

MIL-C-46487 (Ord)
6 February 1961
Superseding
FA-PD-MI-1808 (Rev. 1)
dated 5 December 1956

MILITARY SPECIFICATION
FOR
CLEANING, PREPARATION AND ORGANIC COATING OF STEEL CARTRIDGE CASES

1. SCOPE

1.1 This specification covers the requirements for cleaning, surface preparation and organic coating for steel artillery ammunition cartridge cases, 37MM and larger and steel small arms ammunition cartridge cases, ammunition, through 30 millimeter.

1.2 The cartridge case finish system shall be one of the following types, as specified (see 6.1).

Type I Epoxide Modified Phenol Formaldehyde Varnish
Type II - Phenol Formaldehyde Varnish

2. APPLICABLE DOCUMENTS

2.1 The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids shall apply.

SPECIFICATIONS

Federal

O-A-115 - Acid - Sulphuric, Technical Grade
O-C-303 - Chromic Acid, Technical Grade
O-P-313 - Phosphoric Acid, Technical Grade
O-A-51 - Acetone, Technical
UU-T-101 - Tape, Gummed, Mending Reinforcing and Securing

Military

MIL-G-2550 - General Specification for Ammunition Except
Small Arms Ammunition
MIL-V-12276 - Varnish, Phenolic Baking

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STANDARDS

Federal

Federal Test Method Standard No. 151 Metals; Test Methods

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

3. REQUIREMENTS

3.1 General. - Unless otherwise specified by the procuring activity or unless previous approval has been granted on continuing or supplemental contracts, details of the proposed procedure, equipment and chemicals to be used shall be forwarded in writing to Frankford Arsenal, Philadelphia 37, Pennsylvania, ATTN: ORDBA-6111 for review, comment and approval. The contractor shall not commence operations until such time as he has received written approval of the proposed methods, procedures and chemicals to be used. The exact designation of each material proposed for use shall be stated. The proposed procedure shall include a detailed method of control, including limits for time, temperature, pH values, method of application of the organic coating, method of reworking, repair and all other pertinent details which will insure compliance with the requirements of this specification.

3.2 Preproduction Sample. - Unless otherwise directed by the contracting officer, a preproduction sample shall be required.

3.3 Finish Systems. - Type I and Type II systems shall consist of a surface treatment followed by the application of an organic coating.

3.3.1 Surface Treatment.

3.3.1.1 Foreign Matter. - All surfaces of the cartridge case shall be thoroughly cleaned to remove all traces of grit, oil, wax, grease, rust or other foreign matter prior to the start of each process or treatment.

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3.3.1.2 Finish System Type I. - Unless otherwise specified by the contracting officer, the surface treatment for the Type I finish system shall consist of a chemical conversion treatment which will produce a continuous amorphous iron phosphate coating on the metal surfaces.

3.3.1.3 Finish System Type II. - Unless otherwise specified by the contracting officer, the surface treatment for the Type II finish system shall consist of either an acid etch treatment or a chemical conversion treatment which will produce a continuous amorphous iron phosphate coating on the metal surfaces.

3.3.1.4 Iron Phosphate Coating. - The iron phosphate treatment shall deposit a hard iridescent coating on the previously cleaned metal surfaces. The processing for the iron phosphate treatment shall consist of not less than 5 stages, as follows:

- a. Cleaning
- b. Water rinse
- c. Phosphating
- d. Water rinse
- e. Conditioning rinse

When pickling to remove rust and scale is necessary, the process for this treatment shall consist of not less than 7 stages as follows:

- a. Cleaning
- b. Water rinse
- c. Pickling
- d. Water rinse
- e. Phosphating
- f. Water rinse
- g. Conditioning rinse

3.3.1.4.1 Weight of Phosphate Coating. - The iron phosphate coating weight on the finished surface shall be 2.5 milligrams per square decimeter (mg/sq. dec) minimum and 9 mg/sq. dec maximum (25 mg per square foot minimum and 80 mg/sq. ft maximum).

