL-PRF-62309F
12 JANUARY 2004
SUPERSEDING
MIL-DTL-62309E
29 April 1999

PERFORMANCE SPECIFICATION

FILTER ELEMENT, AIR

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification establishes the performance, inspection, and acceptance requirements for an air filter element used in the air induction system of the M60 series tank (see 6.1).

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 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 requirement 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 (see 6.2).

Comments, suggestions, or questions on this document should be addressed to Tank-automotive and Armaments Command, 6501 E. 11 Mile Road, Warren, MI 48397-5000 or emailed to standardization@tacom.army.mil Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at www.dodssp.daps.mil

AMSC N/A FSC 2940

SPECIFICATIONS

FEDERAL

P-D-245 - Detergent, General Purpose, Laundry and Hand Dishwashing (Granular).

STANDARDS

DEPARTMENT OF DEFENSE

MIL-STD-810 - Environmental Engineering Considerations and Laboratory Tests.

(Copies of these documents are available from the Document Automation and Production Service, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094 or website http://assist.daps.dla.mil)

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

DRAWINGS

ARMY

10959032 - Efficiency and Dust Capacity Cap Tester.
10959082 - Master Box Assembly Gage.
10959091 - Master Box Assembly Gage Calibration and Operating Procedures.
11669740 - Air Filter Element.
12251922 - Air Cleaner Assembly - Steel.

(Copies of these drawings are available from the U.S. Army Tank-automotive and Armaments Command, AMSRD-TAR-E/ASI, 6501 E. 11 Mile Road, Warren, MI 48397-5000.)

2.2.3 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of 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 issue of the documents cited in the solicitation (see 6.2).

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI/ASQC Z1.4 - Sampling Procedures and Tables for Inspection by Attributes (DoD Adopted).

(Copies of these documents are available from the American National Standards Institute, 11 West 42nd Street, New York, NY 10036 or website: www.ansi.org)

ASTM INTERNATIONAL

ASTM D689 - Internal Tearing Resistance of Paper, Standard Test Method (DoD Adopted).
ASTM D774 - Bursting Strength of Paper, Standard Test Method (DoD Adopted).
ASTM D828 - Tensile Properties of Paper and Paperboard Using Constant-Rate-of-Elongation Apparatus, Standard Test Method (DoD Adopted).
ASTM D1149 - Rubber Deterioration - Surface Ozone Cracking in a Chamber, Standard Test Method (DoD Adopted).

(Copies of these documents are available from the ASTM International, PO Box C700, 100 Barr Harbor Drive, West Conshochocken, PA 19428-2959 or website: www.astm.org)

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 5011 - Inlet Air Cleaning Equipment for Internal Combustion Engines and Compressors, Performance Testing.

(Copies of these documents are available from the American National Standards Institute (ANSI), 11 West 42nd Street, New York, NY 10036 or website: www.ansi.org)

SOCIETY OF AUTOMOTIVE ENGINEERS, INC. (SAE)

SAE AS478 - Identification Marking Methods.

(Copies of these documents are available from the Society of Automotive Engineers Inc., 400 Commonwealth Drive, Warrendale, PA 15096 or website: www.sae.org)

2.4 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, 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 First article. When specified (see 6.2), a sample shall be subjected to first article inspection in accordance with 4.1.1 (see 6.3). First article inspection samples, properly marked with identifying information shall be representative of the unit to be furnished to the Government. All subsequent air filter elements delivered to the Government shall conform to these samples in all of their pertinent physical and performance attributes.

3.2 Design, materials and manufacturing processes. Unless otherwise specified, the design, materials and manufacturing process selection is the prerogative of the contractor as long as all articles submitted to the government fully meet the operating, interface, support and ownership, and environment requirements specified.

3.2.1 Materials. Materials shall be uniform and free from imperfections or defects which affect their serviceability. All metallic parts shall be made from corrosion resistant materials or treated/plated with corrosion-resistant materials. All non-metallic materials shall be inherently fungistatic or treated to resist fungus growth. Asbestos and cadmium materials shall not be used in any form in any part of the filter. No item, part or assembly shall contain radioactive materials in which the specific activity is greater than 0.002 microcuries per gram or activity per item equals or exceeds 0.01 microcuries.

3.2.2 Recycled, recovered, or environmentally preferable materials. Recycled, recovered, or environmentally preferable materials shall 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 (see 6.5.3).

3.2.3 Design and construction. The air filter element, referred to herein as the element, shall be of the dry type for use as the second stage in a heavy duty two-stage air cleaner with a 25 485 liters per minute (L/min) [900 cubic foot per minute (ft^3/min)] rating, and shall meet the interfaces in accordance with Drawing 11669740 (see 4.3.2).

3.2.3.1 Seal. The seal shall be properly seated and bonded in the seal retaining channel. The seal base surface shall be free of any release agent. No separation shall exist between the seal body and the channel, and between channel and end cover. There shall be no excessive bonding material buildup between the seal and the top edge of the channel walls (see 4.3.2.1).

3.2.3.1.1 Seal compression. The seal shall be capable of being compressed to the stops 6.35 millimeters (mm) [0.25 inch (in.)] over a 152.4 mm (6 in.) section with a force of 289 ± 89 Newton (N) [65 ± 20 pound-force (lbf)] (see 4.3.2.1.1).

3.2.3.1.2 Seal adhesion. The seal shall be capable of withstanding a maximum pull of 876 Newtons per meter (N/m) [5 pound-force per inch (lbf/in.)] of length perpendicular to the surface without any separation (see 4.3.2.1.2).

3.2.3.2 Media. The filtering element media shall be securely bonded to the element end-caps. The bonding shall be free of porosity, voids, and pin-hole leak paths (see 4.3.2.2).

3.2.3.2.1 Internal tear strength. The filtering media shall be capable of withstanding 40 grams (g) (1.4 ounces (oz)) minimum internal tear resistance without evidence of physical damage (see 4.3.2.2.1).

3.2.3.2.2 Bursting strength. The filtering media shall withstand differential pressure of 15 pounds per square inch gage (psig) (103 kilopascals gage (kPag) minimum without evidence of tearing (see 4.3.2.2.2 and 6.5.1).

