

MIL-I-23310B(AS)  
9 October 1984  

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SUPERSEDING  
MIL-I-23310A(AS)  
16 May 1967

## MILITARY SPECIFICATION

### INHIBITORS, CORROSION, VOLATILE, OIL TYPE

This specification is approved for use by the Naval Air Systems Command, Department of the Navy and is available for use by all Departments and Agencies of the Department of Defense.

#### 1. SCOPE

1.1 Scope. This specification establishes the requirements for oil type volatile corrosion inhibitors, used for the preservation of materials in "closed" systems (see 6.1).

1.2 Classification. The oil type volatile corrosion inhibitors (VCI) covered by this specification shall be of the following grades:

- Grade 1 - Low viscosity
- Grade 2 - Medium viscosity

#### 2. APPLICABLE DOCUMENTS

2.1 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

- O-M-232 - Methanol - (Methyl Alcohol).
- QQ-A-250/4 - Aluminum Alloy 2024, Plate and Sheet.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Systems Engineering and Standardization Department (Code 93), Naval Air Engineering Center, Lakehurst, NJ 08733 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of the document or by letter.

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## SPECIFICATIONS (cont.)

FEDERAL (cont.)

- QQ-C-576 - Copper Flat Products with Slit, Slit and Edge-Rolled, Sheared, Sawed or Machined Edges (Plate, Bar, Sheet, and Strip).
- RR-S-366 - Sieve, Test.
- TT-T-291 - Thinner, Paint, Mineral Spirits, Regular and Odorless.

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- MIL-S-7952 - Steel, Sheet and Strip, Uncoated, Carbon (1020 and 1025) (Aircraft Quality) (Asg)

## STANDARDS

FEDERAL

- FED. TEST METHOD STD. NO. 101 - Test Procedures for Packaging Material.
- FED. STD. 313 - Material Safety Data Sheets, Preparation and Submission of.
- FED. TEST METHOD STD. NO. 791 - Lubricant, Liquid Fuel and Related Products, Methods of Testing.

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- MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes.
- MIL-STD-290 - Packaging of Petroleum and Related Products.

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

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. The issues of the documents which are indicated as DoD adopted shall be the issue listed in the current DoDISS and the supplement thereto, if applicable.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS

- A 568 - Steel, Carbon and High Strength Low Alloy, Hot Rolled Sheet, Hot Rolled Strip and Cold Rolled Sheet, General Requirements.

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## AMERICAN SOCIETY FOR TESTING AND MATERIALS (cont.)

- D 92 - Flash and Fire Points by Cleveland Open Cup, Test for.
- D 97 - Pour Point of Petroleum Oils, Test for.
- D 445 - Kinematic Viscosity of Transparent and Opaque Liquids (and the Calculation of Dynamic Viscosity) Test for.
- D 972 - Evaporation Loss of Lubricating Greases and Oils.

(Copies of ASTM standards or test methods may be obtained from the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.)

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

## 3. REQUIREMENTS

3.1 Qualification. The inhibitors, corrosion, volatile, oil type, furnished under this specification, shall be products that are qualified for listing on the applicable qualified products list at the time set for opening bids (see 4.5 and 6.2).

3.2 Material. The material shall be a volatile type inhibitor in a petroleum base oil conforming to the requirements of this specification. The material shall be homogeneous, free from grit, abrasives, water, chlorides, and other impurities.

3.2.1 Toxicity. The corrosion preventive compound shall have no adverse effect on the health of personnel when used for its intended purpose. The acquiring activity shall refer questions pertinent to the effect of the compound to the appropriate medical service, who will act as advisor. When directed in the contract or order at the time of acquisition award, the manufacturer shall prepare Material Safety Data Sheets (MSDS) in accordance with FED-STD-313. The manufacturer shall send copies to the designated industrial hygienist, the acquisition activity, the using activity, if different, and to the qualifying laboratory (see 4.3, 4.5.1 and 6.2).

3.3 Physical properties. The corrosion preventive compound shall comply with the applicable requirements of table I when tested as specified in Section 4.

3.4 Workmanship. The corrosion preventive compound shall be free from suspended matter, grit, water, or any other adulterant or defects which could cause the material to be unsuitable for the purpose intended.

## 4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, 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 facilities or any other facilities suitable for the performance of the inspection requirements

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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 of components and materials. The contractor is responsible for insuring that materials used were manufactured, tested, and inspected in accordance with the requirements of referenced subsidiary specifications and standards to the extent specified, or, if none, in accordance with this specification. In the event of conflict, this specification shall govern.