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3.3.1.5 Acid Etch Treatment. - When an acid etch treatment is used for the Type II finish system, it shall leave the metal surface bare. The surface treatment shall consist of not less than five (5) stages as follows:

- a. Cleaning
- b. Water rinse
- c. Acid treatment
- d. Water rinse
- e. Conditioning rinse

3.3.1.5.1 When sulphuric acid which shall comply with the requirements of Federal Specification O-A-115 is used for rust removal, such treatment may be considered sufficient for the acid etch treatment, required in paragraph 3.3.1.5, stage C.

3.3.1.6 Conditioning Rinse. - The conditioning rinse shall be maintained at a pH value of from 2.0 to 5.0 by the addition of a sufficient amount of chromic acid which shall comply with the requirements of Federal Specification O-C-303 (approximately .08 ounces per gallon) or a mixture of phosphoric acid which shall comply with the requirements of Federal Specification O-P-313 and chromic acids (approximately .04 ounces of each per gallon).

3.3.1.7 Rinsing. - All water rinses shall employ clean running water in a spray unit or in a continuous overflowing tank. After rinsing, the cartridge case shall be free of harmful chemicals.

3.3.1.8 Drying. - The drying procedure shall be such that at the end of the drying period or cycle the temperature of the cartridge case shall be not less than 70 degrees fahrenheit ($^{\circ}$ F).

3.3.2 Organic Coating

3.3.2.1 Type I. - The organic coating for Type I finish system shall consist of an epoxide modified phenol formaldehyde varnish which shall comply with the requirements of Specification MIL-V-12276, Type III when cured at the baking schedule required by the contractor's process.

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3.3.2.2. Type II. - The organic coating for Type II finish system shall consist of a phenol formaldehyde varnish which shall comply with the requirements of Specification MIL-V-12276, Type I when cured at the baking schedule required by the contractor's process.

3.3.2.3 Coating Application. - The organic coating shall be applied to the cartridge case within 4 hours after surface treatment has been completed, preferably while cartridge case is still warm. The organic coating applied to the cartridge case shall produce an adherent film with no visible pinholes, craters, blisters or unevenness. Particular care shall be taken to obtain a smooth coating on roughened or machined surfaces.

3.3.2.4 Cured Coating. - After curing, the organic coating shall be smooth and continuous, completely covering the surface of the cartridge cases.

3.3.2.4.1 Thickness of Coating. - Unless otherwise specified, on the cartridge case drawing, the thickness of the organic protective coating shall be not less than 0.0003 inches and not greater than 0.001 inches.

3.3.2.4.2 Salt Spray. - For lot acceptance and approval of the preproduction sample, the cartridge cases with approved treatment and finish shall withstand a twenty four (24) hour salt spray exposure in accordance with Federal Test Method Standard No. 151 Metals; Test Methods 811 and shall be without any evidence of rust. However, rust on stamped letters on the head, within one thirty second (1/32) inches of all other edges or on any surface not requiring coating shall be permitted.

3.3.2.4.3 Curing. - Type I and Type II finish systems after curing, shall not soften or loosen when subjected to the acetone curing test. The acetone shall comply with the requirements of Federal Specification O-A-51.

3.3.2.4.4 Flexibility. - Type I finish system, after curing, shall not crack or flake when subjected to the flexibility test.

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3.4 Rework or Repair. - When a lot of cartridge cases is rejected for noncompliance with the requirements of the specification, the coating shall be completely removed and the cases reworked with the type finish specified for this application. The recoated cases shall comply with 3.3.2. When repair to damaged or defective areas is made, the varnish shall be removed from the area to be repaired. The area shall be solvent cleaned prior to recoating. Type I or Type II finishes shall be repaired with the varnish or other materials specified for this application.

4. QUALITY ASSURANCE PROVISIONS

4.1 General. - The quality assurance provisions in this section and other documents referenced in this specification are applicable to inspection performed by or for the Government. Inspection shall be in accordance with Specification MIL-G-2550, except as specified herein.

4.1.1 Contractor Inspection. - The supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified, the supplier may utilize his own or any other inspection facilities and services acceptable to the Government. Inspection records of the examination and tests shall be kept complete and available to the Government as specified in the contract or order. 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 requirement.

