

MIL-F-45356B
25 July 1984

SUPERSEDING
MIL-F-45356A
18 January 1971

MILITARY SPECIFICATION

FILTER ASSEMBLY, FLUID PRESSURE, AND FILTER ELEMENT FLUID PRESSURE: FOR GASOLINE INTERNAL COMBUSTION ENGINES

This specification is approved for use by the US Army Tank-Automotive Command, Department of the Army, and is available for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers filter assemblies and replacement filter elements for use in the fuel system of gasoline engines and accessories.

1.2 Classification. Fuel filter assemblies and fuel filter elements shall be furnished in the following types and classes as specified (see 6.2).

Type I	- Fuel Filter Assembly with Element.
Class 1	- Fine Filtration.
Class 2	- Coarse Filtration.
Type II	- Fuel Filter Replacement Element.
Class 1	- Fine Filtration.
Class 2	- Coarse Filtration.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: US Army Tank-Automotive Command, ATTN: DRSTA-GSS, Warren, MI 48090, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.
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2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications and standards. Unless otherwise specified, the following specifications and standards of the issue listed in that issue of the Department of Defense Index of Specifications and Standards (DoDISS) specified in the solicitation form a part of this specification to the extent specified herein.

SPECIFICATIONS
FEDERAL

P-D-680 - Dry Cleaning Solvent.

STANDARDS
FEDERAL

FED-STD-H28 - Screw Thread Standards for Federal Services.

MILITARY

MIL-STD-105	- Sampling Procedures and Tables for Inspection by Attributes.
MIL-STD-130	- Identification Marking of US Military Property.
MIL-STD-810	- Environmental Test Methods.
MIL-STD-45662	- Calibration Systems Requirements.
MS 51085	- Filter, Fluid, Pressure, Automotive Fuel (10 gph Filtration).
MS 51086	- Strainer, Sediment: Automotive Fuel (10 gph).
MS 51087	- Filter, Fluid, Pressure and Strainer, Sediment; Automotive Fuel (21 gph).
MS 51088	- Filter, Fluid, Pressure.
MS 51090	- Filter Element, Fluid, Pressure - Automotive Fuel.
MS 51091	- Gasket: Filter, Fluid, Pressure Automotive Fuel.

(Copies of specifications, standards, handbooks, drawings, and publications required by manufacturers in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting officer.)

2.1.2 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein, the text of this specification shall take precedence.

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3. REQUIREMENTS

3.1 First article. Unless otherwise specified (see 6.2), the contractor shall furnish filter assemblies or replacement elements which shall be subjected to first article inspection (see 4.4 and 6). First article inspection samples, properly marked with identifying information shall be representative of the unit to be furnished to the Government. All subsequent filter assemblies delivered to the Government shall conform to these samples in all their pertinent physical and performance attributes.

3.2 Materials. Materials shall be of such quality to produce fuel filters meeting the performance requirements of this specification (see 4.1.2).

3.3 Design and construction.

3.3.1 Envelope. The fuel filter assembly or element shall be constructed to the form and dimensions specified in MS 51085 through MS 51088 or MS 51090 or MS 51091, as specified (see 6.2). Design and construction that is not specified on referenced standards shall be in accordance with the best current commercial practice (see 4.1.3 and 4.5.2).

3.3.2 Screw threads. All screw threads shall conform to FED-STD-H28 (see 4.1.2).

3.3.3 Servicing. Servicing, including cleaning and reassembly, shall be easily accomplished without disturbing the filter assembly connection to the engine and shall be designed to prevent improper assembly (see 4.1.3 and 4.5.2).

3.4 Performance characteristics.

3.4.1 Pressure-temperature resistance. The filter assembly shall show no signs of leakage or permanent deformation after being pressure tested at -65 ± 3 degrees Fahrenheit ($^{\circ}\text{F}$), $80 \pm 3^{\circ}\text{F}$, and $160 \pm 3^{\circ}\text{F}$. The pressures used in this test shall be 15 ± 1 pounds per square inch (psi) for filter assemblies with a flow rate of 25 gallons per hour (gph) or less, and 40 ± 1 psi for assemblies with a flow rate greater than 25 gph (see 4.6.1). Unless otherwise specified, MS 51085-2 assemblies shall meet the 300 psi air pressure test of 4.6.1.3.