3.2.3.2.3 Tensile breaking strength. The filtering media shall withstand 3.6 kilograms (kg) (8 pounds (lb)) minimum in tensile load without evidence of damage (see 4.3.2.2.3).

3.2.3.3 Pin loading.

3.2.3.3.1 End loading. The element shall be capable of withstanding a compressive end load without damage, when a 1334 ± 13 N (300 ± 3 lbf) static load is applied uniformly over a 127 mm (5 in.) diameter circular area (see 4.3.2.3.1).

3.2.3.3.2 Maximum loading. The element shall be capable of withstanding a compressive, (end to end) load without damage when a 2669 ± 133 N (600 ± 30 lbf) static load is simultaneously applied to each clamping pin, totaling 5338 ± 267 N (1200 ± 60 lbf) (see .3.2.3.2).

3.2.3.3.3 Nominal loading. Each of the two spring-loaded pins shall support a preload of 623 ± 133 N (140 ± 30 lbf) at 138.2 mm (5.44 in.) from the rear of the pin to the element stops. Compression of the seal, and positioning of the pins 131.1 mm (5.16 in.) from the rear of the pin to the element stops, shall cause the load on each pin to be 1246 ± 267 N (280 ± 60 lbf) (see 4.3.2.3.3).

3.2.3.4 Element protection. Protective means shall be provided on the inside and outside of the element, to securely attached the frame and bond to the element media. In addition, structural members shall be securely attached to the inside frame of the element. The resulting assembly shall ensure that any flexure of the internal elements are minimized and do not exceed 1/32 in. (see 4.3.2.4).

3.3 Operating requirements. Each filter element shall provide the following functional, operational and performance capabilities.

3.3.1 Initial air flow restriction. The initial air-flow restriction of the element shall not exceed 2.24 kPa (9 in. of water) (see 4.3.3.1).

3.3.2 Dust capacity. After 80 hours of operation with stepped air flow in accordance with Table I and fed ISO 5011 coarse dust using the ISO 5011 Figure B.2 dust injector, restriction shall be not more than 20 inches water gage (wg). There shall be no dust tracking on the downstream side of the element (see 4.3.3.2).

TABLE I. Stepped air flow.

Time (minutes)	Rated flow (percent)	Air-flow (L/min)	(ft^3/min)
10	100	25485	(900)
10	80	20388	(720)
10	60	15291	(540)
10	40	10194	(360)
10	20	5097	(180)
10	60	15291	(540)

3.3.3 Dust filtration efficiency. The assembly dust filtration efficiency shall be not less than 99.7% after 60 minutes of operation when fed with fine grade dust in accordance with ISO 5011 (see 4.3.3.3).

3.4 Interface requirements.

3.4.1 Filter element interface. The filter element interface requirements shall conform to interfaces on Drawing 11669740 to ensure proper interface with the air cleaner assembly (see 4.3.4.1).

3.4.2 Master box assembly gage interface. The master box assembly interface shall conform to the interfaces on Drawing 10959082 (referred to herein as the assembly) that contains filter element interfaces to Drawing 11669740 (see 4.3.4.2).

3.4.3 Weight. The weight of the element shall not exceed 15.4 kg (34 lb) (see 4.3.4.3).

3.4.4 Metals. The use of dissimilar metals in intimate metal to metal contact shall be avoided (see 4.3.4.4).

3.5 Support and ownership requirements. The filter element shall meet the following logistic requirements.

3.5.1 Air cleaning durability. When operated at a dust feed rate of 3.53 ± 0.7 gram per cubic meter (g/m^3) (0.1 ± 0.02 g/ft^3) of air, and after reaching load capacity (see 6.5.2) and subsequently air cleaned three times, the time for the assembly to reach load capacity a fourth time, at a rate of 0.025 g/ft^3 shall not be decreased by more than 45%. Dust tracking shall not develop on the down-stream side of the filter element during these cycles (see 4.3.5.1).

3.5.2 Washing durability. The assembly shall meet the requirements of 3.3.3 after the filter element reaches load capacity (see 6.5.2), and then washed, cleaned and dried (see 4.3.5.2).

3.5.2.1 Post service air flow restriction. After one operation to load capacity (see 6.5.2) in accordance with 3.4.2, followed by a cleaning in accordance with 4.3.5.2.1, the assembly air-flow restriction shall not have increased by more than 0.25 kPa (1 in. of water) above that measured in 3.4.1.

3.5.3 Marking. Identification and marking shall be permanent in accordance with SAE AS478, and shall include as a minimum, the manufacturer's identification code (CAGE), contract number, part number, maximum rated air-flow, and month and year of manufacture (see 4.3.5.3 and 6.2).

3.5.4 Workmanship. The element shall be free of cracked end caps, visually apparent surfaces out of alignment or out of contour, and missing portions of material. Sheet metal parts shall be free of blisters, tears, and excessive thinning at drawn sections. The element seal shall be properly seated inside the end cap channel with no separation between the seal and channel. There shall be no excessive adhesive adjacent to the bonding surface. The interior shall contain no foreign particles. The media shall contain no tears, rips, or holes (see 4.3.5.4).

3.6 Operating environment requirements. The filter element shall operate under the following environmental conditions without degradation of performance (see 3.3.3).

3.6.1 Dust filtration. Dust filtration requirements (see 3.3.1 through 3.3.3, 3.5.1 through 3.5.2.1 and 3.6.4 through 3.6.6) shall be met by Master Box Assembly Gage Drawing 10959082 containing filter element interfaces of Drawing 11669740. Except as otherwise specified herein, requirements shall be met with a clean, new element and under the following standard conditions (see 4.3.6.1 and 6.2):

a. Temperature: 23 ± 10 degrees Celsius (°C) [73 ± 18 degrees Fahrenheit (°F)].
b. Relative humidity: 50 ± 20 percent (%).
c. Density of air: 1.169 kilogram per cubic meter (kg/m^3)
   [0.073 pounds per cubic foot (lb/ft^3)]
   at 27°C (80°F) and 101 kPa [29.92 in. of mercury (Hg)].
d. Dust: Chemical analysis of the dust shall be as shown in Table II. Particle size distribution shall be in accordance with ISO 5011.
e. Air flow: 25 485 L/min (900 ft^3/min).

f. Dust feed rate: 0.883 ± 0.177 g/m^3 [0.025 ± 0.005 gram per cubic foot (g/ft^3)] of air.

