

## METRIC

MIL-DTL-440D (AR)  
30 September 2015  
SUPERSEDING  
MIL-C-440C (AR)  
25 November 1974

## DETAIL SPECIFICATION

## COMPOSITION A-3 AND A-4

This specification is approved for use by the US Army Armament Research, Development and Engineering Center (ARDEC), and is available for use by all Departments and Agencies of the Department of Defense.

## 1. SCOPE

1.1 Scope. This specification covers two high explosives for use in ammunition.

1.2 Classification. The explosives are designated by the following compositions (See 6.1).

Composition A-3

Composition A-4

1.2.1 Compositions. Composition A-3 are of the following:

Type I.

- |         |   |  |
|---------|---|--|
| Class 1 | - | Minimum bulk density of 0.77 g/cm <sup>3</sup> , typically for Army use. |
| Class 2 | - | Minimum bulk density of 0.81 g/cm <sup>3</sup> , typically for Navy use. |

Type II. Composition A-3, Type II can be found in specification MIL-C-63217.

Comments, suggestions, or questions on this document should be addressed to Commander, US Army ARDEC, RDAR-EIQ-SE, Picatinny Arsenal, New Jersey 07806-5000 or emailed to [usarmy.picatinny.ardec.list.ardec-stdzn-branch@mail.mil](mailto:usarmy.picatinny.ardec.list.ardec-stdzn-branch@mail.mil). Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at <https://assist.dla.mil>.

AMSC N/A

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## 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 cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements of 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 cited in the solicitation or contract.

#### DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-DTL-398	-	RDX (Cyclotrimethylenetrinitramine)
MIL-W-20553	-	Wax, Desensitizing

#### DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-650	-	Explosive; Sampling, Inspection and Testing
MIL-STD-1168	-	Ammunition Lot Numbering and Ammunition Data Card
MIL-STD-1916	-	DOD Preferred Methods for Acceptance of Product

(Copies of these documents are available online at <http://quicksearch.dla.mil/>)

2.3 Non-Government publications. The following document(s) form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents are those cited in the solicitation or contract.

#### ASTM INTERNATIONAL

ASTM E11	-	Standard Specification for Woven Wire Test Sieve Cloth and Test Sieves
ASTM E203	-	Standard Test Method for Water Using Volumetric Karl Fischer Titration
ASTM E300	-	Standard Practice for Sampling Industrial Chemicals

(Application for copies should be addressed to the ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA, 19428-2959 or [www.astm.org](http://www.astm.org).)

2.4 Order of precedence. Unless otherwise noted herein or in the contract, in the event of a conflict between the text of this document and the references cited, 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 Required inspections.

3.1.1 First article. When specified (see 6.2), a sample of Composition A-3 and/or Composition A-4 shall be subjected to first article inspection in accordance with 4.2.

3.1.2 Conformance inspection. A sample of Composition A-3 and/or Composition A-4 shall be subjected to conformance inspection in accordance with 4.3.

3.2 Material. Composition A-3 and A-4 shall consist of RDX and shall be thoroughly and uniformly coated with a desensitizing wax to form a homogeneous composition.

3.2.1 RDX. Compositions A-3 and A-4 shall consist of RDX crystals, complying with the requirements of MIL-DTL-398, Type II.

3.2.2 Desensitizing wax. The desensitizing wax shall comply with the requirements of MIL-W-20553.

3.2.3 Composition. The composition shall be as specified in Table I, on a moisture free basis.

TABLE I. Composition.

	Composition A-3	Composition A-4
RDX, %	91.0 $\pm$ 0.7	97.0 $\pm$ 0.5
Desensitizing wax, %	9.0 $\pm$ 0.7	3.0 $\pm$ 0.5

3.3 Moisture. The moisture content of the compositions shall be no greater than 0.1 percent.

3.4 Acidity. The acid content, as acetic acid, shall be no greater than 0.02 percent.

3.5 Insoluble particles. There shall be no insoluble particles retained in a No. 40 sieve and not more than 5 insoluble particles retained on a No. 60 sieve when tested in accordance with 4.5.4.