3.4.2 Flow rate. The flow rate of the type I filter assembly or the type II replacement element shall be as specified on the applicable standard drawing. The differential pressure across the filter assembly or replacement element, when tested in an assembly, shall not exceed the values specified in table I for the applicable flow rate and type (see 4.6.2 and 4.6.3).

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TABLE I. Flow rate and maximum pressure differential.

Type	Flow rate (gph)	Maximum pressure differential (inches of water)
I	10	4
I	21	6
I	45	8
II	45	8

3.4.3 Filtering efficiency. The filtering efficiency shall conform to the requirements specified in table II for the applicable flow rate and filter type. Class 1 filters shall be tested with fine contaminants and class 2 filters shall be tested with coarse contaminants in accordance with table III. Test fluid shall be as specified (see 4.6.2 and 4.6.4.1).

TABLE II. Filtering efficiency.

TYPE	TEST DURATION/HRS.	FLOW RATE - GPH	MAXIMUM CONTAMINANT ADD RATE - GRAMS/HR.	MINIMUM FILTERING EFFICIENCY (%) AT 0.1 HR.	MINIMUM FILTERING EFFICIENCY (%) AT 1.0 HR.	MINIMUM FILTERING EFFICIENCY (%) AT END OF TEST
I	3	10	0.6	65	85	95
I	3	21	0.6	65	85	95
I	5	45	35.0	65	85	95
II	5	45	35.0	65	85	95

TABLE III. Contaminant size.

Fine contaminant		Coarse contaminant	
Particle size in micrometer	Percent by weight	Particle size in micrometer	Percent by weight
0-5	39 + 2	0-5	12 + 2
5-10	18 + 3	5-10	12 + 3
10-20	16 + 3	10-20	14 + 3
20-40	18 + 3	20-40	23 + 3
40-80	9 + 3	40-80	30 + 3
80-200	----	80-200	9 + 3

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3.4.4 Vibration resistance. When tested in accordance with MIL-STD-810, method 514.2, procedure VIII, the filter assembly shall show no evidence of leakage in the body, at gaskets, or at the fittings (see 4.6.5).

3.5 Marking. The filter assembly or a replacement element shall be identified in accordance with the parts identification requirements of MIL-STD-130 and shall consist of the Military part number and the manufacturer identification (see 4.1.3 and 4.5.2).

3.6 Workmanship. Workmanship shall be of such quality as to produce filter assemblies and elements free from burrs, sharp surfaces, blemishes, scratches, and paint imperfections (see 4.1.3 and 4.5.2).

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order (see 6.2), the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.1.1 Inspection equipment. Unless otherwise specified in the contract (see 6.2), the supplier is responsible for the provision and maintenance of all inspection equipment necessary to assure that supplies and services conform to contract requirements. Inspection equipment must be capable of repetitive measurements to an accuracy of 10 percent of the measurement tolerance. Calibration of inspection equipment shall be in accordance with MIL-STD-45662.

4.1.2 Materials and construction. To determine conformance to 3.2 and 3.3, 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.

4.1.3 Physical characteristics. Conformance to 3.3.1, 3.3.3, 3.5 and 3.6 shall be determined by visual and tactile examination, and measurement with standard inspection equipment.

4.2 Classification of inspection:

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

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4.3 Inspection conditions. Unless otherwise specified (see 6.2), all inspections shall be performed in accordance with the test conditions specified in MIL-STD-810.

4.4 First article inspection. Unless otherwise specified (see 6.2), the Government shall select three filter assemblies or replacement elements produced under the production contract (see 6.2) for first article inspection. First article samples shall be examined as specified in 4.5.2, and numbered and tested as specified in tables IV and V. Approval of the first article sample by the Government shall not relieve the contractor of his obligation to supply filter assemblies or replacement 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 to the Government.

4.5 Quality conformance inspection.

4.5.1 Sampling.

4.5.1.1 Lot formation. An inspection lot shall consist of all the filter assemblies or replacement elements of one type and part number, from an identifiable production period, from one manufacturer, submitted at one time for acceptance.

4.5.1.2 Sampling for examination. Samples for quality conformance examination shall be selected in accordance with general inspection level II of MIL-STD-105.

4.5.2 Quality conformance examinations.

4.5.2.1 Acceptable quality level. Each sample selected in accordance with 4.5.1.2 shall be examined to determine conformance to the following acceptable quality levels (AQL) on the basis of percent defective.