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

- a. Qualification inspection (see 4.5).
- b. Quality conformance inspection (see 4.6).

4.3 Submission of Material Safety Data Sheets. When the Material Safety Data Sheets are required, the contractor shall send copies to the designated activities as stated in 3.2.1. The qualifying laboratory copy shall be submitted with qualification sample (see 3.2.1 and 6.2).

4.4 Inspection conditions. Unless otherwise specified, all inspections shall be performed in accordance with the test conditions specified in the applicable paragraph of the specification.

4.5 Qualification inspection. The qualification inspection shall consist of all the examinations and tests specified in table I.

4.5.1 Qualification test samples. Qualification test samples shall consist of 1 gallon of the finished product, 1 quart of the base oil, and 1/2 pint or 1/2 pound (as applicable) of each ingredient added to the base oil. Qualification test samples shall be accompanied by a report showing the formula number of the finished product, base oil and each ingredient added to the base oil and results for all tests and analyses required by this specification and performed by the manufacturer. Qualification test samples, certifications, and reports shall be forwarded to the Commander, Naval Air Development Center, Aircraft and Crew Systems Technology Directorate (Code 60622), Warminster, PA 18974. Samples shall be plainly identified by securely attached durable tags marked with following information:

Inhibitors, Corrosion, Volatile, Oil Type.  
 Grade \_\_\_\_\_  
 Name of manufacturer (plant where material is manufactured).  
 Product formula number.  
 Date of manufacture.  
 Submitted by (name) (date) for qualification tests in accordance  
 with the requirements of MIL-I-23310B(AS) under authority  
 (reference authorizing letter). (See 6.2.)

4.5.2 Retention of qualification. In order to retain qualification of a product approved for listing on the Qualified Products List (QPL), the contractor shall verify by certification to the qualifying activity that the

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contractor's product complies with the requirements of this specification. The time of periodic verification by certification shall be in two-year intervals from the date of the original qualification. The Government reserves the right to re-examine the qualified product whenever deemed necessary to determine that the product continues to meet any or all of the specification requirements.

4.6 Quality conformance inspection. Quality conformance inspection shall consist of examinations and tests listed in table II, which shall be performed on filled containers and shipping containers to determine their conformance with the requirements set forth herein. Unless otherwise specified, inspection shall be performed in accordance with MIL-STD-105.

4.6.1 Sampling.

4.6.1.1 Inspection lot. Unless otherwise specified in the contract or order, the lot size shall consist of filled containers of all material of one grade manufactured as one batch, under essentially the same conditions, and presented for acceptance at one time.

4.6.1.2 Sampling for visual and packaging examination. Samples for visual and packaging examination shall be determined by the inspection level indicated in table II.

4.6.1.3 Samples for quality conformance tests. Sampling for quality conformance tests shall be determined by the inspection level indicated in table II.

4.6.1.4 Acceptance criteria. The acceptance criteria shall be as specified in table II. Sampling and acceptance or rejection shall be in accordance with MIL-STD-105.

4.6.2 Examinations.

4.6.2.1 Examination of filled containers. Random samples of filled containers shall be selected from each lot offered for acceptance in accordance with table II to verify compliance with all requirements of this specification regarding fill, closure, marking and other requirements for which no test method is specified. The compound shall also be examined in accordance with Method 9601 of Fed. Test Method Std. No. 791.

4.6.2.2 Examination of the end product for defects in packaging. An examination shall be made to determine that preservation, packing, and markings as required by Section 5 of this specification are complied with.

4.7 Test conditions. In general, the physical tests contained in this specification shall be made under the controlled atmosphere conditions having a relative humidity of 50 plus/minus 5 percent and a temperature ranging from 70 to 80°F. Waiver of this requirement may be permitted where proper conditioning facilities are not available for control testing. However, for referee purposes, the specified tests shall be made upon the material in the specified atmospheric conditions.

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4.7.1 Preparation of equipment for test.4.7.1.1 Cleaning.

- a. The utensils and cloths used in the preparation of panels and test specimens shall be clean and free of contamination. Solvents shall be clean and renewed frequently. In all stages of treatment handling panels with bare hands shall be avoided. Test panels shall be handled with hooks or forceps at all times. Panels shall not be permitted to contact contaminated surfaces during the cleaning procedure.
- b. After polishing metal panels and test specimens as specified for each procedure they shall be cleaned with surgical gauze and then scrubbed in a beaker of hot mineral spirits conforming to grade I of IT-T-291 with surgical gauze swab. This shall be followed by successive immersions in hot mineral spirits, boiling 95 percent methanol, and boiling absolute methanol, and then allowed to dry, and stored in a desiccator, until ready for use. If storage of more than 24 hours occurs, the surface preparation shall be repeated starting with the hand polishing.
- c. Apparatus used in the VIA test and exhaustion procedure shall be cleaned in a solution of hot water and soap, followed by a double rinse in hot tap water and a final rinse in distilled water.

