NOT MEASUREMENT SENSITIVE

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DETAIL 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 design and 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 listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplement thereto, cited in the solicitation (see 6.2).

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: 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

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.

(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 documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues 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.
12326132	- Cleaning Wand.
12325888	- Air Cleaner Assembly - Armored (Clean Air).

(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 TESTING AND MATERIALS (ASTM)

ASTM D774	- Paper, Bursting Strength of (DoD Adopted).
ASTM D828	- Paper and Paperboard, Standard Test Method for Tensile Breaking Strength of (DoD Adopted).
ASTM D1149	- 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 Conshochocken, PA 19428-2959.)

SOCIETY OF AUTOMOTIVE ENGINEERS, INC. (SAE)

SAE AS478	- Identification Marking Methods (DoD Adopted).
SAE J726	- Air Cleaner Test Code (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.

3.2 Material. Materials shall be uniform and free from imperfections or defects which affect their serviceability (see 4.7.1).

3.2.1 Corrosion protection. All metallic parts shall be made from corrosion resistant steels or treated/plated with corrosion-resistant materials (see 3.7.4).

3.2.2 Asbestos and cadmium usage. Asbestos and cadmium materials shall not be used in any form in any part of the element (see 4.7.1).

3.2.3 Radioactive material usage. 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 4.7.1).

3.2.4 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 4.7.1).

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 900 cubic foot per minute (ft^3/min) [425 liters per second (L/s)] rating and shall be in accordance with Drawing 11669740 (see 4.7.1).

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 4.7.1.1).

3.3.1.1 Seal compression. The seal shall be capable of being compressed to the stops 0.25 inch (in.) [6.35 millimeters (mm)] over a 6 in. (152.4 mm) section with a force of 65 $\pm$ 20 pound-force (lbf) [289 $\pm$ 89 Newton (N)] (see 4.7.1.1.1).

3.3.1.2 Seal adhesion. The seal shall be capable of withstanding a pull of 5 pound-force per inch (lbf/in.) [876 Newtons per meter (N/m)] of length perpendicular to the surface (see 4.7.1.1.2).

3.3.1.3 Seal ozone resistance. The seal shall be capable of withstanding exposure for 72 hours to air having an ozone concentration of 45 to 55 parts per 100 000 000 parts of air per volume at a temperature of 100 $\pm$ 5 degrees Fahrenheit (°F) [38 $\pm$ 3 degrees Celsius (°C)] (see 4.7.1.1.3).

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 4.7.1.2).

3.3.2.1 Internal tear strength. The filtering media shall withstand 40 grams (g) minimum internal tear resistance without evidence of physical damage per TAPPI T414 OM (see 4.7.1.2.1).

3.3.2.2 Bursting strength. The filtering media shall withstand a differential pressure of 15 points minimum without evidence of tearing per ASTM D774 (see 4.7.1.2.2 and 6.6.1).

3.3.2.3 Tensile breaking strength. The filtering media shall withstand 8 pounds minimum in tensile load without evidence of damage per ASTM D828 (see 4.7.1.2.3).

3.3.2.4 Flame resistance. The filtering media shall not continue to burn or smolder after removal of an applied flame at any length of time (see 4.7.1.2.4).

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 4.7.1.3).

3.3.4 Pin loading.

3.3.4.1 End loading. The element shall be capable of withstanding a compressive, end to end load without damage when a 300 $\pm$ 3 lbf (1334 $\pm$ 13 N) static load is applied uniformly over a 5 in. (127 mm) diameter circular area (see 4.7.1.4.1).

3.3.4.2 Maximum loading. The element shall be capable of withstanding a compressive, end to end load without damage when a 600 $\pm$ 30 lbf (2669 $\pm$ 133 N) static load is simultaneously applied to each clamping pin, totaling 1200 $\pm$ 60 lbf (5338 $\pm$ 267 N) (see 4.7.1.4.2).

3.3.4.3 Nominal loading. Each of the two spring-loaded pins shall support a preload of 140 $\pm$ 30 lbf (623 $\pm$ 133 N) at 5.44 in. (138.2 mm) from the rear of the pin to the element stops. Compression of the seal, and positioning of the pins 5.16 in. (131.1 mm) (from the rear of the pin) to the element stops, shall cause the load on each pin to be 280 $\pm$ 60 lbf (1246 $\pm$ 267 N) (see 4.7.1.4.3).