<u>Classification</u>	<u>AQL</u>
Major	1.0
Minor	2.5

4.5.2.2 Classification of defects. For examination purposes, defects shall be classified as listed in table IV.

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TABLE IV. Classification of defects.

Category	Defects	Method of inspection
Critical		
<u>Major</u>	<u>AQL 1.0% Defective</u>	
101	Dimensions affecting interchangeability not within tolerance (see 3.3).	SIE <u>1/</u>
102	Improper marking (see 3.5).	Visual
103	Servicing not easily accomplished (see 3.3)	Visual
<u>Minor</u>	<u>AQL 2.5% Defective</u>	
201	Dimensions not affecting interchangeability not within tolerance (3.3.1).	SIE <u>1/</u>
202	Poor workmanship (see 3.6).	Visual

1/ SIE = Standard Inspection Equipment

TABLE V. Classification of tests.

Characteristic	Requirement	First	Acceptance (100%)	Control
Static pressure and temperature	3.4.1	4.6.1	X	
Flow rate	3.4.2	4.6.3	X	
Filtering efficiency	3.4.3	4.6.4		X
Vibration	3.4.4	4.6.5		X

4.5.3 Acceptance tests.

4.5.3.1 Sampling. All filter assemblies and elements furnished under this specification shall be subjected to all acceptance tests specified in table V.

4.5.3.2 Failure. Failure of any filter assembly or element to pass any of the specified tests 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.

4.5.4 Control tests.

4.5.4.1 Control inspection. Control tests shall be performed upon samples selected in accordance with general inspection level II of MIL-STD-105.

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4.6 Methods of inspection.

4.6.1 Pressure - temperature resistance. To determine conformance to 3.4.1, the filter assembly shall be tested at the pressures and temperatures as specified (see 3.4.1).

4.6.1.1 Pressure and application. Fluid pressure shall be applied by means of a suitable pump. Both fluid and air pressure shall be 15 ± 1 psi for filter assemblies with a flow rate of 25 gallons per hour (gph) or less and a pressure of 40 ± 1 psi for filter assemblies having a flow rate of more than 25 gph. The outlet shall be blocked before the pressure is applied. Pressure shall be applied for 5 minutes and reduced to zero. During the test the filter assembly shall show no signs of leakage.

4.6.1.2 160°F test. For the 160°F test air shall be used instead of test fluid. The assembly shall be submerged in water (stabilized at 160°F), with the air pressure applied. For all tests the pressure shall be applied for 5 minutes and reduced to zero. During the test, the assembly shall show no signs of leakage.

4.6.1.3 300 psi air pressure application. Unless otherwise specified (see 6.2), MS 51085-2 filter assemblies shall have the fuel outlet port plugged and a source of compressed air shall be connected to the fuel inlet port. Air pressure of 300 psi shall then be applied and the fuel filter submerged in water. If no leakage occurs, the assembly shall be dried off, assembled, and the bowl shall be secured to the head with a safety wire.

4.6.2 Testing equipment. A typical test apparatus for the flow rate (see 3.4.2) and filtering efficiency (see 3.4.3) tests is shown in figure 1. The major components of the apparatus should include a pump capable of delivering the test fluid at the specified flow rates and pressures; gages accurate to ± 5 percent to monitor the fluid pressure, injector air pressure, and differential pressure across the specimen; a system for introducing contaminant into the test fluid in measured amounts; a system for measuring the differential pressure across the test filter assembly; a sampling port; and a filter to trap any contaminant which passes through the test filter assembly.

4.6.2.1 Contaminant injector. The contaminant injector shall consist of a container for the contaminant and test fluid, a motor-operated stirring device to maintain a homogenous mixture, and a metering device to permit the mixture to be continually added to the circulating test fluid at a uniform rate.

4.6.2.2 Test fluid. The test fluid shall be a solvent conforming to P-D-680, and shall have a solid contaminant content of not more than 5 milligrams per liter (mg/L). If necessary, the test fluid shall be filtered until this limitation is obtained. Temperature of test fluid shall be $90^\circ \pm 10^\circ\text{F}$.

4.6.2.3 Cleanup filter. A commercially available filter capable of reducing the solid contaminant content of the test fluid to not more than 5 mg/L in a single pass shall be used.