4.8 Test methods.

4.8.1 Physical tests. The following tests shall be performed in accordance with the applicable ASTM method.

Test	ASTM TEST METHOD
Flash Point	D 92
Pour Point	D 97
Viscosity	D 445

4.8.2 Evaporation loss.

4.8.2.1 Volatile matter. This test shall be conducted at 210°F in accordance with test method ASTM D 972 using a 15.00 plus/minus 0.05 gram sample of the corrosion preventive compound.

4.8.2.2 Viscosity change. After the completion of the evaporation loss test and the evaporation loss has been determined, the residual corrosion preventive compound shall be evaluated for viscosity at 100°F. The percent viscosity change shall be calculated based upon the original viscosity of the compound.

4.8.3 Water displacement and water stability.

4.8.3.1 Test panels. Three panels for this test shall be 2 by 3 by 1/16 inch, low carbon, cold rolled 1020 steel conforming to MIL-S-7952. Badly rusted stock shall not be used for making test panels. The edges of the panels shall be rounded, and prior to cleaning, a 1/16 inch hole shall be drilled in the center of the 2-inch side, 3/16 inch from the edge.



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4.8.3.2 Cleaning test panels. The test surfaces of the panels shall be cleaned in accordance with 4.7.1.1.

4.8.3.3 Sandblasting test panels. The unnumbered side and edges of the test panels shall be sandblasted to a fresh, uniformly, abraded surface with clean, white, dry, sharp sand of a size that will allow all of it to pass through a number 10 sieve, a minimum of 90 percent to pass through a number 20 sieve and not more than 10 percent to pass through a number 50 sieve. The size designation of all sieves shall conform to RR-S-366. Immediately after sandblasting, the panels shall be placed into a container of anhydrous methanol. Remaining residue and contamination shall be removed by holding the panels in a rack at 25 degrees from the vertical and spraying downward with mineral spirits. Flush the test surfaces progressively downward, spraying first the test surface, then the back of the panel and the test surface again. The panels shall then be rinsed in hot mineral spirits and boiling methanol. After the panels are dry they shall be stored in a desiccator and used the same day as prepared.

4.8.3.4 Preparation of corrosion preventive compound. Fifty ml of the corrosion preventive compound shall be placed in a 125 ml Erlenmeyer flask, 5 ml of distilled water added, and the mixture thoroughly shaken. The stoppered flask shall be stored overnight at 130 plus/minus 5°F and then cooled to 77 plus/minus 5°F for testing.

4.8.3.5 Test procedure. Three test panels shall be dipped into distilled water momentarily and drained in a vertical position for not more than 5 seconds, with the bottom edge in contact with absorbent paper. The panels shall be immersed horizontally and without agitation for 15 seconds in a petri or evaporating dish containing 50 ml of the test compound. After draining momentarily, the panels shall be placed in a static humidity chamber, (for example, a desiccator containing some distilled water), for one hour at 77 plus/minus 5°F. At the completion of the static humidity exposure the test compound shall be removed with mineral spirits and examined. The presence of rust, mottling or other abnormal surface stains on any of the panels shall be cause for rejection.

4.8.4 Vapor inhibitor ability (VIA). The vapor inhibitor ability test shall be conducted in accordance with FED. TEST METHOD STD. NO. 101, test Method 4031. (Strict adherence to the details of this test shall be required to obtain accurate and reproducible results.)

4.8.5 Vapor inhibitor ability after exhaustion. The vapor inhibitor ability after exhaustion test shall be conducted in accordance with FED. TEST METHOD STD. NO. 101 Test Method 4031.

4.8.6 Temperature stability. Twenty-five ml of the corrosion preventive compound shall be poured into a one ounce glass jar and tightly sealed. The junction of the glass and lid shall be covered with tape having a low water vapor transmission rate. The jar shall then be exposed to a temperature of 150 plus/minus 2°F for 7 days. At the end of this time it shall be permitted to cool to room temperature.

4.8.6.1 Procedure. The lid shall be removed from the jar. The jar, containing the compound, shall be rapidly placed into a VIA test assembly (see 4.8.4), and a VIA test run. Each compound shall be tested in triplicate.