TABLE II. Chemical analysis of dust.

Substance	Percent by weight
Silicon dioxide (SiO_2)	67 to 69
Ferric oxide (Fe_2O_3)	3 to 5
Aluminum oxide ($A1_2O_3$)	15 to 17
Calcium oxide (CaO)	2 to 4
Magnesium oxide (MgO)	0.5 to 1.5
Total alkalis as sodium oxide (Na_2O)	3 to 5
Ignition loss	2 to 3

3.6.2 Seal ozone resistance. The seal shall show no evidence of cracks or breaks due to ozone exposure (see 4.3.6.2).

3.6.3 Flame resistance. The filtering media shall not continue to burn or smolder directly after removal of an applied flame (see 4.3.6.3).

3.6.4 Low temperature. The element shall withstand exposure to a low temperature of -54°C (-65°F). The seal compression set shall not exceed 5% of its original height after subsequent stabilization at room ambient temperature (see 4.3.6.4).

3.6.5 High temperature. The element shall withstand exposure to a high temperature of 71°C (160°F). The seal compression set shall not exceed 25% of its original height after subsequent stabilization at room ambient temperature (see 4.3.6.5).

3.6.6 Vibration. The element shall be capable of withstanding the vibration at an amplitude of 0.9 gravity units and frequency rate from 5 to 500 to 5 hertz (Hz) in each of the three mutually perpendicular axes (see 4.3.6.6).

4. VERIFICATION

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

a. First article inspection (see 4.1.1).
b. Conformance inspection (see 4.1.2).
    1. Examination (see 4.1.2.2).
    2. Acceptance tests (see 4.1.2.3).
    3. Control tests (see 4.1.2.4).

4.1.1 First article inspection. First article inspection shall be performed on the initial production ready production-representative units of an order up to 5 units, or whenever else the contract specifies when first article sample is required (see 3.1). This inspection shall include those first article inspections listed in Table III. Any changes or deviation of the production units from the first article sample shall be subject to the approval of the Contracting Officer.

4.1.1.1 First article inspection failure. Test item deficiencies during, or as a result of the first article test, shall be cause for rejection of the items until evidence has been provided by the contractor that corrective action has been taken to eliminate the deficiency. Any deficiency found during, or as a result of the first article test, shall be prima facie evidence that all items already produced prior to completion of the first article test are similarly deficient unless evidence satisfactory to the Contracting Officer is furnished by the contractor that they are not similarly deficient. Such deficiencies on all items shall be corrected by the contractor at no cost to the Government. The Government shall not final accept products until first article testing is completed to the satisfaction of the Government.

4.1.2 Conformance inspection. Conformance inspection shall include the conformance examinations and tests from Table III as defined in the contract.

4.1.2.1 Conformance tests failure. Failure of any air filter assembly to pass any of the specified inspections shall be cause for the Government to refuse acceptance of the production quantity represented until action taken by the contractor to correct defects and prevent recurrence has been approved by the Government.

4.1.2.2 Sampling.

4.1.2.2.1 Lot formation. A lot shall consist of all air filter elements of one type, from an identifiable production period, from one manufacturer, submitted at one time for conformance inspection.

4.1.2.2.2 Conformance examination. Samples for conformance examination shall be selected in accordance with general inspection level II of ANSI/ASQC Z1.4.

4.1.2.3. Acceptance tests (100 percent). Each sample air filter assembly shall be subjected to the acceptance tests specified in Table III. Sample air filter assemblies shall not be delivered as part of the order after testing.

4.1.2.4 Control tests. Control tests shall be conducted on two air filter assemblies from each 100 units consecutively produced, except that not more than one test shall be performed in a three month period, nor less than one test in a six month period. The air filter assemblies shall be numbered and subjected to the control tests specified in Table III.

4.1.2.5 Defects. Conformance to 3.2 through 3.2.2, 3.4.1, 3.4.2, 3.5.3, 3.5.4 and 5.1 shall be determined by examination for the defects listed in Table IV. Examination shall be visual, tactile, or by measurement with standard inspection equipment.

TABLE III. Verification methods.

Title	Requirement	Inspection	First article					Conformance inspection		
			1	2	3	4	5	Acceptance tests (100%)	Control tests 1	Control tests 2
Materials	3.2 thru 3.2.2		X	X	X	X	X	X		
Design and construction	3.2.3	4.3.2	X	X	X	X	X	X		
Defects (see Table IV)			X	X	X	X	X	X		
Seal	3.2.3.1	4.3.2.1	X	X	X	X	X			
Seal compression	3.2.3.1.1	4.3.2.1.1				X	X			
Seal adhesion	3.2.3.1.2	4.3.2.1.2				X	X	X		
Media	3.2.3.2	4.3.2.2	X	X	X	X	X			
Internal tear strength	3.2.3.2.1	4.3.2.2.1	X	X				X		
Bursting strength	3.2.3.2.2	4.3.2.2.2	X	X				X		
Tensile breaking strength	3.2.3.2.3	4.3.2.2.3	X	X				X		
Pin loading:	3.2.3.3	4.3.2.3						X		
End loading	3.2.3.3.1	4.3.2.3.1	X	X	X	X	X			
Maximum loading	3.2.3.3.2	4.3.2.3.2	X	X	X	X	X			
Nominal loading	3.2.3.3.3	4.3.2.3.3	X	X	X	X	X			
Element protection	3.2.3.4	4.3.2.4	X	X	X	X	X		1/	
Operating requirements	3.3	4.3.3								
Initial airflow restriction	3.3.1	4.3.3.1	X	X	X	X	X		X	X
Dust capacity	3.3.2	4.3.3.2	X	X						X
Dust efficiency	3.3.3	4.3.3.3		X		X	X		X	
Interface requirements	3.4	4.3.4								
Filter element	3.4.1	4.3.4.1	X							
Master box assembly	3.4.2	4.3.4.2	X							
Weight	3.4.3	4.3.4.3	X	X	X	X	X			
Metals	3.4.4	4.3.4.4	X							

TABLE III. Verification methods - Continued.