3.3.5 Weight. The weight of the element shall not exceed 34 lb [15.4 kilograms (kg)] (see 4.7.1.5).

3.4 Operating requirements. Dust filtration requirements (see 3.4.1 through 3.4.6) shall be met by Master Box Assembly Gage 10959082 (referred to herein as the assembly) containing filter element 11669740. Except as otherwise specified herein, requirements shall be met under the following standard conditions (see 4.7.2):

a. Temperature: 73 ± 18°F (23 ± 10°C).
b. Humidity: 50 ± 15 percent (%).
c. Density of air: 0.073 pounds per cubic foot (lb/ft^3) [1.17 kilogram per cubic meter (kg/m^3)] at 80°F (27°C).
d. Pressure: 30 ± 1 in. of mercury (Hg) (101 ± 3 kPa).
e. Dust: Chemical analysis of dust and particle size distribution shall be in accordance with SAE J726.
f. Air flow: 900 ft^3/min (425 L/s).
g. Dust feed rate: 0.025 ± 0.005 gram per cubic foot (g/ft^3) (0.88 ± 0.18 g/m^3) of actual input airflow.

Actual input airflow shall be defined as airflow plus the scavenge airflow for each of the five 10 minute stepped airflow cycles listed in table I. (NOTE: First step would have an actual input airflow of 970 ft^3/min.)

3.4.1 Initial air flow restriction. The initial air flow restriction of the element shall not exceed 9 in. of water (2.24 kPa) (see 4.7.2.1).

3.4.2 Dust capacity. When operating with a stepped airflow in accordance with table I and fed with SAE J726 coarse dust using the SAE J726 figure 8 dust injector, the time for the assembly to reach load capacity (see 6.6.2) shall not be less than 80 hours and the assembly shall have an accumulative efficiency of not less than 99.9%. There shall be no dust tracking on the downstream side of the element (see 4.7.2.2).

Table I. Stepped air flow.

Time (minutes)	Rated flow (percent)	Air flow ft^3/min	Air flow (L/s)
10	100	900	(425)
10	80	725	(342)
10	60	540	(255)
10	40	360	(170)
10	20	180	(85)

3.4.3 Dust efficiency. The assembly shall remove SAE J726 fine dust from air at an initial efficiency of not less than 99.5% with a period of 10 minutes using the SAE J726 figure 8 dust injector (see 4.7.2.3 and 4.7.2.3.1).

3.4.4 Washing durability. The assembly shall meet the requirements of 3.4.3 after the filter element reaches load capacity (see 6.6.2), then washed, cleaned and dried (see 4.7.2.4).

3.4.5 Post service air flow restriction. After one operation to load capacity (see 6.6.2) in accordance with 3.4.2, followed by a cleaning in accordance with 4.7.2.6, the assembly air flow restriction shall not have increased by more than 1 in. of water (0.25 kPa) above that measured in 3.4.1 (see 4.7.2.5).

3.4.6 Air cleaning durability. When operated with SAE J726 course dust, fed at a rate of 0.1 ± 0.02 g/ft^3 (3.53 ± 0.7 g/m^3) of air using the SAE J726 figure 8, dust injector, the assembly shall be loaded to capacity and subsequently air cleaned three times in accordance with 4.7.2.6. The time for the assembly to reach load capacity (see 6.6.2) a fourth time shall not be decreased by more than 45% relative to the time to reach load capacity the first time. Dust tracking shall not develop on the filter element up stream side during these cycles (see 4.7.2.6).

3.5 Interface requirements. The air filter element shall conform to the interface envelope dimensions in Drawing 11669740 (see 4.7.3).

3.6 Support and ownership requirements. Each element shall possess the following life cycle ownership characteristics.

3.6.1 Identification marking. Identification marking shall be permanent and in accordance with SAE AS478, and shall include the maximum rated air flow, part number (see 6.2), month, and year of manufacture (see 4.7.4.1).

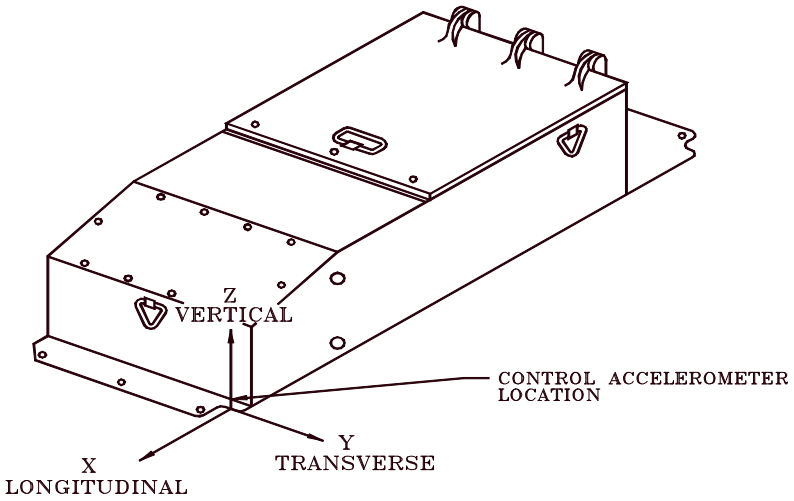
3.6.2 Safety. Each element shall be free of cracked end caps, visually apparent surfaces out of alignment or out of contour, and missing portions of material. Sheet metal parts shall be free of blisters, tears, and excessive thinning at drawn sections. Each element seal must be properly seated inside 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 4.7.4.2).