4.1.2 Contractor Quality Assurance System. - The contractor shall provide and maintain an adequate quality assurance system, acceptable to the Government covering the supplies under the contract. A current written description of the system shall be submitted to the contracting officer prior to the start of production. The written description will be considered acceptable when, as a minimum, it provides the quality assurance required by this specification and other applicable documents referenced in this specification. The contractor shall notify the Government of and obtain approval for any change to the written procedure that might affect the degree of assurance required by this specification or other applicable documents referenced herein.

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4.1.3 Government Verification. - All quality assurance operations performed by the contractor will be subject to Government verification at unscheduled intervals. Verification will consist of (a) surveillance of the operations to determine that practices, methods, and procedures of the written inspection plan are being properly applied, and (b) Government product inspection to measure quality of product offered for acceptance. Deviations from the prescribed or agreed upon procedures or instances of poor practices which might have a detrimental effect upon the quality of the product will be immediately called to the attention of the contractor. Failure of the contractor to promptly correct deficiencies discovered will be cause for suspension of acceptance until correction has been made or until conformance of product to prescribed criteria has been demonstrated. To avoid interference with operations, the contractor shall designate a responsible official or officials to whom the Government inspector will report such instances.

4.2 Preproduction Inspection. - Unless otherwise specified in the detail specification, 4 cartridge cases from the preproduction sample required by the detail specification shall be subjected to the test prescribed herein. The sample shall be processed in the same manner, using the same material and procedures as will be used in regular production and shall be obtained from the same source of supply. After inspection and provisional acceptance at source the preproduction sample shall be inspected for all requirements of this specification. The Government reserves the right to require new preproduction samples until such time as an acceptable sample is submitted.

4.3 Inspection Provisions. - Alternative inspection procedures and inspection equipment may be used by the contractor when such procedures and equipment provide, as a minimum, quality assurance required in the contractual documents. The inspection procedures or equipment specified in this specification will prevail in case of dispute.

4.3.1 Material. - Authenticated reports of objective tests performed on the material by the contractor shall be required to insure compliance with the chemical requirements. Reports shall include positive identification of the material, the applicable requirements, the specific tests performed and the results obtained.

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Numerical results of each specimen or sample inspected shall be included except that where numerical results are impossible an adjective description shall be used. Initial test reports shall accompany the preproduction sample. Prior to inspection the inspector shall determine from the information stated on test reports whether the material submitted complies with the requirements. Material which does not comply shall be rejected.

4.3.2 Submittal of Product. - The contractor shall submit the product in accordance with the requirements of the detail specification.

4.3.3 Inspection Testing. - The following tests shall be in accordance with the provisions of 4.4 except as provided in 4.3.

4.3.3.1 pH Factor. - The pH factor of the conditioning rinse shall be determined every 2 hours by either testing the surfaces of 2 cartridge cases as they come from the rinse or by checking the rinse itself. Failure of the rinse to comply with 3.3.1.6 shall be reported to the contractor. Failure on the part of the contractor to take necessary corrective action will be cause for suspension of inspection for acceptance until the corrective action has been taken.

4.3.3.2 Weight of Phosphate Coating. -

4.3.3.2.1 Preproduction Sample. - Two test panels shall be processed with the preproduction sample up to the completion of the phosphate coating operation. Failure of any of the test panels to comply with 3.3.1.4.1 shall be cause for rejection of the preproduction sample.

4.3.3.2.2 Production Sample. - Two test panels shall be processed with each 4 hours of production up to the completion of the phosphate coating operation. Failure of any test panels to comply with 3.3.1.4.1 shall be cause for rejection of all cartridge case processed since the last acceptable test panels for this test.

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4.3.3.3 Thickness of Organic Coating.

4.3.3.3.1 Preproduction Sample. - Unless otherwise specified in the detailed specification, 4 cartridge cases from the preproduction sample shall be subjected to this test. Failure of any specimen to comply with 3.3.2.4.1 shall be cause for rejection of the preproduction sample.

4.3.3.3.2 Production Lot Sample. - Unless otherwise specified in the detailed specification, one cartridge case from each 1000 cartridge cases or fraction thereof shall be subjected to this test, except that in no instance shall there be less than 2 cartridge cases selected and tested for each 8 hours production. Failure of any specimen to comply with 3.3.2.4.1 shall be cause for rejection of the production represented by the failing sample.