Title	Requirement	Inspection	First article					Conformance inspection		
			1	2	3	4	5	Acceptance tests (100%)	Control tests 1	2
Ownership & support requirements	3.5	4.3.5								
Air cleaning durability	3.5.1	4.3.5.1			X					
Washing durability	3.5.2	4.3.5.2	X							
Post service air-flow restriction	3.5.2.1	4.3.5.2.1			X					
Marking	3.5.3	4.3.5.3	X							
Workmanship	3.5.4	4.3.5.4	X							
Operating environment requirement	3.6	4.3.6.								
Dust filtration	3.6.1	4.3.6.1				X	X			
Seal ozone resistance	3.6.2	4.3.6.2		X						
Flame resistance	3.6.3	4.3.6.3			X				1/	
Low temperature	3.6.4	4.3.6.4				X	X			
High temperature	3.6.5	4.3.6.5				X	X			
Vibration	3.6.6	4.3.6.6				X	X			

1/ Perform flame resistance test after completing post service airflow restriction test.

TABLE IV. Classification of defects.

Category	Defect	Method of examination
Major:		
101	Incorrect or faulty materials (see 3.2 thru 3.2.2).	Visual
102	Dimensions affecting interchangeability, not within tolerance (see 3.4.1 and 3.4.2).	Visual and gage
103	Incorrect or illegible marking (see 3.5.3).	Visual
Minor:		
201	Dimensions not affecting interchangeability, not within tolerance (see 3.4.1 and 3.4.2).	Visual and gage
202	Poor workmanship (see 3.5.4).	Visual
203	Incorrect packaging (see 5.1).	Visual

4.2 Order of inspection. Perform environmental tests first, followed by the remaining verification in any order.

4.2.1 Inspection equipment. Unless otherwise specified in the contract (see 6.2), the supplier is responsible for the provision, maintenance and accuracy of all inspection equipment necessary to assure that supplies and services conform to contract requirements. The following test equipment, or equivalent shall be used in the performance of the inspections and tests specified herein:

a. Elmendorf tear resistance testing equipment.
b. Static load test set up equipment (see Figure 1).
c. Dust capacity tester (see Figure 2 or equivalent).
d. Mullen burst tester.
e. Tensile test machine.

4.2.2 Inspection conditions. Unless otherwise specified (see 6.2), all inspections shall be performed in accordance with the test conditions specified herein.

4.3 Verification methods. The types of verification methods included in this section are visual inspection, measurement, sample tests, full scale demonstration tests, simulation, modeling, engineering evaluation, component properties analysis, and similarity to previous-approved or previously-qualified designs.

4.3.1 Verification alternatives. The manufacturer may propose alternative test methods, techniques, or equipment, including the application of statistical process control, tool control, or cost-effective sampling procedures to verify performance. See the contract for alternatives that replace verifications required by this specification.

4.3.2 Design and construction verification.

4.3.2.1 Seal. To determine conformance to 3.2.3.1, the seal shall be examined for proper seating and bonding to the retaining channel. The retaining channel shall also be checked for proper sealing to the end cover.

4.3.2.1.1 Seal compression. To determine conformance to 3.2.3.1.1 the element shall be immobilized and force shall be applied over a 152.4 mm (6 in.) section until the seal is depressed to the stops or 56% of its free height. The force required shall be measured and verified that it is between 200 and 378 N (45 and 85 lbf).

4.3.2.1.2 Seal adhesion. To determine conformance to 3.2.3.1.2, the following test procedure shall be performed:

a. Make a transverse cut through the seal to the end cap with a sharp instrument.
b. Attach a 25.4 mm (1 in.) clamp to one side of the cut seal, and measure the perpendicular force required to pull the seal from the end cap.
c. Verify that the seal does not detach itself from the end cap with a pull force of 876 N/m (5 lbf/in.) of length perpendicular to the surface.

4.3.2.2 Media. To determine conformance to 3.2.3.2, element media bonding areas shall be examined for secure bonding and the absence of porosity, voids, and leak paths.

4.3.2.2.1 Internal tear strength. Filter media samples shall be tested for conformance to 3.2.3.2.1 by verifying that no tearing is evident at a minimum of 40 grams using procedure ASTM D689.

4.3.2.2.2 Burst strength. Filter media samples shall be tested for conformance to 3.2.3.2.2 by verifying that no tearing is evident at a minimum of 15 psig using procedure ASTM D774.

4.3.2.2.3 Tensile breaking strength. Filter media samples shall be tested for conformance to 3.2.3.2.3 by verifying that no physical damage is evident at a minimum of 8 pounds using procedure ASTM D828. The following formula shall be used to verify tensile strength:

$$\text{Tensile strength (kPa) [lbf/in.}^2\text{]} = \frac{\text{Breaking force (kg/cm) [lbf/in.]}}{\text{Thickness (cm) [in.]}}$$

4.3.2.3 Pin loading.

4.3.2.3.1 End loading. To determine conformance to 3.2.3.3.1, the element shall be placed on its stops in a device capable of measuring 1335 ± 13 N (300 ± 3 lbf) load equally distributed over a 127 mm (5 in.) diameter circular area, and applied to the element as shown in Figure 1. The element shall be subjected to three successive non-overlapping static loads of 1335 ± 13 N (300 ± 3 lbf). It shall be verified that no damage has resulted to the element.

4.3.2.3.2 Maximum loading. To determine conformance to 3.2.3.3.2, the element shall be placed in a device capable of measuring two 2669 ± 133 N (600 ± 30 lbf) loads simultaneously applied to the element clamping pins as shown in Figure 1. The element shall be subjected to a static load of 2669 N (600 lbf) simultaneously applied to each clamping pin (total 5338 ± 267 N) (total 1200 ± 60 lbf), until the seal is compressed to the stop. It shall be verified that no damage has resulted to the element.