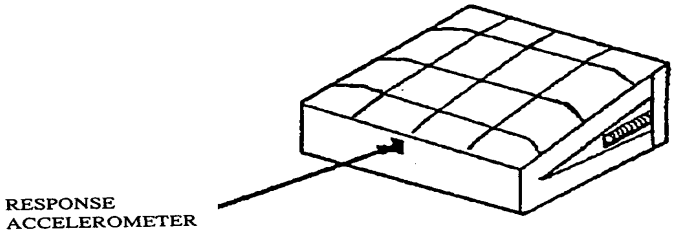
3.7 Operating environment requirements. Each element shall meet the requirement of 3.4.3 after being subjected to and passing the environmental requirements specified herein.

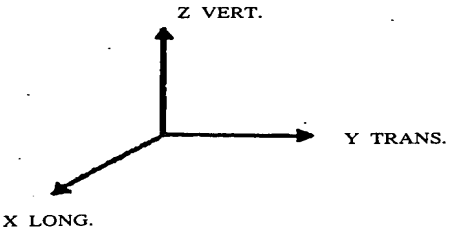
3.7.1 Low temperature. The element shall withstand exposure to a temperature of -65°F (-54°C). The seal compression set shall not exceed 5% of its original height after subsequent stabilization at room ambient temperature (see 4.7.5.1).

3.7.2 High temperature. The element shall withstand a high temperature of +160°F (71°C). The seal compression set shall not exceed 25% of its original height after subsequent stabilization at room ambient temperature (see 4.7.5.2).

3.7.3 Vibration. The element shall be capable of withstanding the vibration profile at an amplitude of 0.9 gravity units for a period of 80 minutes (including forced dwells of 13.33 minutes each) in each of the three mutually perpendicular axes as shown in figure 1 (see 4.7.5.3).







Axis	Sweep acceleration 5 to 500 to 5 Hz at 0.9 octaves/minute	Forced dwells					
	gravity (G)	1st		2nd		3rd	
		Accel. (G-level)	Freq. (Hz)	Accel. (G-level)	Freq. (Hz)	Accel. (G-level)	Freq. (Hz)
Vertical (Z)	0.9	4.2	20	2.4	105	2.4	265
Transverse (Y)	0.9	1.5	50	1.8	100	-	-
Longitudinal (X)	0.9	1.2	245	-	-	-	-

FIGURE 1. Vibration accelerometer location.

3.7.4 Salt fog. The assembly shall withstand exposure to salt fog atmosphere. The salt fog atmosphere shall consist of a salt fog solution defined as 5% by weight NaCl and 95% by weight distilled water. The exposure zone temperature range shall be 90 to 95ºF. The fog density shall be approximately 3 quarts of solution to each 10 cubic feet (see 4.7.5.4).

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 equivalents 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. Tests (see 4.5.3).

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

a. Temperature: 73 ± 18°F (23 ± 10°C).
b. Humidity: 50 ± 15%.
c. Pressure: 30 ± 1 in. of Hg (101 ± 3 kPa).

4.4 First article inspection. When specified, first article inspection shall be performed on five elements selected 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 II. 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.

4.5 Conformance inspection (CI). Conformance inspection shall include the examinations of 4.5.2 and the tests of 4.5.3.

4.5.1 Sampling. Sampling shall be as specified in the contract or order (see 6.2).

4.5.2 Examination. The samples selected in accordance with 4.5.1 shall be subjected to the examinations specified in table II, and shall be determined by examination for the defects listed in table III. Examination shall be visual, tactile, or by measurement with SIE.

4.5.3 Tests (100% inspection). Each air filter assembly shall be subjected to the tests specified in table II. Failure to any test shall be cause for rejection.

4.6 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 previously-approved or previously qualified designs.

4.6.1 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.