4.3.3.4 Salt Spray.

4.3.3.4.1 Preproduction Sample. - Unless otherwise specified by the detail specification, 2 cartridge cases from the preproduction sample shall be subjected to this test. Failure of any specimens to comply with 3.3.2.4.2 shall be cause for rejection of the preproduction sample.

4.3.3.4.2 Production Lot Sample. - One cartridge case from each 5000 cartridge cases produced, during the first 5 days of production, shall be subjected to this test, except that not less than 2 samples from each 8 hours daily production shall be selected and tested. Failure of any specimens to comply with 3.3.2.4.2 shall be cause for rejection of the lot. When the samples selected from the first 5 days production complies with 3.3.2.4.2, the sample size may be reduced to one cartridge case from each 10,000 cartridge cases or fraction thereof, but in no instance shall there be less than 2 cartridge cases per lot subjected to this test. Failure of any specimens to comply with 3.3.2.4.2 shall be cause for rejection of the lot. When on reduced sampling, rejection of a lot for non-compliance with 3.3.2.4.2 shall be cause for returning to the original method of sampling until 5 successive days production has been accepted, after which reduced sampling may again be instituted, until such time as another lot failure occurs.

4.3.3.5 Curing Test. - Unless otherwise specified in the detail specification, one cartridge case from the preproduction sample and one cartridge case from each 4 hours production or

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fraction thereof shall be subjected to this test. Failure of the specimen to comply with 3.3.2.4.3 shall be cause for rejection of the preproduction sample or the 4 hours production represented by the failing specimen.

4.3.3.6 Flexibility Test.

4.3.3.6.1 Small Arms Ammunition Cartridge Cases, Preproductic Sample. - Unless otherwise specified in the detail specification, 2 cartridge cases or sections of 2 cartridge cases from the preproduction sample, shall be subjected to this test. Failure of any specimens to comply with 3.3.2.4.4 shall be cause for rejection of the lot.

4.3.3.6.1.1 Small Arms Ammunition Cartridge Cases, Production Sample. - Unless otherwise specified in the detail specification, 2 cartridge cases or sections of 2 cartridge cases, from each 8 hours production shall be subjected to this test. Failure of any specimen to comply with 3.3.2.4.4 shall be cause for rejection of the lot.

4.3.3.6.2 Artillery Ammunition Cartridge Cases, Production Sample. - Unless otherwise specified in the detail specification, 2 test panels 4 inches by 6 inches by 0.0125 inches, made from the same material as the cartridge case, or plain carbon cold rolled steel which have been processed with the lot of cartridge cases, shall be subjected to this test. Failure of any specimens to compl with 3.3.2.4.4 shall be cause for rejection of the lot.

4.3.3.6.2.1 Artillery Ammunition Cartridge Cases, Production Lot Sample. - Unless otherwise specified in the detail specification 2 test panels 4 inches by 6 inches by 0.0125 inches, made from the same material as the cartridge case, or plain carbon cold rolled steel, which have been processed with the lot of cartridge cases, shall be subjected to this test. Failure of any specimens to compl with 3.3.2.4.4 shall be cause for rejection of the lot.

4.3.4 Retest. - In the event of a lot failure in any test phase, at the request of the contractor, a retest will be permitted using 6 cartridge cases from the failing lot. The retest will be confined to the phase or phases in which the original specimen failed. Failure of more than one specimen from the retest sample to comply with the applicable requirements shall be cause for rejection of the lot. No retest will be permitted on preproduction sample.

4.3.5 Inspection Equipment. - The examination and tests shall be made using equipment approved by the Government.

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4.4 Test Methods and Procedures.

4.4.1 pH Factor. - The pH factor of the conditioning rinse shall be determined by the use of Universal pH papers or equivalent, by applying the paper to the side of the cartridge case immediately after removal from the rinse or to the rinse bath itself.

