METRIC
MIL-PRF-62309C
6 March 1996
SUPERSEDING
MIL-F-62309B(AT)
27 January 1986

PERFORMANCE SPECIFICATION

FILTER ELEMENT, AIR

This specification is approved for use by 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 requirements documents cited in sections 3 and 4 of this specification, whether or not they are listed.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: U.S. Army Tank-automotive and Armaments Command, ATTN: AMSTA-TR-E/BLUE, Warren, MI 48397-5000, by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document, or by letter.

AMSC N/A FSC 2940

2.2 Government documents.

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

SPECIFICATIONS

FEDERAL

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

STANDARDS

DEPARTMENT OF DEFENSE

MIL-STD-810 - Environmental Test Methods and Engineering Guidelines.

(Unless otherwise indicated, copies of the above specifications and standards are available from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.2.2 Other Government drawings. The following drawings form a part of this document to the extent specified herein. Unless otherwise specified, the issues are those cited in the solicitation.

DRAWINGS

ARMY

10959032	- Efficiency and Dust Capacity 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, AMSTA-TR-E/BLUE, Warren, MI 48397-5000.)

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 issues of the documents cited in the solicitation (see 6.2).

AMERICAN SOCIETY FOR QUALITY CONTROL (ASQC)

ANSI/ASQC Z1.4 - Sampling Procedures and Tables for Inspection by Attributes.

(Application for copies should be addressed to American Society for Quality Control, 611 East Wisconsin Avenue, Milwaukee, WI 53202-4606.)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 800	- Standard Specification for Glass Fiber Blanket Insulation (Aircraft Type) (DoD Adopted).
ASTM D 774	- Standard Test Method for Bursting Strength of Paper (DoD Adopted).
ASTM D 828	- Standard Test Method for Tensile Properties of Paper and Paperboard, Using Constant-Rate-of-Elongation Apparatus (DoD Adopted).
ASTM D 1149	- Standard Test Method for Rubber Deterioration - Surface Ozone Cracking in a Chamber (DoD Adopted).

(Application for copies should be addressed to the American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.)

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE)

SAE AS478 - Identification Marking Methods (DoD Adopted).

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

TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY (TAPPI)

TAPPI T414 OM - Internal Tearing Resistance of Paper (Elmendorf-Type Method).

(Application for copies should be addressed to the Technical Association of the Pulp and Paper Industry, 15 Technology Parkway South, P.O. Box 105113, Norcross, GA 30092.)

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 4.4 (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 Materials. Materials shall be uniform and free from imperfections or defects which affect their serviceability. All non-metallic materials shall be inherently fungistatic or treated to resist fungus growth. All metallic parts shall be made from corrosion resistant steels or treated/ plated with corrosion-resistant materials. 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 microcurie per gram or activity per item equals or exceeds 0.01 microcuries (see 4.6.1).

3.2.1 Recycled, recovered, or environmentally preferable materials. Recycled, recovered, or environmentally preferable 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 (see 4.6.1 and 6.5.3).

3.3 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 be in accordance with Drawing 11669740 (see 4.6.2).

3.3.1 Seal. The seal shall be properly seated and bonded in the seal retaining channel with adhesive. 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 adhesive buildup between the seal and the top edge of the channel walls (see 4.6.3).

3.3.1.1 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 $\pm$89 Newton (N) [65 $\pm$ 20 pounds (lb)] (see 4.6.4).

3.3.1.2 Seal adhesion. The seal shall be capable of withstanding a pull of 876 Newtons per meter (N/m) [5 pound per inch (lb/in)] of length perpendicular to the surface (see 4.6.5).

3.4 Performance. Dust filtration requirements (see 3.4.1 through 3.4.7) shall be met by Master Box Assembly Cage 10959082 (referred to herein as the assembly) containing filter element 11669740. Except as otherwise specified herein, requirements shall be met with a clean, new element and under the following standard conditions (see 4.6.11):

a. Temperature: 23 ± 10 degrees Celsius (°C) [73 ± 18 degrees Fahrenheit (°F)].
b. Humidity: 5 ± 5 percent (%).
c. Density of air: 0.169 kilogram per cubic meter (kg/m^3) [0.073 pounds per cubic foot lb/ft^3)] at 27°C (80°F) and 101.3 kPa (29.92 in) of mercury (Hg).
d. Dust: Chemical analysis of the test dust shall be as shown in table I. Particle size distribution shall be as shown in table II.
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 I. Chemical analysis of test 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

TABLE II. Particle size distribution.