4.7 Methods of inspection.

4.7.1 Materials, design, and construction. Conformance to 3.2 through 3.3.5 shall be determined by inspection of contractor records providing proof or certification that design, construction, processing, and materials conform to requirements. Applicable records shall include drawings, specifications, design data, receiving inspection records, processing and quality control standards, vendor catalogs and certifications, industry standards, test reports, and rating data. Examinations shall be one or more of the methods outlined in 4.6 or 4.6.1.

4.7.1.1 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.

4.7.1.1.1 Seal compression. To determine conformance to 3.3.1.1, the element shall be immobilized and force shall be applied over a 6 in. (152.4 mm) 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 45 and 85 lbf (200 and 378 N).

4.7.1.1.2 Seal adhesion. To determine conformance to 3.3.1.2, a transverse cut shall be made through the seal to the end cap with a sharp instrument. Attach a 1-in. (25.4 mm) 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 5 lbf/in. (876 N/m) of length perpendicular to the surface.

Table II. Verification methods.

Title	Requirement	Verification	First article					CI	
								Test	
			1	2	3	4	5	100%	Exam
Materials	3.2	4.7.1	X	X	X	X	X	X	
Design and construction	3.3 thru 3.3.5	4.7.1	X	X	X	X	X		
Seal	3.3.1	4.7.1.1	X	X	X	X	X		
Seal compression	3.3.1.1	4.7.1.1.1				X	X		
Seal adhesion	3.3.1.2	4.7.1.1.2				X	X		
Seal ozone resistance	3.3.1.3	4.7.1.1.3		X					
Media	3.3.2	4.7.1.2	X	X	X	X	X		X
Internal tear resistance	3.3.2.1	4.7.1.2.1	X	X					
Bursting strength	3.3.2.2	4.7.1.2.2	X	X					
Tensile breaking strength	3.3.2.3	4.7.1.2.3	X	X					
Flame resistance	3.3.2.4	4.7.1.2.4			X				1/
Screen bonding and supports	3.3.3	4.7.1.3	X	X	X	X	X	X	X
Pin loading	3.3.4	4.7.1.4						X	
End loading	3.3.4.1	4.7.1.4.1	X	X	X	X	X		
Maximum loading	3.3.4.2	4.7.1.4.2	X	X	X	X	X		
Nominal loading	3.3.4.3	4.7.1.4.3	X	X	X	X	X		
Weight	3.3.5	4.7.1.5	X	X	X	X	X		
Operating requirement	3.4	4.7.2							
Initial airflow restriction	3.4.1	4.7.2.1	X	X	X	X	X		
Dust capacity	3.4.2	4.7.2.2	X	X					X
Dust efficiency	3.4.3	4.7.2.3		X		X	X		
Washing durability	3.4.4	4.7.2.4		X					
Post service air flow restriction	3.4.5	4.7.2.5	X	X					
Air cleaning durability	3.4.6	4.7.2.6			X				
Interface requirement	3.5	4.7.3							
Support and ownership requirement	3.6	4.7.4							
Identification marking	3.6.1	4.7.4.1	X	X	X	X	X		
Safety	3.6.2	4.7.4.2	X	X	X	X	X		
Operating environment requirement	3.7	4.7.5							
Low temperature	3.7.1	4.7.5.1				X	X		
High temperature	3.7.2	4.7.5.2				X	X		
Vibration	3.7.3	4.7.5.3				X	X		
Salt fog	3.7.4	4.7.5.4				X	X		

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

TABLE III. Classification of defects.

Category	Defect	Method of examination
Major:		
101	Incorrect or faulty materials (see 3.2 thru 3.2.4).	Visual
102	Dimensions affecting interchangeability not within tolerance (see 3.3).	Visual and Gage
103	Incorrect or illegible marking (see 3.6.1).	Visual
Minor:		
201	Dimensions not affecting interchangeability, not within tolerance (see 3.3).	Visual and Gage
202	Safety not as specified (see 3.6.2).	Visual
203	Incorrect packaging (see 5.1).	Visual

1/ SIE = Standard Inspection Equipment.

4.7.1.1.3 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 and pass 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 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 95°F to 105°F (35°C to 41°C). Test specimens shall be examined frequently without magnification.

4.7.1.2 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.

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

4.7.1.2.2 Media bursting strength. To determine conformance to 3.3.2.2, element media samples shall be tested for and pass bursting strengths in accordance with ASTM D774.

4.7.1.2.3 Media tensile breaking strength. To determine conformance to 3.3.2.3, element media samples shall be tested for tensile strengths in accordance with ASTM D828. There shall be no evidence of physical damage.