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4.8.7 Protection. Three panels as described in 4.8.3.1 shall be cleaned in accordance with 4.7.1.1. The panels shall be dipped in the test compound and drained for 1 hour at room temperature. One panel shall be suspended from the lid of a 2-3/8 inch mouth diameter and 7 inch deep quart jar in such a manner as to prevent contact with the side walls. Place 2 ml of distilled water in the jar. Place the lid on the jar and seal the junction of the lid and the jar with a pressure sensitive tape. Place the assembly in a 120°F oven for 168 hours. This test shall be run in triplicate. Remove the test specimen and examine for the requirement listed in table I.

4.8.8 Acid neutralization.

4.8.8.1 Test panels. Three panels for this test shall be 2 by 3 by 1/16 inch, of low carbon, cold rolled 1020 steel conforming to MIL-S-7952. The panels shall be cleaned as specified in 4.7.1.1.

4.8.8.2 Test procedure. Three test panels shall be handled separately with forceps, and totally immersed for not more than one second in a 0.1 plus or minus .01 percent aqueous hydrobromic acid solution. Within one second thereafter the panels shall be dipped into the sample of corrosion preventive compound under test maintained at a temperature of 77 plus/minus 5°F. In performing this test the transfer of the panels from the hydrobromic acid to the test compound shall be done immediately without waiting for the draining of any excess hydrobromic acid. The test compound sample shall be placed in a 400 ml beaker. The panels shall be totally immersed and removed from the test compound twelve times in 60 seconds. The position of the tips of the forceps shall be changed for each immersion, to assure access of the test compound to all surfaces of the panels. The panels shall be placed in a slotted wood block support and stored at 77 plus/minus 5°F for 4 hours. At the completion of the storage period the test compound is removed with mineral spirits and examined for corrosion, etching and pitting as stated in table I. Any corrosion, staining or other attack occurring within 1/8 inch of any edge of the panel or within 1/8 inch of the line of contact of the panel and the upper surface of the slot in the wood block support shall not be considered in evaluating the test results.

4.8.9 Corrosivity.

4.8.9.1 Test specimens. The test specimens shall be 1 by 2 by 1/4 inch of metal conforming to the following:

Aluminum	QQ-A-250/4
Copper	QQ-C-576
Steel	MIL-S-7952

4.8.9.2 Preparation of test specimens. Three each of the aluminum, copper and steel specimens shall be used. The test specimens shall be polished by use of slow speed, horizontal, metallurgical polishing wheel with the final polishing being done with 280 grit silicon carbide or aluminum oxide paper. The specimen shall be held in a suitable holder to avoid contact with the operator's hands. The specimens shall then be cleaned as specified in 4.7.1.1. After the specimens are dry, they shall be stored in a desiccator and used the same day as prepared.



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4.8.9.3 Test procedure. Weigh each specimen and place in a wide mouth jar approximately 3 inches in diameter and fitted with a screw cap. A suitable means should be used to insure that the specimens do not touch each other. Cover the specimens with 300 ml of the test corrosion preventive compound. The sealed jar shall then be placed in an oven maintained at 130 plus/minus 5°F for 7 days. Upon completion of the test, remove the compound and any corrosion products from the specimens by swabbing with mineral spirits, followed by methanol, employing surgical gauze pads. Follow each swabbing operation by a rinse in a clean solvent. Reweigh the specimens and calculate the change in weight in milligrams per square centimeter. A change in weight shall not exceed the limits stated in table I.

4.8.10 Storage stability. The stored qualification sample (one year) of corrosion preventive compound shall not be agitated prior to the removal of 100 ml by pipette or siphon from the upper quarter of the stored sample. This sample shall be subjected to the VIA test of paragraph 4.8.4. After removal of the sample for the VIA test, the material shall be thoroughly agitated and the viscosity determined as specified in paragraph 4.8.1.

## 5. PREPARATION FOR DELIVERY

5.1 Preservation, packaging, and marking. Unless otherwise specified in the contract or order, the corrosion preventive compound shall be preserved, packaged, and marked in accordance with the requirements of MIL-STD-290. The levels of preservation and packing and the type and size of the containers shall be as specified in the procurement document (see 6.2).

## 6. NOTES

6.1 Intended use. The oil type volatile corrosion inhibitors are intended for use as a preservative in "closed" systems constructed essentially of ferrous and ferrous alloys with components containing aluminum and aluminum based alloys. The volatile compound will provide protection above the oil level. It can also be effectively used as a contact preservative. It is not intended for use as an operational preservative oil and should not be used in applications where magnesium, cadmium-plated or rubber components are present. It is not effective as a vapor phase inhibitor unless an adequate reservoir of oil can be maintained. A minimum of 0.15 quart for grade 1 and 0.25 quart for grade 2 should be used for each cubic foot of area to be protected.