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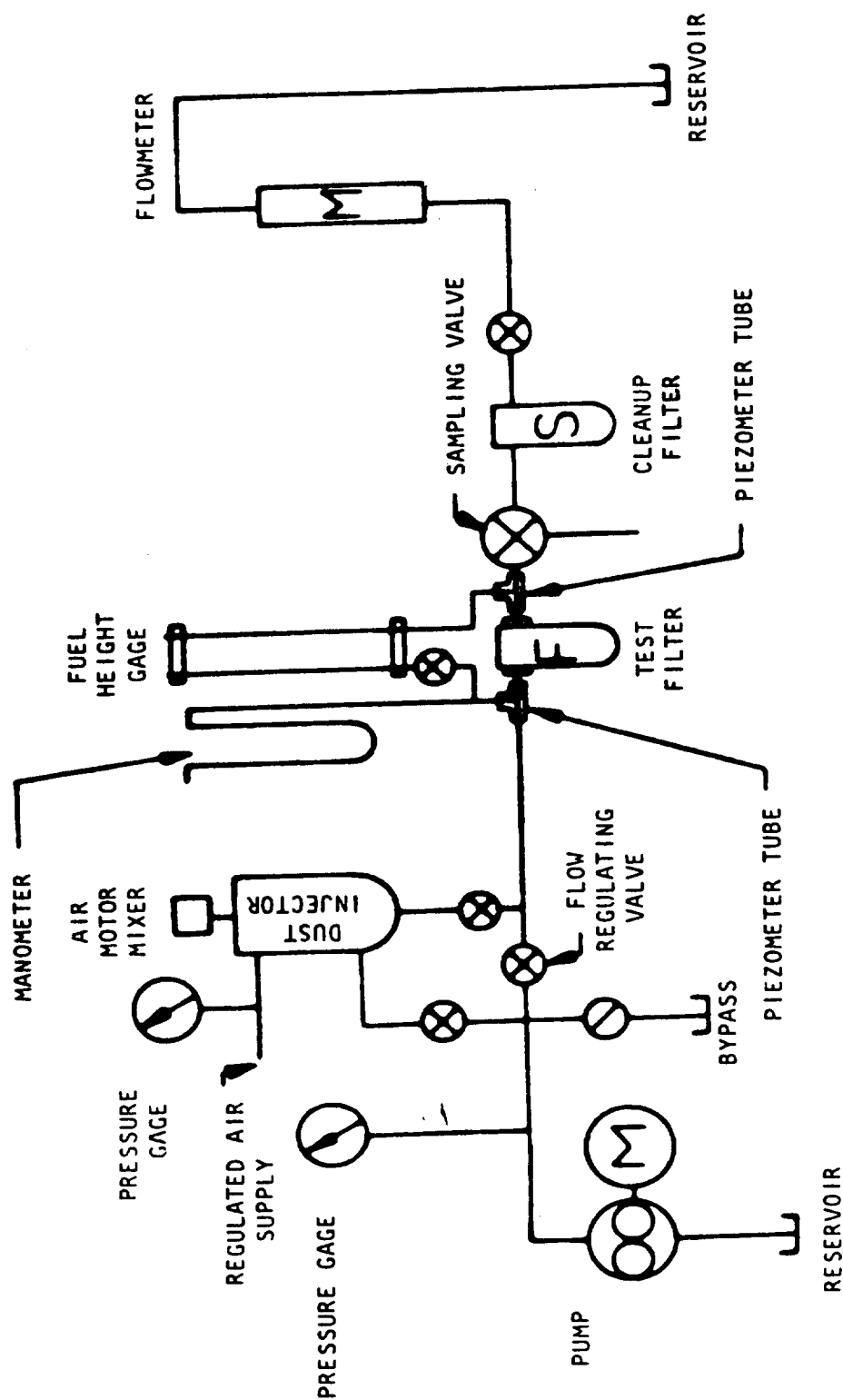


FIGURE 1. Fuel filter test system.

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4.6.3 Flow rate. To determine conformance to 3.4.2 the fluid shall be circulated at the proper rate of flow for 1 hour or until the pressure has stabilized. The pressure differential across the filter shall conform to table I.