4.7.1.2.4 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 for a discontinuation of effects of the flame.

4.7.1.3 Screen bonding and supports. To determine conformance to 3.3.3, the mesh screens shall be examined for secure attachment to the frame and for secure attachment of the bonding to the media. The structural supports shall be examined for secure attachment to the frame and minimal flexure.

4.7.1.4 Pin loading.

4.7.1.4.1 End loading. To determine conformance to 3.3.4.1. the element shall be placed on its stops in a device capable of measuring 300 ± 3 lbf (1335 ± 13 N) load equally distributed over a 5 in. (127 mm) diameter circular area, and applied to the element as shown in figure 2. The element shall be subjected to three successive non-overlapping static loads of 300 ± 3 lbf (1335 ± 13 N). It shall be verified that no damage has resulted to the element.

4.7.1.4.2 Maximum loading. To determine conformance to 3.3.4.2, the element shall be placed in a device capable of measuring two 600 ± 30 lbf (2669 ± 133 N) loads simultaneously applied to the element clamping pins as shown in figure 2. The element shall be subjected to a static load of 600 lbf (2669 N) simultaneously applied to each clamping pin (total 1200 ± 60 lbf) (total 5338 ± 267 N), until the seal is compressed to the stop. It shall be verified that no damage has resulted to the element.

4.7.1.4.3 Nominal loading. To determine conformance to 3.3.4.3, the element shall be positioned as in figure 2 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 5.44 ± 0.06 in. (138.2 ± 1.5 mm) from the element stops. Verify that the distance measured is between 110 and 170 lbf (489 and 756 N).
b. Apply additional force, until the point on the rear of the pin reaches a position of 5.16 ± 0.06 in. (131.1 ± 1.5 mm) from the stops. Verify that the distance measured is between 220 and 340 lbf (979 and 1512 N).
c. With a feeler gage, verify that the seal is seated at all points about the perimeter of the seal.

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

4.7.2 Operating requirements verification. Except as otherwise specified herein, air filtration performance tests shall be performed on the element installed in the Master Box Assembly Gage 10959082 or an instrumented functional equivalent to Assembly 12325888. If

an instrumented functional equivalent is utilized, it shall be approved by the procuring activity. 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 (see figure 3) modified to incorporate the SAE J726 figure 8, dust injector or a functional equivalent to this test setup which utilizes the SAE J726 figure 8, dust injector. If a functional equivalent test setup is utilized it shall be approved by the procuring activity.
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 0.1 in. of water (2.54 mm).
c. Actual air flow values used in tests shall be corrected to standard conditions (see 3.4c) and shall be within $\pm$ 2% 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.

4.7.2.1 Initial air flow restriction. To determine conformance to 3.4.1, the assembly shall be subjected to a dust free flow of 900 ft^3/min (425 L/s) through the assembly. The restriction to flow shall be measured and shall not exceed 9 in. of water (2.24 kPa).

4.7.2.2 Dust capacity. To determine conformance to 3.4.2, an element shall be installed in the test setup of 4.7.2a, and 1 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 900 ft^3/min (425 L/s). The test shall be conducted until the assembly air flow restriction at 900 ft^3/min (425 L/s) reaches 20 in. of water (see 3.4). The operational time shall be at least 80 hours. At approximately 20-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. At the conclusion of testing, the contractor shall verify that a minimum coarse dust accumulative efficiency of 99.9% was attained, using the formula from 4.7.2.3.