6.2 Ordering data. Acquisition documents should specify the following:

- a. Title, number, and date of this specification.
- b. Grade desired (1.2).
- c. Level of preservation and level of packing required (5.1).
- d. Type and size of containers (5.1).
- e. Addresses for submission of MSDSs (see 3.2.1).

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6.3 Handling precautions. Personnel handling the materials covered by this specification should be instructed to wash their hands thoroughly with soap and water before handling or eating food. Any questions raised regarding toxicity should be referred by the procuring agency to the departmental medical authority.

6.4 Compatibility. The blending of different manufacturer's VCI oils procured in accordance with this specification is not recommended. The permissible variation in chemical composition of several manufacturer's products might cause serious compatibility problems.

6.5 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.

Preparing Activity  
Navy - AS  
(Project No. 6850-N756)

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TABLE I. Physical properties.

Test	Unit	Requirement	Test paragraph
Flash point Grade 1 Grade 2	°F	240 min. 250 min.	4.8.1
Pour point Grade 1 Grade 2	°F	-60 max. -10 max.	4.8.1
Viscosity, kinematic Grade 1 210°F 100°F -40°F Grade 2 210°F 100°F -40°F	Centistokes	Not required 12 min. 8,000 max. 8.50 to 12.98 95 to 125 Not required	4.8.1
Evaporation loss Volatile matter  Grade 1 Grade 2  Viscosity change at 100°F  Grade 1 Grade 2	Percent   Percent	17 max 5 max.  -5 to +20 -5 to +20	4.8.2
Water displacement and water stability	--	No rust, mottling or other abnormal sur- face stains permitted on the test specimen.	4.8.3

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TABLE I. Physical properties - Continued

Test	Unit	Requirement	Test Paragraph
Vapor inhibitor ability (VIA)	--	Test specimen shall show no visible evidence of attack consisting of corrosion, etching, or pitting except that haze or stain that can be readily removed by wiping with gauze saturated with meth- and shall be discounted as well as any attack occurring within 1/16 inch of the edge of the specimen.	4.8.4
Vapor inhibitor ability (VIA) after exhaustion	--		4.8.5
Temperature stability	--		4.8.6
Protection	--		4.8.7
Acid neutralization	--		4.8.8
Corrosivity	Milligrams per square centimeter	The corrosion preventive compound shall not produce corrosive effects as shown by weight gain or loss in excess of the following, to the metal test specimens indicated: aluminum 0.2 steel 0.5 copper 1.5	4.8.9
Storage stability	--	Shall conform to viscosity and VIA test requirements after one year	4.8.10

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TABLE II. Quality conformance inspection.

Examination or Test	Requirement paragraph	Examination or test paragraph	Inspection level	AQL
Visual examination		4.6.2.1	S-3	2.5
Packaging examination		4.6.2.2	S-2	2.5
Flash point	Table I	4.8.1	S-1	#
Pour point	Table I	4.8.1	S-1	#
Viscosity	Table I	4.8.1	S-1	#
Evaporation loss	Table I	4.8.2	S-1	#
Vapor inhibitor ability	Table I	4.8.4	S-1	#

# The AQL will vary so that the acceptance number will be zero and the rejection number will be 1.

## STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

*(See Instructions - Reverse Side)*

1. DOCUMENT NUMBER <b>MIL-I-23310B(AS)</b>	2. DOCUMENT TITLE <b>INHIBITORS, CORROSION, VOLATILE, OIL TYPE</b>
3a. NAME OF SUBMITTING ORGANIZATION	4. TYPE OF ORGANIZATION <i>(Mark one)</i> <input type="checkbox"/> VENDOR  <input type="checkbox"/> USER  <input type="checkbox"/> MANUFACTURER  <input type="checkbox"/> OTHER <i>(Specify):</i> _____
b. ADDRESS <i>(Street, City, State, ZIP Code)</i>	
5. PROBLEM AREAS	
a. Paragraph Number and Wording:	
b. Recommended Wording:	
c. Reason/Rationale for Recommendation:	
6. REMARKS	
7a. NAME OF SUBMITTER <i>(Last, First, MI) - Optional</i>	b. WORK TELEPHONE NUMBER <i>(Include Area Code) - Optional</i>
c. MAILING ADDRESS <i>(Street, City, State, ZIP Code) - Optional</i>	8. DATE OF SUBMISSION <i>(YYMMDD)</i>