4.3.2.3.3 Nominal loading. To determine conformance to 3.2.3.3.3, the element shall be positioned as in Figure 1, and the following shall be performed with a force applied equally to each pin:

a. Apply force until a point on the rear of the pin reaches a position of 138.2 ± 1.5 mm (5.44 ± 0.06 in.) from the element stops. Verify that it is between 489 and 756 N (110 and 170 lbf).
b. Apply additional force, until the point on the rear of the pin reaches a position of 131.1 ± 1.5 mm (5.16 ± 0.06 in.) from the stops. Verify that it is between 979 and 1512 N (220 and 340 lbf).
c. With a feeler gage, verify that the seal is seated at all points about the perimeter of the seal.

4.3.2.4 Element protection. To determine conformance to 3.2.3.4, examine the element assembly as specified for secure attachment to the frame and bonding to the media. Also, that flexure of the element assembly and its internal parts are not exceeded as specified in 3.2.3.4.

4.3.3 Operating requirements verification.

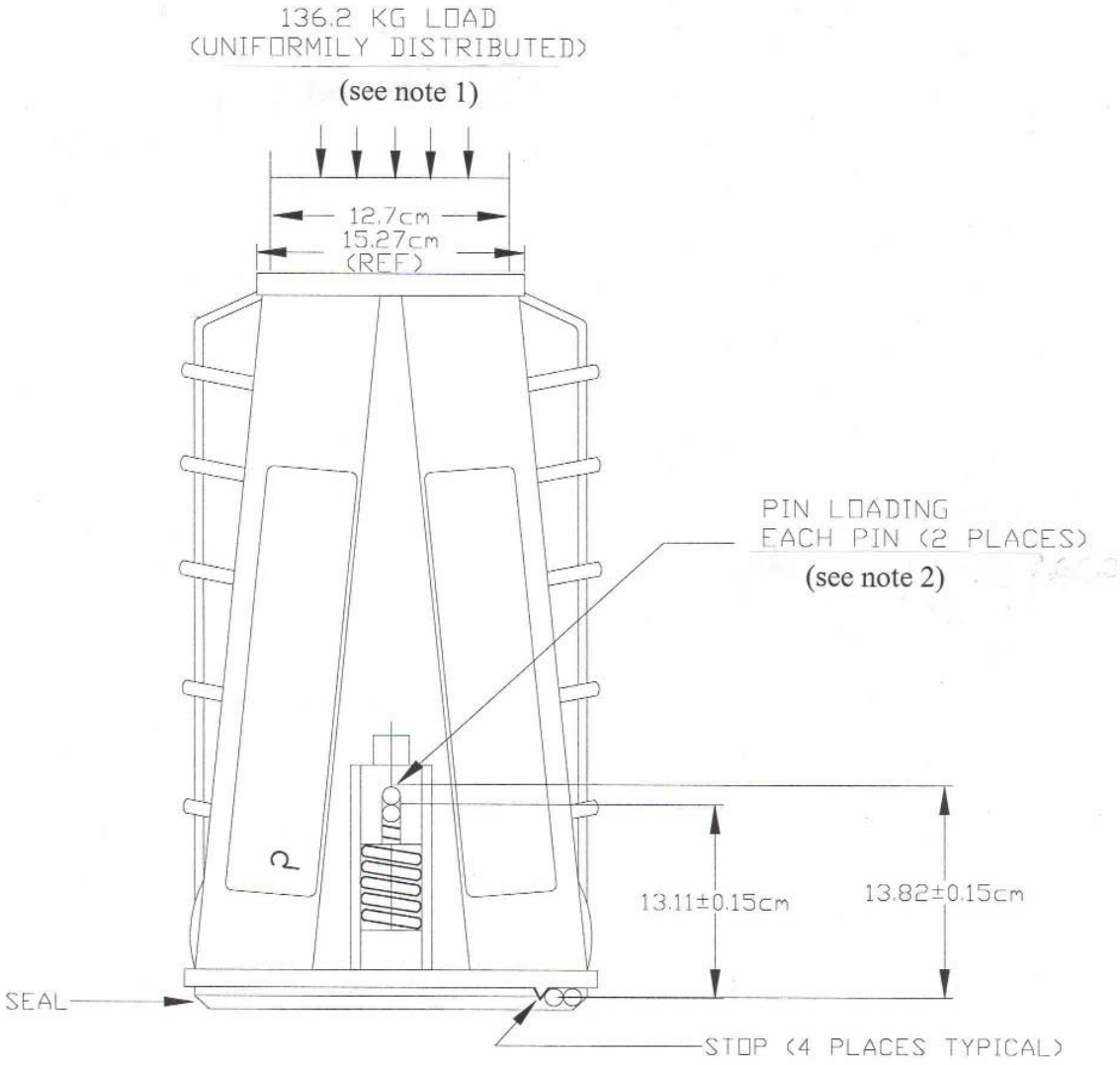
4.3.3.1 Initial airflow restriction. To determine conformance to 3.3.1, the assembly shall be subjected to a dust free flow of 25 485 L/min (900 ft^3/min) through the assembly. The restriction to flow shall be measured and shall not exceed 2.24 kPa (9 in.) of water.

4.3.3.2 Dust capacity To determine conformance to 3.3.2, an element shall be installed in the test setup of 4.3.6.1a, and one hour cycles with stepped flow rates shall be completed as specified in Table I. The restrictions to flow pressure drop through the assembly and absolute filter shall be measured each time the flow is adjusted to 25 485 L/min (900 ft^3/min). The test shall be conducted, until the assembly air flow restriction at 25 485 L/min reaches 20 in. of water or 80 hours, whichever comes first (see 3.6.1). At the end of the test, inspect the clean side of the element and test housing assembly. Any visual signs of dust tracking shall be cause for rejection.

4.3.3.3 Dust efficiency. To determine conformance to 3.3.3, the element shall be mounted in the test setup of 4.3.6.1a with an absolute filter (see 4.3.3.3.1) at the output end of the assembly. Dust shall be placed in a dust feeder, and shall be fed into the input side of the assembly for 60 minutes with an airflow of 25 485 L/min (900 ft^3/min). Restriction at the start of the test, and at 10-minute intervals throughout the test shall be determined. The absolute filter shall be removed from the test setup taking care not to disturb the entrapped dust, redried, and reweighed. Dust and absolute filter weighing shall be accurate to 0.01 gram inch pound equivalent (0.0004 oz) whenever possible, but never less than 0.1 g. The efficiency of the assembly shall be verified using the following formula:

$$\text{Assembly Efficiency (\%)} = \frac{[W_1 - (W_2 - W_3)]}{W_1} \times 100$$

Where: W_1 = Weight of dust fed into the assembly.
W_2 = Weight of absolute filter and its entrapped dust.
W_3 = Weight of absolute filter before test.