Dust size	Percent dust of total weight	
(Microns)	Coarse grade	Fine grade
0 - 5	12 ± 2	39 ± 2
5 - 10	12 ± 3	18 ± 3
10 - 20	14 ± 3	16 ± 3
20 - 40	23 ± 3	18 ± 3
40 - 80	30 ± 3	9 ± 3
80 - 200	9 ± 3	----

3.4.1 Initial air flow restriction. The initial air flow restriction of the element shall not exceed 2.24 kPa (9 in) of water (see 4.6.12).

3.3.1.3 Seal ozone resistance. The seal shall show no evidence of cracks or breaks, when subjected to the tests of 4.6.6.

3.3.2 Media. The element media shall be securely bonded to the element end caps with adhesive. The adhesive shall be free of porosity, voids, and pin hole leak paths (see 4.6.7).

3.3.2.1 Internal tear strength. The element media shall have a minimum internal tear resistance of 1000 grams (g) (see 4.6.7.1).

3.3.2.2 Bursting strength. The element media shall have a minimum bursting strength of 80 points (see 4.6.7.2 and 6.5.1).

3.3.2.3 Tensile breaking strength. The element media shall have a minimum tensile breaking strength of 6895 kiloPascals (kPa) [1000 pound per square inch (lb/in^2)] (see 4.6.7.3).

3.3.2.4 Flame resistance. The filtering media shall not continue to burn or smolder after removal of an applied flame (see 4.6.7.4).

3.3.3 Screen bonding and supports. Protective mesh screens shall be provided on the inside and outside of the element and shall be securely attached to the frame and bonded to the element media. In addition, structural channels shall be securely attached to the inside frame of the element and shall be bonded to the surface of the mesh screens in such a manner that flexure of the screens is minimized (see 4.6.8).

3.3.4 Pin loading.

3.3.4.1 End loading. The element shall be capable of withstanding a compressive, end load without damage when a 1335 $\pm$ 13 N (300 $\pm$ 3 lb) static load is applied uniformly over a 127 mm (5 in) diameter circular area (see 4.6.9.1).

3.3.4.2 Maximum loading. The element shall be capable of withstanding a compressive, (end to end) load without damage when a 2669 $\pm$133 N (600 $\pm$ 30 lb) static load is simultaneously applied to each clamping pin, totaling 5338 $\pm$ 267 N (1200 $\pm$ 60 lb) (see 4.6.9.2).

3.3.4.3 Nominal loading. Each of the two spring-loaded pins shall support a preload of 623 $\pm$ 133 N (140 $\pm$ 30 lb) at 138.18 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 $\pm$ 267 N (280 $\pm$ 60 lb) (see 4.6.9.3).

3.3.5 Weight. The weight of the element shall not exceed 15.4 kilograms (kg) (34 lb) (see 4.6.10).

3.4.2 Dust capacity. When operating with a stepped air flow in accordance with table III and fed with coarse dust in accordance with table II, the time for the assembly to reach load capacity (see 6.5.2) shall be not less than 80 hours. There shall be no dust tracking on the downstream side of the element (see 4.6.13).

TABLE III. Stepped air flow.

Time (minutes)	Rated flow (percent)	Air flow L/min	Air flow (ft^3/min)
10	100	25485	(900)
10	80	20530	(725)
10	60	15291	(540)
10	40	10194	(360)
10	20	5097	(180)
10	60	15291	(540)

3.4.3 Dust efficiency. The assembly dust filtration efficiency shall be not less than 99.5% after 60 minutes of operation when fed with fine grade dust in accordance with table II (see 4.6.14).

3.4.4 Washing durability. The assembly shall meet the requirements of 3.4.3 after the filter element reaches load capacity (see 6.5.2), then washed, cleaned and dried (see 4.6.15).

3.4.5 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 4.6.17, the assembly air flow restriction shall not have increased by more than 0.25 kPa (1 in) of water above that recorded in 3.4.1 (see 4.6.16).