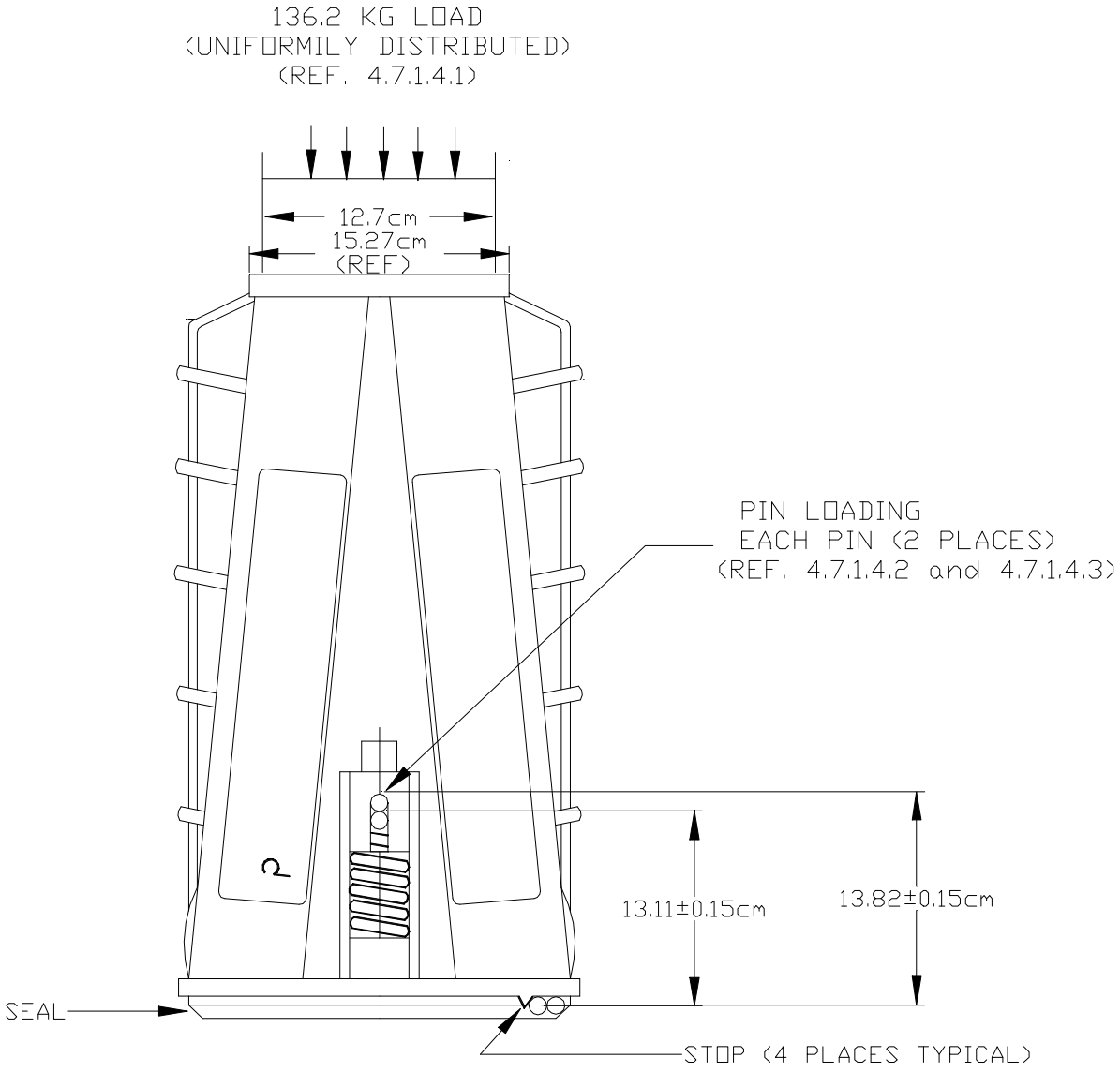


FIGURE 2. Static load test setup (filter element 11669740).