4.4.2 Weight of Phosphate Coating. - Two (2) test panels, 4 inches wide by 6 inches long, made from the same material as the cartridge cases shall be processed through all stages with the cartridge cases. When the panels have been processed, they shall be dried and accurately weighed, after which the coating shall be completely removed, by immersion in 5 percent chromic acid solution at 165 degrees Fahrenheit plus or minus 2 degrees fahrenheit ($^{\circ}$ F) for 15 minutes. The test panels shall again be rinsed, dried and weighed and the surface of both sides calculated. Coating weight shall be determined from the following formulas.

$$\text{Coating Weight (mg/sq. dec.)} = \frac{\text{Initial weight in grams} - \text{final weight in grams}}{\text{X } 100,000} \text{ Total Area in Sq. Cms.}$$

$$\text{Coating Weight (mg/sq. ft.)} = \frac{\text{Initial weight in grams} - \text{final weight in grams}}{\text{X } 144,000} \text{ Total Area in Sq. Inches}$$

The chromic acid used in this test shall conform to the requirements of Specification O-C-303. The solution shall be used one time only.

4.4.3 Thickness of Organic Coating. - The thickness of the protective organic coating shall be tested using gaging equipment designed for this purpose, using the method prescribed by the manufacturer of the equipment. (See 6.5)

4.4.4 Salt Spray. - The salt spray test shall be performed using a 20 percent sodium chloride solution in accordance with Method 811. In performing this test the equipment and criteria prescribed by Federal Test Method Standard No. 151 shall be utilized.

4.4.5 Curing Test. - An area of at least one (1) inch square on the sample cartridge case shall be kept wet with acetone, complying

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with Federal Specification O-A-51, for two (2) minutes. The area being tested shall be vigorously rubbed with the thumb or the hand and visually inspected for evidence of lifting, blistering or softening.

4.4.6 Flexibility Test.

4.4.6.1 Small Arms Ammunition Cartridge Cases. - The cartridge cases or sections thereof shall be held in a vice and bent 180 degrees, care shall be taken so as not to damage the organic coating at the bend with the creasing tool. A strip of transparent pressure sensitive tape conforming to the requirements of Federal Specification UU-T-101 shall be pressed firmly over the bend area, and then stripped off. Upon removal, the tape shall be visually examined for presence of organic coating adhering thereto.

4.4.6.2 Artillery Ammunition Cartridge Cases. - The sections removed from the cartridge cases of the preproduction sample and the coated test panels representing each production lot shall be tested by bending the sample 180 degrees rapidly around a mandrel 0.125 inches plus or minus 0.01 inches in diameter, after which the coating of the bend area shall be visually examined for cracks. A strip of transparent pressure sensitive tape conforming to Federal Specification UU-T-101 shall be pressed firmly over the bend area, and then stripped off. Upon removal, the tape shall be visually examined for presence of organic coating adhering thereto.

5. PREPARATION FOR DELIVERY

5.1 Preparation for delivery not applicable.

6. NOTES

6.1 Intended Use. - Type I coating should be used on all cartridge cases 20MM and smaller and on all other sizes when the steel may be subjected to deformation, after the application of the coating. Phenol formaldehyde varnish which has been modified by the addition of an epoxide resin has increased flexibility permitting deformation of a coated steel item without damage to the coating. Type II coating should be used where there is no further deformation of the metal after the application of the coating.

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6.2 Color. - Slight variation in color of the coated surface due to chromic acid rinse shall not be cause for rejection.

6.3 Rinsing. - Adequate rinsing is very important in the cleaning procedure. When the water film remaining on the case after the conditioning rinse maintains its continuity (is free from water break) the surface may be considered free from oil and grease.

6.4 Optimum results are obtained with varnish thickness between 0.0004 inches and 0.0006 inches.

6.5 For testing thickness of the organic coating the following instruments are recommended.

Amico - Brenner Magne Gages - American Instrument Co.,
Silver Springs, Md.

Elecometer - Distributed by Henry H. Gardner Laboratory, Inc.
4723 Elm St. Bethesda 14, Maryland.

G.E. Gage - General Electric Co., Schenectady, N. Y.

Lea Gage - Lea Manufacturing Co., Waterbury, Conn.

Krouse, Portable Magnifying Micrometer - McNary Engineering
Service Springfield, Ohio

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