3.4.6 Air cleaning durability. When operated at a dust feed rate of 3.53 ± 0.7 milligram per cubic meter (mg/m^3) (0.1 ± 0.025 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 shall not be decreased by more than 45%. Dust tracking shall not develop on the filter element up stream side during these cycles (see 4.6.17).

3.4.7 Environmental conditions. The element shall meet the requirement of 3.4.3 after being subjected to the environmental condition specified herein.

3.4.7.1 Low temperature. The element shall withstand exposure to a 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 4.6.18).

3.4.7.2 High temperature. The element shall withstand 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 4.6.19).

3.4.7.3 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 shown in figures 1 and 2 (see 4.6.20).

3.5 Marking. Identification and marking shall be permanent and in accordance with SAE AS478, and shall include the maximum rated air flow, part number, month, and year of manufacture (see 4.6.2).

3.6 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 must 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 4.6.2).

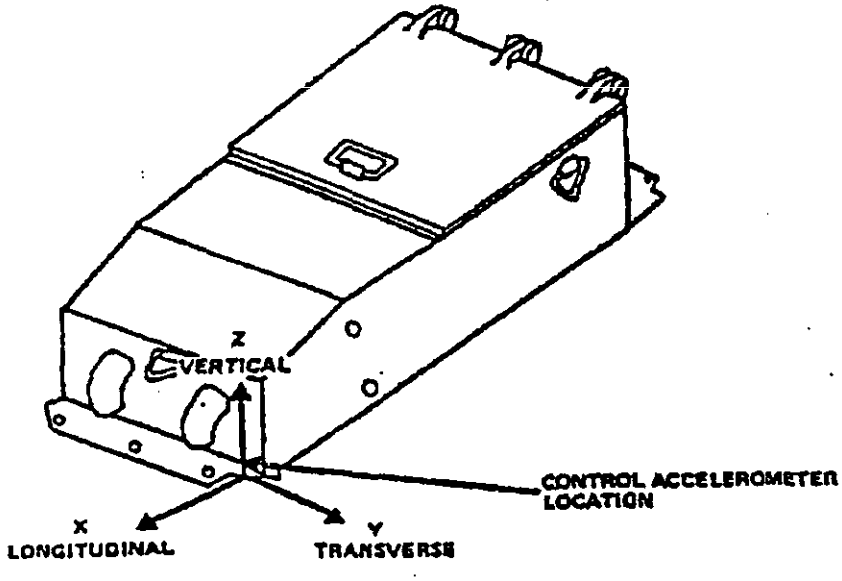

FIGURE 1. Vibration accelerometer location.

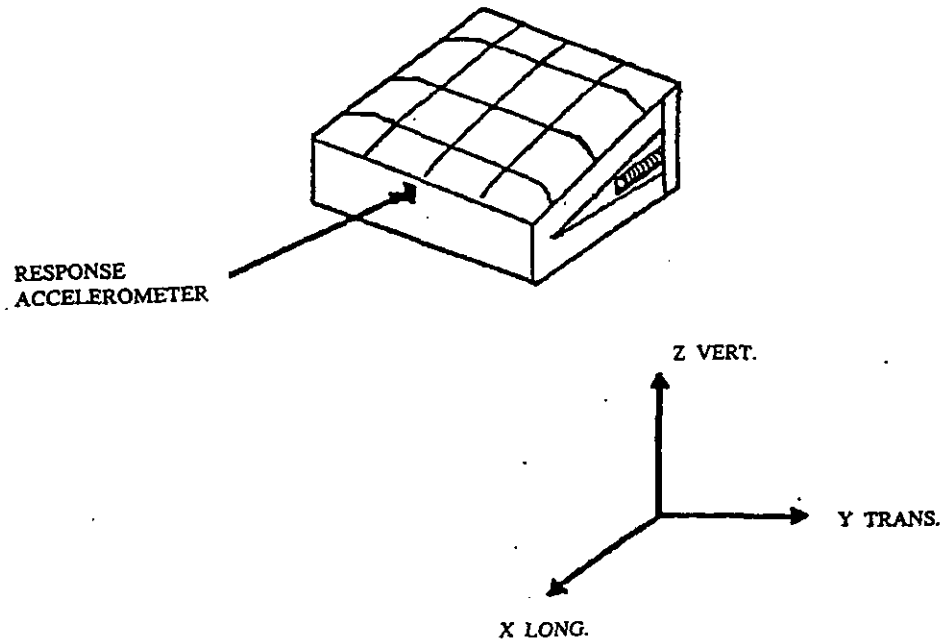

FIGURE 2. Vibration accelerometer location.