4.6.4 Filtering efficiency. To determine conformance to 3.4.3 the flow rate and rate of contaminant addition shall be maintained as specified in table II. Immediately before the test begins, a test fluid sample shall be withdrawn to determine cleanliness of the test fluid (see 4.6.2.2). The test shall begin at the time the first contaminant injection is made. The test shall continue until the time specified in table II has elapsed or until the pressure differential across the filter assembly becomes 6 psi. The pressure differential across the filter assembly shall be measured and recorded at 15-minute intervals after the start of the test. Pressure at the filter inlet shall not fall below 2 psi throughout the test. The quantity of each sample of influent or effluent taken during the test shall be one liter. Samples of influent to the filter assembly shall be taken from the system at the beginning and end of the test to verify the rate of contamination addition. Samples of effluent from the test filter shall be taken 6 minutes after the start of the test and at 1-hour intervals thereafter. Contaminant (solids) content by weight shall be determined by this millipore analysis technique. Curves shall be plotted indicating efficiency versus elapsed test time. Filtering efficiency (percent) shall be calculated from the equation:

$$E_f = \frac{E_i - E_e}{E_i}$$

Where E_f = Filtering efficiency (percent)

E_i = Solids in influent (percent)

E_e = Solids in effluent (percent)

The calculated filtering efficiency shall meet the requirements of table II.

4.6.4.1 Contaminant. The contaminant used in the filtering efficiency test shall consist of the sizes shown in table III. The solid shall be composed of various materials designed for filter testing available on the open market. The A.C. Spark Plug Division, Fine Air Cleaner Dust, package No. 1543094 and Coarse Air Cleaner Dust, package No. 1543637 or equivalent have been satisfactory for filter testing. Class 1 filters shall be tested with fine contaminants and class 2 shall be tested with coarse contaminants.

4.6.5 Vibration resistance. To determine conformance to 3.4.4 vibration resistance shall be tested in accordance with MIL-STD-810, method 514.2, procedure VIII, except a frequency range of 5 to 500 cycles per second shall be used. There shall be no signs of leakage during or after the test.

5. PREPARATION FOR DELIVERY

5.1 Preservation, packaging, packing and marking. Preservation, packaging, packing, and marking shall be in accordance with the applicable packaging standard or packaging data sheet specified by the acquisition activity (see 6.2).

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6. NOTES

6.1 Intended use. The fuel filters covered by this specification are intended for use in the fuel system of internal combustion engines, for stationary and automotive application, and for personnel heaters.

6.2 Ordering data. Acquisition documents should specify the following:

- a. Title, number, and date of this specification.
- b. Type and class to be furnished (see 1.2).
- c. If first article samples are not required (see 3.1).
- d. Applicable military standard drawing (see 3.3.1).
- e. If 300 psi air pressure is not required for MS1085-2 assemblies (see 3.4.1).
- f. If responsibility for inspection shall be other than as specified (see 4.1).
- g. If responsibility for inspection equipment shall be other than as specified (see 4.1.1).
- h. If inspection conditions shall be other than as specified (see 4.3).
- i. If first article inspection is not required (see 4.4).

6.3 Recycled materials. The use of recycled materials which meet the requirements of the applicable material specifications without jeopardizing the intended use of the item shall be encouraged (see 3.2).

6.4 Changes from previous issue. Asterisks are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

Custodian:

Army - AT
Navy - SH
Air Force - 82

Preparing activity

Army - AT

(Project No. 2910-0170)

Review activity:

Army - AV

User activities:

Army - MI
Navy - MC, YD

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL*(See Instructions - Reverse Side)*

1. DOCUMENT NUMBER		2. DOCUMENT TITLE	
3a. NAME OF SUBMITTING ORGANIZATION		4. TYPE OF ORGANIZATION (Mark one)	
b. ADDRESS (Street, City, State, ZIP Code)		<input type="checkbox"/> VENDOR	
		<input checked="" type="checkbox"/> USER	
		<input type="checkbox"/> MANUFACTURER	
		<input type="checkbox"/> OTHER (Specify): _____	
5. PROBLEM AREAS			
a. Paragraph Number and Wording:			
b. Recommended Wording:			
c. Reason/Rationale for Recommendation:			
6. REMARKS			
7a. NAME OF SUBMITTER (Last, First, MI) - Optional		b. WORK TELEPHONE NUMBER (Include Area Code) - Optional	
c. MAILING ADDRESS (Street, City, State, ZIP Code) - Optional		8. DATE OF SUBMISSION (YYMMDD)	

(TO DETACH THIS FORM, CUT ALONG THIS LINE.)