NOTES: 1. Reference paragraph 4.3.2.3.1.
2. Reference paragraph 4.3.2.3.2 and 4.3.2.3.3.

FIGURE 1. Static load test setup (filter element 11669740).

4.3.3.3.1 Preparation of the absolute filter. An absolute filter in accordance with ISO 5011 shall be placed in an air oven and dried for 6 hours at a temperature of 93 to 116°C (200 to 240°F), prior to insertion in the test setup. This drying time may be reduced, and the absolute filter considered as completely dry, if there is no change in weight of the absolute filter over two consecutive 10-minute intervals.

4.3.4 Interface requirements verification.

4.3.4.1 Filter element interface. To determine conformance to 3.4.1, verify that the filter element interface meets the interfaces of Drawing 11669740 for mating with Drawing 10959082.

4.3.4.2 Master box assembly gage interface. To determine conformance to 3.4.2, verify that the master box assembly gage interface meets the interfaces of Drawing 10959082 for mating with Drawing 11669740.

4.3.4.3 Weight. To determine conformance to 3.4.3, the element shall be weighed to verify that it does not exceed 15.4 kg (34 lb).

4.3.4.4 Metals. To determine conformance to 3.4.4, verification shall be shown that the use of dissimilar metals in intimate metal to metal contact were avoided where possible (see 4.3.4.4).

4.3.5 Ownership and support requirements verification.

4.3.5.1 Air cleaning durability. To determine conformance to 3.5.1 the following procedure shall be performed: Install the filter element in the test setup of 4.3.6.1a, and load it at the dust feed rate of 3.53 ± 0.7 g/m^3 (0.1 ± 0.02 g/ft^3) until load capacity (see 6.5.2) is reached, and record the time. Prior to removal of the filter element from the air cleaner, carefully observe the clean side of the filter element for visual signs of dust tracking. Visual observation will be made through the air cleaner outlet. Any visual signs of dust tracking on the clean side of the filter media or seal shall be cause for rejection. Air clean the filter element with clean, dry, compressed air as specified in 4.3.5.2.1, until there is no visible evidence of dust being removed. Repeat the above procedure three times. The filter dust leading time shall not be decreased by more than 45% after third cleaning.

4.3.5.2 Washing durability. To determine conformance to 3.5.2, the dust-loaded element shall be immersed and agitated for six hours in a solution of warm water, 27 to 43°C (80 to 110°F) and detergent conforming to P-D-245, after completing the dust capacity test of 4.3.3.2. The element shall then be removed from the solution and flushed with cool water 2 to 27°C (35 to 80°F) at low pressure from inside to outside for three minutes, or until all solution and dirt are removed. The rinse water shall be flowing clean. The excess water shall be

allowed to drain from the element for one hour. The element shall then be dried by one of the following methods:

a. Place the element in a circulating air oven at 102 to 113°C (215 to 235°F) and dry it for 24 hours, or until the element is dry. The element shall be returned to the cleaned assembly and air shall be drawn through the assembly with a turbine vacuum source to ensure element drying.
b. Install the filter element in an air cleaner housing attached to an air source and draw air through the filter element until dry.

The element shall then be subjected to the efficiency-test of 4.3.3.3 and shall conform to 3.3.3.

4.3.5.2.1 Post service airflow restriction. To determine conformance to 3.5.2.1, after the dust capacity test to 4.3.6.2, the element shall be removed and cleaned of dust by using clean, dry, compressed air with 689 (+0, -69) kPa [100 (+0, -10) lbf/in.^{2}] line pressure, and air nozzle inner dimension of at least 3.175 mm (0.125 in.). The air nozzle shall be inserted into the element, using a back and forth motion along the length of each serration, and a direct flow into each pocket from inside out. After the element is thoroughly air cleaned, it shall be reassembled in the assembly and tested for airflow restriction. The assembly shall not exceed its previously measured restriction by more than 0.25 kPa (1 in.) of water.

4.3.5.3 Marking. Verify that the identification and marking are in accordance with 3.5.3.

4.3.5.4 Workmanship. Verify that the workmanship is in accordance with 3.5.4.

4.3.6 Operating environment requirements verification.

4.3.6.1 Dust filtration. Except as otherwise specified herein, air filtration performance tests shall be performed on the element installed in Master Box Assembly Gage Drawing 10959082; this installation is an instrumented functional equivalent to Assembly Drawing 12251922. Except as otherwise specified herein, test conditions and procedures shall be in accordance with 3.6.1 and the following:

a. The test set-up for all tests requiring airflow shall be conducted on an Efficiency and Dust Capacity Tester Drawing 10959032 (see Figure 2), or functional equivalent, modified to incorporate the ISO 5011 Figure B.2, dust injector. If a functional equivalent test setup is utilized, it shall be approved by the Procuring Agency.
b. Dust feed rates shall be averaged over ten minute intervals. Measured air restriction values shall be corrected to the specified air density to an accuracy of 2.54 mm (0.1 in.) of water.

c. Actual air-flow values used in tests shall be corrected to standard conditions (see 3.6.1c) and shall be within plus or minus two % of specified values.
d. The assembly shall be mounted in its normal operating attitude as shown in Figure 2, and shall be electrically grounded.
e. The scavenge air flow shall be as specified on Drawing 10959091.
f. Air shall be drawn through the assembly with a turbine vacuum source to ensure filter element dryness before starting tests.