4. VERIFICATION

4.1 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. Dust capacity tester (see figure 3).
c. Mullen burst tester.
d. Tensile test machine.

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

a. First article inspection (see 4.4).
b. Conformance inspection (see 4.5).
   1. Examination (see 4.5.2).
   2. Acceptance tests (see 4.5.3.1).
   3. Control tests (see 4.5.3.2).

4.3 Inspection conditions. Unless otherwise specified (see 6.2), all inspections shall be performed under the following conditions:

a. Air temperature: 23 ± 10°C (73 ± 18°F)
b. Barometric pressure: 94.8 (+6.8, -10.2) kPa [28 (+2, -3) in] of Hg
c. Relative humidity: 35 ± 5%

4.4 First article inspection. Unless otherwise specified (see 6.2), the Government shall select five elements from the first twenty produced under the production contract for first article inspection. First article samples shall be numbered and inspected as specified in table IV. Approval of the first article sample by the Government shall not relieve the contractor of his obligation to supply air filter elements that are fully representative of those inspected as a first article sample. Any changes or deviation of the production units from the first article sample shall be subject to the approval of the contracting officer.

4.4.1 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.

4.5 Conformance inspection.

4.5.1 Sampling.

4.5.1.1 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.

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

TABLE IV. Classification of inspections.

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 3.2.1	4.6.1	X	X	X	X	X	X		
Design and construction	3.3	4.6.2	X	X	X	X	X			
Defects (see table V)		4.6.2	X	X	X	X	X	X		
Seal	3.3.1	4.6.3	X	X	X	X	X			
Seal compression	3.3.1.1	4.6.4				X	X			
Seal adhesion	3.3.1.2	4.6.5				X	X	X		
Seal ozone resistance	3.3.1.3	4.6.6		X				X		
Media	3.3.2	4.6.7	X	X	X	X	X			
Internal tear resistance	3.3.2.1	4.6.7.1	X	X				X		
Bursting strength	3.3.2.2	4.6.7.2	X	X						
Tensile breaking strength	3.3.2.3	4.6.7.3	X	X						
Flame resistance	3.3.2.4	4.6.7.4			X				X	
Screen bonding and supports	3.3.3	4.6.8	X	X	X	X	X		1/	
Pin loading:								X		
End loading	3.3.4.1	4.6.9.1	X	X	X	X	X			
Maximum loading	3.3.4.2	4.6.9.2	X	X	X	X	X			
Nominal loading	3.3.4.3	4.6.9.3	X	X	X	X	X			
Weight	3.3.5	4.6.10	X	X	X	X	X			
Initial airflow restriction	3.4.1	4.6.12	X	X	X	X	X			
Dust capacity	3.4.2	4.6.13	X	X						X
Dust efficiency	3.4.3	4.6.14		X		X	X		X	
Washing durability	3.4.4	4.6.15		X						
Post service air-flow restriction	3.4.5	4.6.16								
Air cleaning durability	3.4.6	4.6.17			X					
Low temperature	3.4.7.1	4.6.18				X	X			

TABLE IV. Classification of inspections - Continued.

Title	Requirement	Inspection	First article					Conformance inspection	
			1	2	3	4	5	Acceptance tests 100%)	Control tests 1 2
High temperature	3.4.7.2	4.6.19				X	X		
Vibration	3.4.7.3	4.6.20				X	X		

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

4.5.2 Conformance examination.

4.5.2.1 Classification of defects. For examination purposes, defects shall be classified as listed in table V.

TABLE V. Classification of defects.

Category	Defect	Method of examination
Major:		
101	Incorrect or faulty materials (see 3.2 through 3.2.1).	Visual
102	Dimensions affecting interchangeability not within tolerance (see 3.3).	Visual and Gage
103	Incorrect or illegible marking (see 3.5).	Visual
Minor:		
201	Dimensions not affecting interchangeability, not within tolerance (see 3.3).	Visual and Gage
202	Poor workmanship (see 3 6).	Visual
203	Incorrect packaging (see 5.1).	Visual

4.5.3 Conformance tests. 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.

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

4.5.3.2 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 mouth period. The air filter assemblies shall be numbered and subjected to the tests specified in table IV.