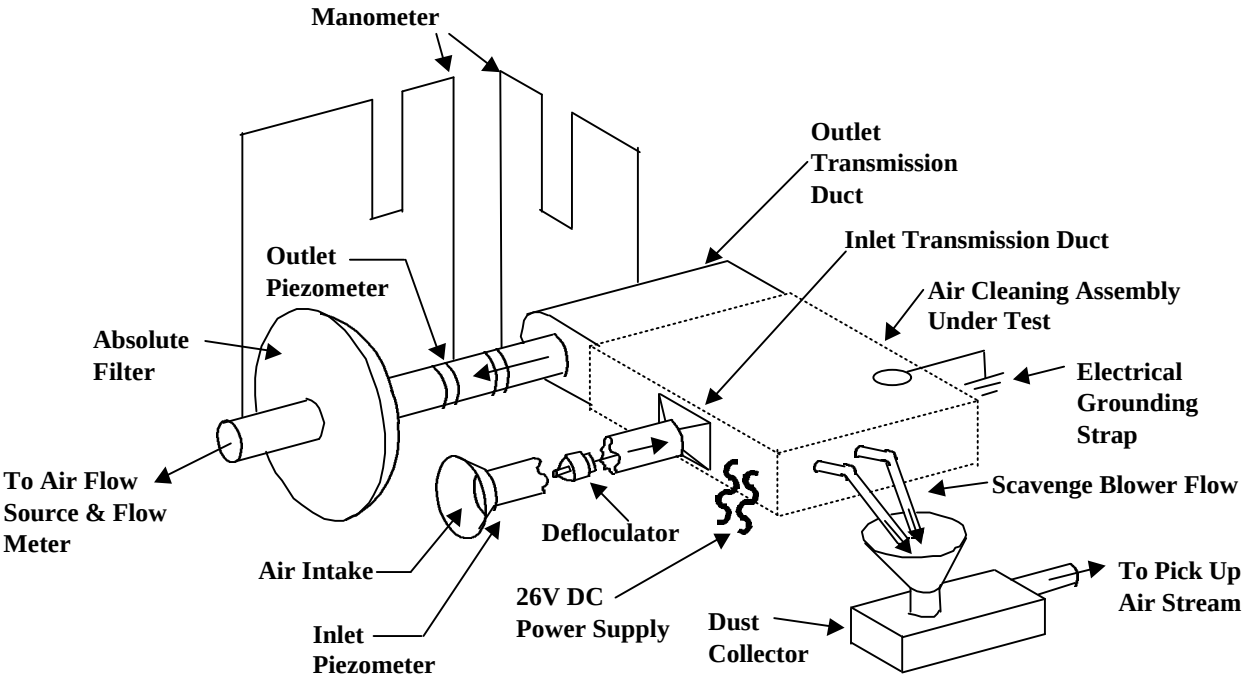


FIGURE 3. Test setup utilizing efficiency and dust capacity tester 10959032.

4.7.2.3 Dust efficiency. To determine conformance to 3.4.3, the element shall be mounted in the test setup of 4.7.2a with an absolute filter (see 4.7.2.3.1) 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 10 minutes with an airflow of 900 ft^3/min (425 L/s). Restriction at the start of the test, and at 2 minutes 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 grams equivalent [0.0004 ounces (oz)] whenever possible, but never less than 0.1 g. The minimum dust efficiency of the assembly shall be 99.5% when 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.

4.7.2.3.1 Preparation of the absolute filter. An absolute filter in accordance with SAE J726, shall be placed in an air oven and dried for 6 hours at a temperature of 200°F to 240°F (93°C to 116°C), 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.

4.7.2.4 Washing durability. To determine conformance to 3.4.4, the dust loaded element shall be immersed and agitated for 6 hours in a solution of warm water ranging from Temperatures of 80°F to 110°F (27°C to 43°C) and detergent conforming to P-D-245, or equivalent, after completing the dust capacity test of 4.7.2.2. The element shall then be removed from the solution and flushed with cool water ranging from temperatures of 35°F to 80°F (2°C to 27°C) at low pressure from inside to outside for 3 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 1 hour. The element shall then be dried by one of the following methods:

a. Place the element in a circulating air oven at 215°F to 235°F (102°C to 113°C) and dry 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 and pass the dust efficiency test of 4.7.2.3 and shall conform to 3.4.3.

4.7.2.5 Post service airflow restriction. To determine conformance to 3.4.5, after the dust capacity test of 4.7.2.2, the element shall be removed and cleaned of dust by using clean, dry, compressed air with 100 (+0, -10) lbf/in.^{2} [690 (+0, -69) kPa] and Cleaning Wand 12326132 or equivalent for no more than one hour. 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 reinstated in the assembly and tested for airflow restriction. The assembly shall not exceed its previously measured restriction by more than 1 in. of water (0.25 kPa).

4.7.2.6 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 4.7.2 (a), and load it at the dust feed rate of 0.1 $\pm$ 0.02 g/ft^3 (3.53 $\pm$ 0.7 g/m^3) until load capacity (see 6.6.2) 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 for no more than one

hour with clean, dry, compressed air as specified in 4.7.2.5. Repeat the above procedure two additional times. The time required to load the filter a fourth time shall not be decreased by more than 45% as compared to the first load time.

4.7.3 Interface requirements verification. Using one or more of the methods outlined in 4.6 or 4.6.1, the air filter element dimensions shall be verified to conform to the interface envelope dimensions in Drawing 11669740.

4.7.4 Support and ownership requirements.

4.7.4.1 Identification marking. To determine conformance to 3.6.1, verify the presence of the required markings on the air cleaner assembly. After performing all environmental tests in 4.7.5, re-inspect the assemblies markings for presence and readability.

4.7.4.2 Safety. To determine conformance to 3.6.2, the assembly shall be inspected to assure that the components are free of hazardous burrs, nicks, sharp edges, foreign materials, or other imperfections posing physical danger to the operators, and that the assembly and components and securely installed and fastened.