4.3.6.2 Seal ozone resistance. To determine conformance to 3.6.2, two or more test specimens of the element gasket seal shall be subjected to the ozone resistance test in accordance with ASTM D1149, for accelerated ozone cracking of vulcanized rubber. The resistance test apparatus shall include an insulated test chamber with an ozone-generating source outside the chamber. Means shall be provided for measuring the ozone concentration, for controlling the temperature of the air in the chamber, and for the circulating air. The apparatus shall also include a means for holding and stretching the specimens. The procedure to be followed will permit specimens to be elongated 12.5%. The stressed specimens, while still elongated in the stretching apparatus, shall be conditioned at room temperature for 45 minutes, and then shall be exposed for 72 hours in the test chamber in which air, having an ozone concentration of 45 to 55 parts per 100 000 000 parts of air by volume, is circulated at a temperature of 35 to 41°C (95 to 105°F). Test specimens shall be examined frequently without magnification to determine conformance to 3.6.2.

4.3.6.3 Media flame resistance. To determine conformance to 3.6.3, a sample of the filter element media shall be exposed to a flame until the sample burns or glows. The flame shall then be removed and the sample shall directly stop burning or glowing.

4.3.6.4 Low temperature. To determine conformance to 3.6.4, the element with the seal in compression to the element stops shall be subjected to a low temperature test as specified in MIL-STD-810, method 502.3, procedure 1. The conditions of 3.6.4 shall apply during exposure to the low temperature. Seal height shall be measured to verify conformance to the compression limit and to the dust efficiency test of 4.3.3.3.

4.3.6.5 High temperature. To determine conformance to 3.6.5, the element with the seal in compression to the element stops shall be subjected to a high temperature test as specified in MIL-STD-810, method 501.3, procedure 1. The conditions of 3.6.5 shall apply during exposure to the high temperature. Seal height shall be measured to verify conformance to the compression limit and to the dust efficiency test of 4.3.3.3.

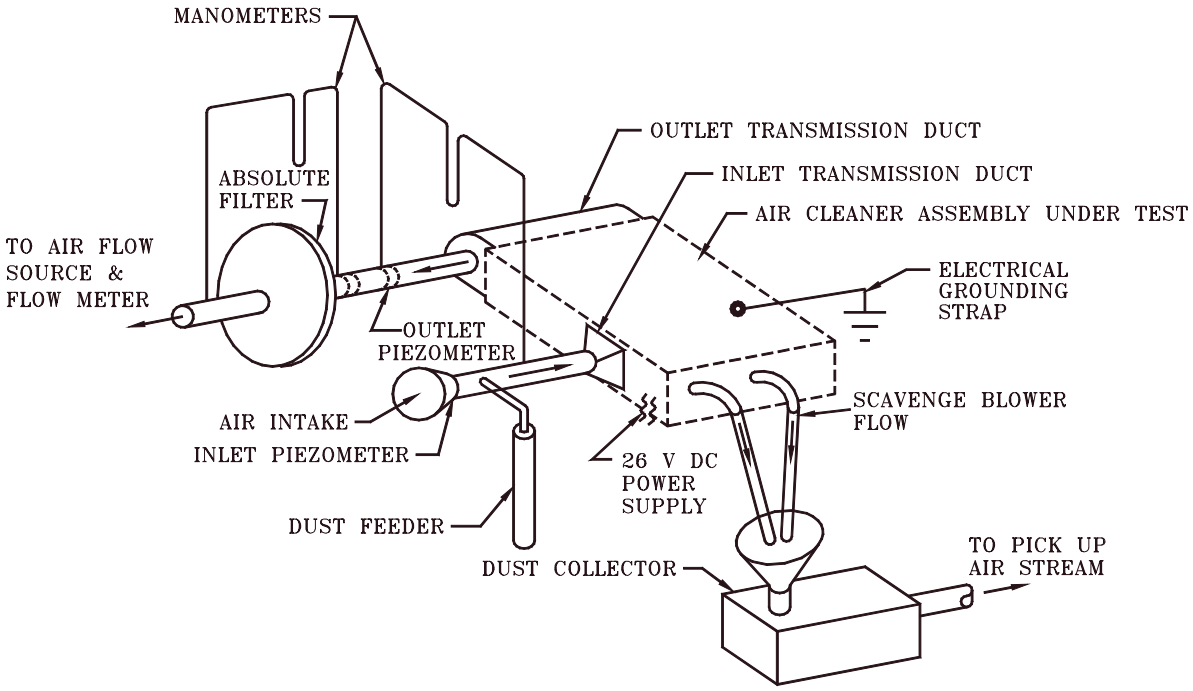


FIGURE.2. Test setup utilizing efficiency and dust capacity tester Drawing 10959032.

4.3.6.6 Vibration. To determine conformance to 3.6.6, the element shall be mounted in the test setup of 4.3.6.1a, and shall vibrate for a period of 80 minutes at specified amplitude and frequency in each of three orthogonal axes shown in Figures 3 and 4. Connections and instrumentation shall be attached to permit testing as follows:

a. The vibration test level shall be conducted at -40°C and 71°C (-40°F and +160°F). The time schedule shall be 80 minutes for each axis including forced dwells of 13.33 minutes each (see Figures 3 and 4).
b. Resonance search. Resonant frequencies of the element shall be determined by varying the frequency of applied vibration slowly through the specified range at reduced test levels, but with sufficient amplitude to excite the element. Sinusoidal resonance search may be performed using the test level and cycling time specified for sinusoidal cycling test, provided the resonance search time is included in the required cycling test time.
c. Resonance dwell. The test element shall be vibrated along each axis at the most severe resonant frequencies. If more than four significant resonant frequencies are found for any one axis, the four most severe resonant frequencies shall be chosen for the dwell test. If a change in the resonant frequency occurs during the test, its time of occurrence shall be measured and immediately the frequency shall be adjusted to maintain the peak resonance condition. The final resonant frequency shall be determined.

d. After vibration, the assembly shall be subjected and meet the dust efficiency test requirements of 4.3.3.3. The assembly shall then be returned to room temperature and the element examined for any physical damage, which if found shall be cause for rejection as a test failure.