4.6 Methods of inspection.

4.6.1 Materials and construction. To determine conformance to 3.2 through 3.2.1, air filter element inspection and material certification records shall be maintained by the contractor. Records shall be subject to review by the Government and shall include date, part, or characteristic identification, inspection results, and disposition of lot (accepted or rejected). Corrective action taken on noted defects shall be subject to approval by the Government.

4.6.2 Defects. Conformance to 3.3 through 3.3.5 shall be determined by examination for the defects listed in table V. Examination shall be visual, tactile, or by measurement with standard inspection equipment.

4.6.3 Seal. To determine conformance to 3.3.1, 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.

4.6.4 Seal compression. To determine conformance to 3.3.1.1, 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 lb).

4.6.5 Seal adhesion. To determine conformance to 3.3.1.2, the following procedure shall be performed: Make a transverse cut through the seal to the end cap with a sharp instrument. 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. Verify that the seal does not detach itself from the end cap with a pull force of 876 N/m (5 lb/in) of length perpendicular to the surface.

4.6.6 Seal-ozone resistance. To determine conformance to 3.3.1.3, two or more test specimens of the element gasket seal shall be subjected to the ozone resistance test in accordance with ASTM D 1149 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 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 12-1/2%. 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°C to 41°C (95°F to 105°F). Test specimens shall be examined frequently without magnification to determine conformance to 3.3.1.3.

4.6.7 Media. To determine conformance to 3.3.2, element media bonding areas shall be examined for secure bonding and the absence of porosity, voids, and leak paths.

4.6.7.1 Media internal tear resistance. To determine conformance to 3.3.2.1, element media samples shall be tested for tear resistance in accordance with TAPPI T414 OM, using Elmendorf tear testing equipment, or its equivalent.

4.6.7.2 Media bursting strength. To determine conformance to 3.3.2.2, element media samples shall be tested for bursting strength in accordance with ASTM D 774.

4.6.7.3 Media tensile breaking strength. To determine conformance to 3.3.2.3, element media samples shall be tested for tensile strength in accordance with ASTM D 828. The following formula shall be used to calculate tensile strength:

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

4.6.7.4 Media flame resistance. To determine conformance to 3.3.2.4, 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 be observed.

4.6.8 Screen bonding and supports. To determine conformance to 3.3.3, the mesh screens for secure attachment to the frame and bonding to the media shall be examined as specified in 3.3.3. Also, the structural supports for secure attachment to the frame and minimal flexure of the mesh screens shall be examined as specified in 3.3.3.

4.6.9 Pin loading.

4.6.9.1 End loading. To determine conformance to 3.3.4.1. the element shall be placed on its stops in a device capable of measuring 1335 ± 13 N (300 ± 3 lb) load equally distributed over a 127 mm (5 in) diameter circular area, and applied to the element as shown in figure 3. The element shall be subjected to three successive non-overlapping static loads of 1335 ± 13 N (300 ± 3 lb). It shall be verified that no damage has resulted to the element.

4.6.9.2 Maximum loading. To determine conformance to 3.3.4.2, the element shall be placed in a device capable of measuring two 2669 ± 133 N (600 ± 30 lb) loads simultaneously applied to the element clamping pins as shown in figure 3. The element shall be subjected to a

static load of 2669 N (600 lb) simultaneously applied to each clamping pin (total 5338 ± 267 N) (total 1200 ± 60 lb), until the seal is compressed to the stop. It shall be verified that no damage has resulted to the element.

4.6.9.3 Nominal loading. To determine conformance to 3.3.4.3, the element shall be positioned as in figure 3, 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. Record the force, and verify that it is between 490 and 756 N (110 and 170 lb).
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. Record the force, and verify that it is between 979 and 1512 N (220 and 340 lb).
c. With a feeler gage, verify that the seal is seated at all points about the perimeter of the seal.

4.6.10 Weight. To determine conformance to 3.3.5, the element shall be weighed to verify that it does not exceed 15.4 kg (34 lb).