4.7.5 Operating environment requirements verification.

4.7.5.1 Low temperature. To determine conformance to 3.7.1, the element with the seal in compression to the element stops shall be subjected to and pass a low temperature test as specified in MIL-STD-810, method 502.3, procedure 1, or equivalent. The conditions of 3.7.1 shall apply during exposure to a temperature of -65°F (-54°C). Seal height shall be measured to verify conformance to the compression limit and to the dust efficiency test of 4.7.2.3.

4.7.5.2 High temperature. To determine conformance to 3.7.2, the element with the seal in compression to the element stops shall be subjected to and pass a high temperature test as specified in MIL-STD-810, method 501.3, procedure 1, or equivalent. The conditions of 3.7.2 shall apply during exposure to a temperature of +160°F (+71°C). Seal height shall be measured to verify conformance to the compression limit and to the dust efficiency test of 4.7.2.3.

4.7.5.3 Vibration. To determine conformance to 3.7.3, the element shall be mounted in the test setup of 4.7.2a. The filter element shall vibrate for a period of 80 minutes at an amplitude of 0.9 g and a frequency rate from 5 to 500 to 5 Hz in each of the 3 mutually perpendicular axes as shown in figure 1. The forced dwells as specified in figure 1 shall be performed in place of the resonance search and dwells. Connections and instrumentation shall be attached to permit testing as follows:

a. The vibration test level shall be conducted at -40°F and +160°F (-40°C and 71°C). The time schedule shall be 80 minutes for each axis including forced dwells of 13.33 minutes each (see figure 1).
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 4 significant resonant frequencies are found for any 1 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 to the dust efficiency test of 4.7.2.3 and shall be returned to room temperature and the element shall be examined for any damage.

4.7.5.4 Salt fog. The assembly shall be subjected and inspected to the salt fog requirements of MIL-STD-810 method 509.3 to verify conformance to 3.2.1. After salt fog exposure, the assembly shall be subjected to and pass the efficiency test of 4.7.2.3

NOTE: A test coupon or witness sample which represents the assembly may be subjected to the salt fog testing and visually inspected in lieu of a full assembly test with prior approval from the procuring activity.

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. The filter element is military unique because it must operate under extreme dust and vibration combat conditions in all theaters of operation. Commercial filters are not designed to operate under such extreme environmental conditions.

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. When first article is required (see 3.1).
d. Part number of element required (see 3.6.1).
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. Sampling plan (see 4.5.1).
h. Packaging requirements (see 5.1).

6.3 Subject term (key word) listing.

Cleaner
Dust capacity
Dust efficiency
Dust filtration
M60 series tank

6.4 First article inspection. When requiring a first article inspection, contracting documents should provide specific guidance to offerors. This guidance should cover whether the first article is a first article sample, a first production item, or the number of test items. These documents should also include specific instructions regarding arrangements for examinations, approval of first article test results, and disposition of first articles. Pre-solicitation documents should provide Government waiver rights for samples for first article inspection to bidders offering a previously acquired or tested product. Bidders offering such products who wish to rely on such production testing must furnish evidence with the bid that prior Government approval is appropriate for the pending contract.

6.5 Conformance inspection. Affordable conformance inspection with confidence varies depending upon a number of procurement risk factors. Some of these factors include: Contractor past performance, Government schedules and budget, product material and design maturity, manufacturing capital equipment and processes applies, the controlled uniformity of those processes, labor skill and training, and the uniformity of measuring processes and techniques. During the solicitation, contracting documents should indicate those tests desired from table II and their designated frequency based on a risk assessment for the procurement.

6.6 Definitions.

6.6.1 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 1.2 in. (30.5 mm) 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.”

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

6.7 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

Preparing Activity:
Army - AT

(Project 2940-0182)

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, and 7.
3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

I RECOMMEND A CHANGE:	1. DOCUMENT NUMBER	2. DOCUMENT DATE *(YYMMDD)*
	MIL-DTL-62309E	990429

3. DOCUMENT TITLE FILTER ELEMENT, AIR

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

6. SUBMITTER

	b. ORGANIZATION	
c. ADDRESS ***(Include Zip Code)***	**d. TELEPHONE** ***(Include Area Code)*** **(1) Commercial (2) AUTOVON** ***)***	**7. DATE SUBMITTED**

8. PREPARING ACTIVITY

a. NAME	**b. TELEPHONE** ***)*** **(1) Commercial** (810) 574-8745 **(2) AUTOVON** 786-8745
(Include Zip Code) **Commander U.S. Army Tank-automotive and Armaments Command**	**IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT: Defense Quality and Standardization Office 5203 Leesburg Pike, Suite 1403 Telephone (703) 756-2340**