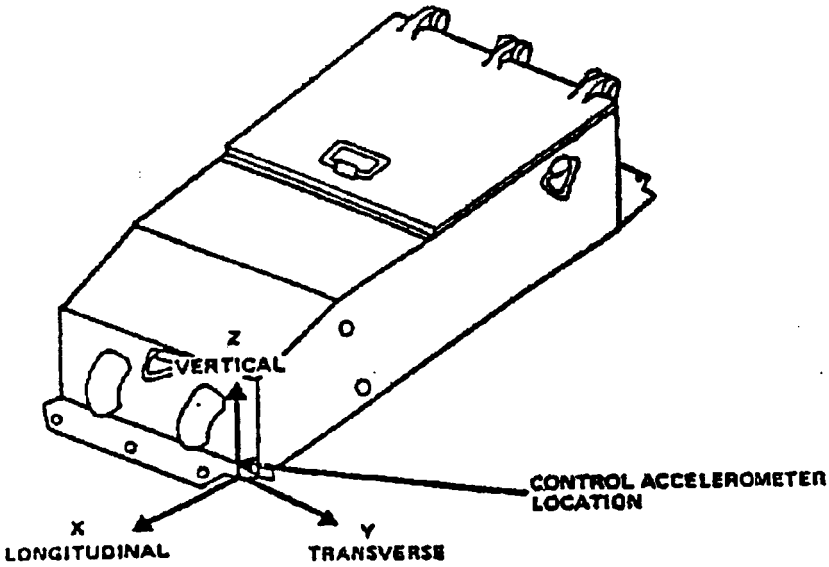


FIGURE 3. Vibration accelerometer location.

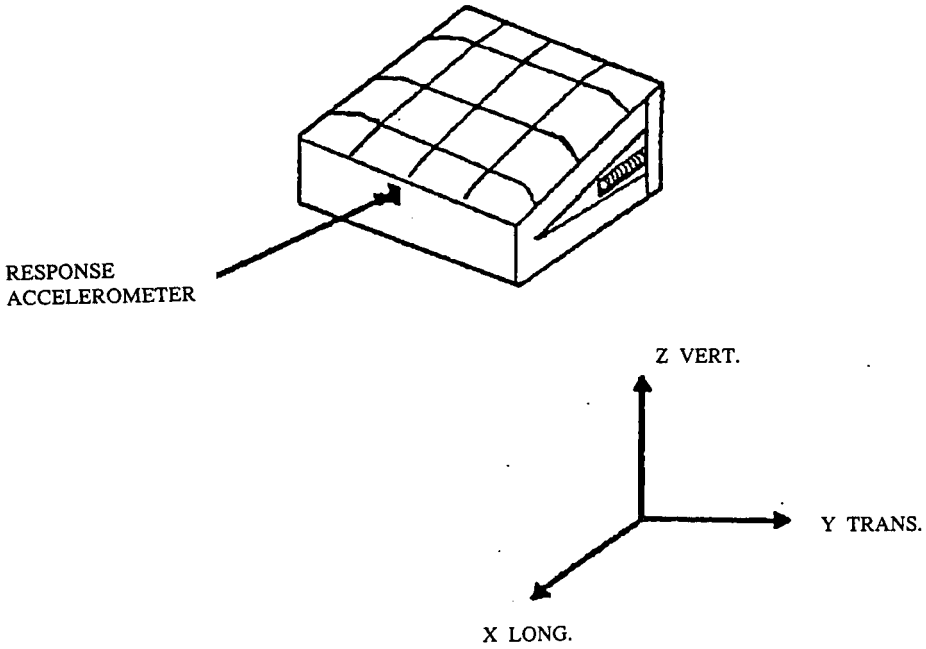


FIGURE 4. Vibration accelerometer location.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When actual packaging of materiel is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activity within the Military Department or Defense Agency, or within the Military Department's System Command. 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.

6. NOTES

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

6.1 Intended use. The filter element is intended specifically for use on Tank, Combat, Full-Tracked, M60 Series.

6.2 Acquisition requirements. Acquisition documents must specify the following:

a. Title, number, and date of this specification.
b. Issue of DoDISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.2.1 and 2.2.3).
c. If first article is not required (see 3.1).
d. Part number of element required (see 3.5.3).
e. If dust filtration is other than specified (see 3.6.1).
f. If the responsibility for inspection equipment should be other than as specified (see 4.2.1).
g. If inspection conditions should be other than as specified (see 4.2.2).
h. Packaging requirements (see 5.1).

6.3 First article. First article samples should be tested and approved under the appropriate provisions of 7-104.55 of the Defense Acquisition Regulation. The contracting officer should include specific instructions in all acquisition instruments regarding arrangements for examination, tests, and acquisition of the first article (see 3.1).

6.4 Subject term (key word) listing.

Dust capacity
Dust efficiency
Dust filtration
Filtering instrument
M60 series tank

6.5 Definitions.

6.5.1 Bursting strength. The hydrostatic pressure, in pounds per square inch, required to produce rupture of the material when the pressure is applied at a controlled increasing rate through a rubber diaphragm to a circular area of 30.5 mm (1.200 in.) in diameter, the area of the material under test being initially flat and held rigidly at the circumference, but free to bulge under the increasing pressure during test. To avoid confusion, this hydrostatic pressure is referred to as "points bursting strength" (see 3.2.3.2.2).

6.5.2 Load capacity. The term used to indicate dust load that has caused the air cleaner restriction to reach 4.98 kPa (20 in.) of water (see 4.3.5.1).

6.5.3 Recovered materials. "Recovered materials" means materials that have been collected or recovered from solid waste (see 6.5.4).

6.5.4 Solid waste. "Solid waste" is (a) any garbage, refuse, or sludge from a waste treatment plant, water supply treatment plant, or air pollution control facility; and (b) other discarded material, including solid, liquid, semisolid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations, and from community activities. It does not include solid or dissolved materials in domestic sewage, or solid or dissolved material in irrigation return flows or industrial discharges which are point sources subject to permits under sections 402 of the Clean Water Act, (33 U.S.C. 1342 et seq.), or source, special nuclear, or byproduct material as defined by the Atomic Energy Act of 1954 042 U.S.C. 201 1 et seq.) (Source: Federal Acquisition Regulations, section 23.402).

6.5 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.

Custodians:
Army - AT
Navy - SH

Review Activities:
Army - MI
Navy - MC
DLA - CC
CIV -FFAE

Preparing Activity:
Army - AT

(Project 2940-0186)

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 www.dodssp.daps.mil .