4.6.11 Filtering performance. Except as otherwise specified herein, air filtration performance tests shall be performed on the element installed in Master Box Assembly Cage 10959082; this installation is an instrumented functional equivalent to Assembly 12251922. Except as otherwise specified herein, test conditions and procedures shall be in accordance with 3.4 and the following.

a. The test set-up for all tests requiring air flow shall be conducted on an Efficiency and Dust Capacity Tester 10959032 shown in figure 4.
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 3.4c) and shall be within plus or minus two percent of specified values.
d. The assembly shall be mounted in its normal operating attitude as shown in figure 1, 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.

4.6.12 Initial airflow restriction. To determine conformance to 3.4.1, 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, recorded, and shall not exceed 2.24 kPa (9 in) of water.

4.6.13 Dust capacity. To determine conformance to 3.4.2, an element shall be installed in the test setup of 4.6.11a, and one hour cycles with stepped flow rates shall be completed as specified in table III. The restrictions to flow pressure drop through the assembly and absolute filter shall be recorded 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 load capacity (see 3.4). The operational time shall be at least 80 hours. At approximately twenty hour intervals of continuous operation, or whenever the test setup is required to be shut down, the filter element shall be viewed through the air cleaner outlet for visual signs of dust tracking on the clean side of the seal or the filter media. Any visual signs of dust tracking shall be cause for rejection.

4.6.14 Dust efficiency. To determine conformance to 3.4.3, the element shall be mounted in the test setup of 4.6.11a with an absolute filter (see 4.6.14.1) 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. Restriction at the start of the test, and at 10 minute intervals throughout the test shall be recorded. 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 (g). The efficiency of the assembly shall be computed 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.

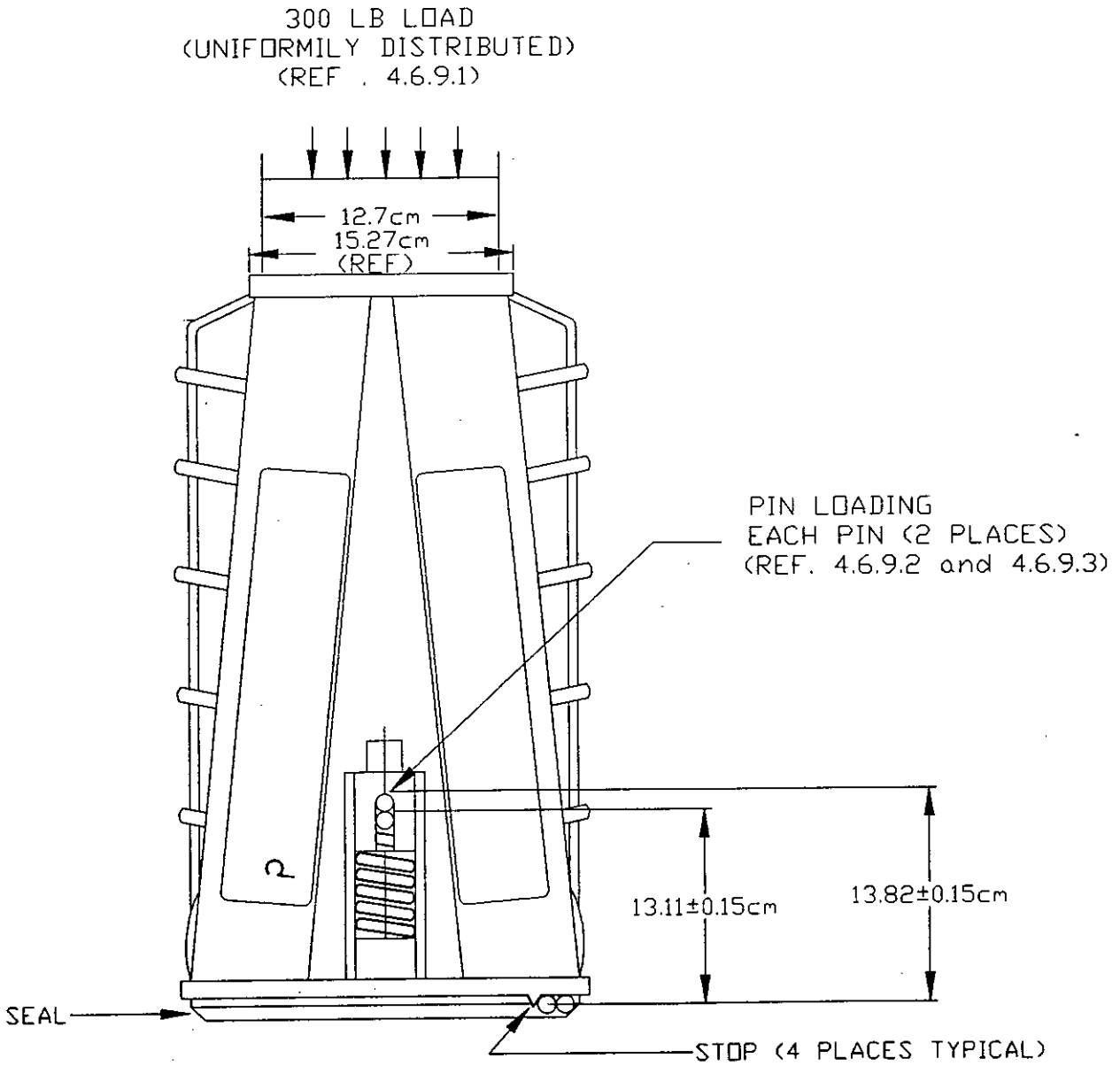

FIGURE 3. Static load test setup (filter element 11669740).

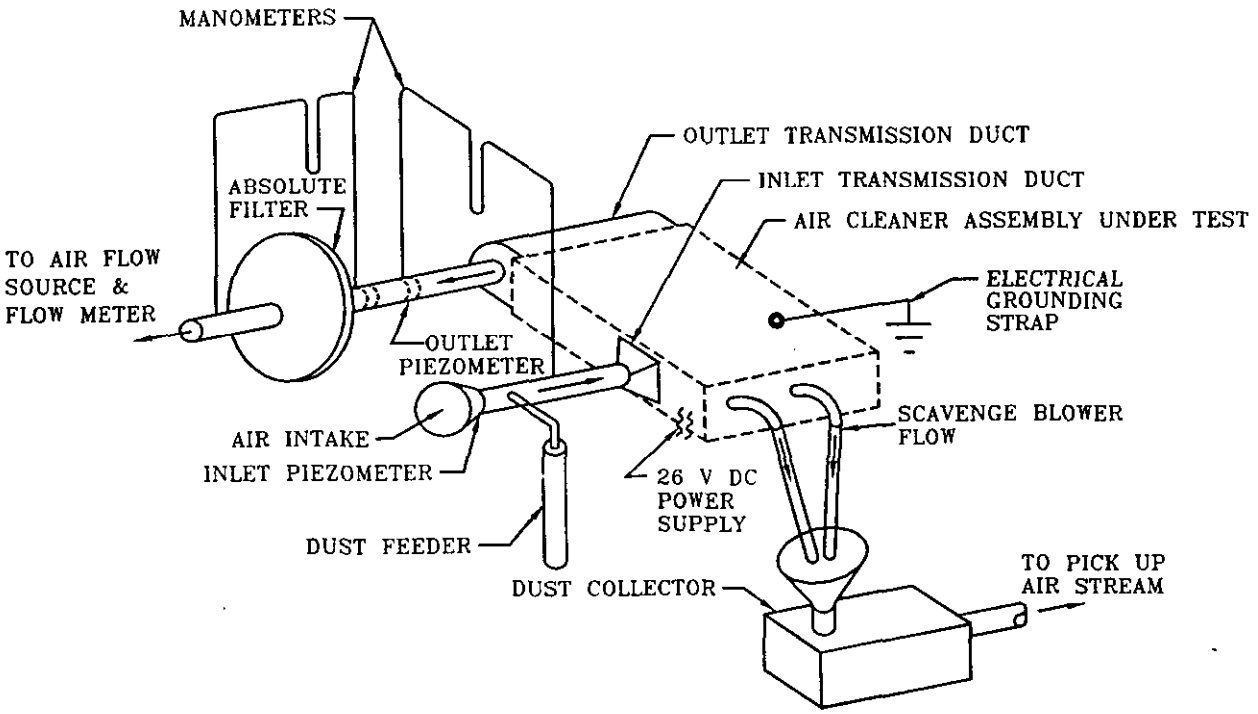

FIGURE 4. Test setup utilizing efficiency and dust capacity tester 10959032.

4.6.14.1 Preparation of the absolute filter. An absolute filter in accordance with ASTM C800, shall be placed in an air oven and dried for 6 hours at a temperature of 93°C to 115°C (200°F 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.

4.6.15 Washing durability. To determine conformance to 3.4.4, the dust loaded element shall be immersed and agitated for six hours in a solution of warm water 27°C to 43°C (80°F to 110°F) and detergent conforming to P-D-245, after completing the dust capacity test of 4.6.13. The element shall then be removed from the solution and flushed with cool water 2°C to 27°C (35°F 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 placed in a circulating air oven at 102°C to 113°C (215°F to 235°F) and dried 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. An optional filter drying method could be to install filter in air cleaner housing attached to an air source and draw air through filter until dry. The element shall then be subjected to the efficiency-test of 4.6.14 and shall conform to 3.4.3.

4.6.16 Post service airflow restriction. To determine conformance to 3.4.5, after the dust capacity test to 4.6.13, the element shall be removed and cleaned of dust by using clean, dry, compressed air with 690 (+0, -69) kPa [100 (+0, -10) lb/in^2] line pressure, and air nozzle inner dimension of at least 3.175 mm (1/8 inch). 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 recorded restriction by more than 0.25 kPa (1 in) of water.

4.6.17 Air cleaning durability. To determine conformance to 3.4.6, the following procedure shall be performed: Install the filter element in the test setup of 4.6.11a, and load it at the dust feed rate of 3.53 ± 0.7 mg/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 4.6.16, 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.

4.6.18 Low temperature. To determine conformance to 3.4.7.1, 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 3.4.7.1 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 4.6.14.

4.6.19 High temperature. To determine conformance to 3.4.7.2, 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 3.4.7.2 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 4.6.14.

4.6.20 Vibration. To determine conformance to 3.4.7.3, the element shall be mounted in the test setup of 4.6.11a, and shall vibrate for a period of 80 minutes at specified amplitude and frequency in each of three orthogonal axes. 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 13-1/3 minutes each (see figures 1 and 2).
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 recorded and immediately the frequency shall be adjusted to maintain the peak resonance condition. The final resonant frequency shall be recorded.
d. After vibration, the assembly shall be subjected to the efficiency test of 4.6.14 and shall be returned to room temperature and the element shall be examined for any damage.

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 and 2.3).
c. If first article is not required (see 3.1).
d. Part number of element required (see 3.4).
e. If the responsibility for inspection equipment should be other than as specified (see 4.1).
f. If inspection conditions should be other than as specified (see 4.3).
g. If first article sample should be other than as specified (see 4.4).
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 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."

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

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).

6.6 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.

Custodian:
Army - AT

Review Activity:
DLA - CS

Preparing Activity:
Army - AT

(Project 2940-0152)

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4, 5, 6, and 7.
3. The preparing activity must provide a reply within 30 days from receipt of the form.

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I RECOMMEND A CHANGE:	1. DOCUMENT NUMBER	2. DOCUMENT DATE (YYMMDD)
	MIL-PRF-62309C	960306

3. DOCUMENT TITLE
Filter Element, Air

4. NATURE OF CHANGE (Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME (Last, First, Middle Initial)	b. ORGANIZATION	
c. ADDRESS (Include Zip Code)	d. TELEPHONE (Include Area Code) (1) Commercial (2) AUTOVON (If applicable)	7. DATE SUBMITTED (YYMMDD)

8. PREPARING ACTIVITY

a. NAME	b. TELEPHONE (Include Area Code) (1) Commercial	(2) AUTOVON
	(810) 574-8745	786-8745
c. ADDRESS (Include Zip Code) Commander U.S. Army Tank-automotive and Armaments Command, ATTN: AMSTA-TR-E/BLUE, Warren, MI 48397-5000	IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT: Defense Quality and Standardization Office 5203 Leesburg Pike, Suite 1403, Falls Church, VA 22041-3466 Telephone (703) 756-2340 AUTOVON 289-2340	