3.6 Granulation. All percentages shall be by weight using sieves conforming to ASTM E11. The powder shall pass through the required sieves readily without balling or the particles clinging together. The composition shall comply with granulation requirements specified in Table II.

TABLE II. Granulation.

Through Sieve No.	Composition A-3		Composition A-4	
	%, Min	%, Max	%, Min	%, Max
6	100	-	100	-
50	-	-	-	95
100	-	5	-	25

3.7 Bulk density. Unless otherwise specified (see 6.2), Composition A-3 shall have a minimum bulk density of 0.77 g/cm<sup>3</sup> for Type I, Class 1 and 0.81 g/cm<sup>3</sup> for Type I, Class 2 and Composition A-4 shall have a minimum bulk density as specified (see 6.2) when determined in 4.5.6.

3.8 Ammunition lot numbering. Ammunition lot numbers shall be assigned in accordance with MIL-STD-1168.

3.9 Workmanship. Composition A-3 and/or A-4 shall be free of coarse gritty particles, visible impurities and foreign material such as dirt, rust, paint, metal chips or any other foreign objects so that the safety and reliability of the explosive are not compromised. The composition shall be thoroughly and uniformly coated with a desensitizing wax.

3.10 Energetic material qualification. Composition A-3 and A-4 and all energetic materials or manufacturing processes used therein shall be qualified for their intended military use by the Army Qualification Authority (see 6.5).

## 4. VERIFICATIONS

TABLE III. Requirement/verification cross reference matrix.

Method of Verification 1- Analysis 2- Demonstration 3- Examination 4- Test		Classes of Verification A- First article B- Conformance						
Section 3 Requirement	Description	Verification Method				Verification Class		Section 4 Verification
		1	2	3	4	A	B	
3.1.1	First article	X		X	X	X		4.2
3.1.2	Conformance	X		X	X		X	4.3
3.2.1	RDX			X		X	X	4.4.1
3.2.2	Desensitizing wax			X		X	X	4.4.2
3.2.3	Composition	X		X	X	X	X	4.5.2
3.3	Moisture			X	X	X	X	4.5.1
3.4	Acidity	X		X	X	X	X	4.5.3
3.5	Insoluble particles			X	X	X	X	4.5.4
3.6	Granulation			X	X	X	X	4.5.5
3.7	Bulk density			X	X	X	X	4.5.6
3.8	Ammunition lot numbering			X		X	X	4.5.7
3.9	Workmanship			X		X	X	4.5.8
3.10	Energetic material qualification			X		X		4.5.9

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

- a. First article inspection (See 4.2)
- b. Conformance inspection (See 4.3)

4.2 First article. When specified, a sample of Composition, Type, and Class of A-3, and/or Composition A-4 shall be subjected to first article verification in accordance with 4.3.2. The testing shall apply for three (3) consecutive batches that have been produced by the contractor using the same production process, procedures, and equipment as will be used in regular production. All materials shall be obtained from the same sources as will be used in regular production.

4.2.1 First article rejection. If any item of the sample fails to comply with the first article requirements, the first article shall be rejected.

4.3 Conformance.

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4.3.1 Lot formation. A lot shall consist of one or more batches from no greater than 1 month of production of one composition and class designation only, produced by one manufacturer, in accordance with the same specification, or same specification revision, under one continuous set of operating conditions. Each batch shall consist of that quantity of composition and class that has been subjected to the same unit chemical or physical mixing process intended to make the final product homogeneous. In addition, each lot shall contain:

- a. RDX of one type, from one interfix lot number and from one manufacturer only.
- b. Desensitizing wax from one interfix lot number, from one manufacturer only.

#### 4.3.2 Classification of characteristics.

4.3.2.1 Sampling. The tests described in 4.3.2 shall be performed on samples representative of the batch which were taken in accordance with ASTM E300, for solids. Approximately 600 grams of the composition shall be taken for each batch. If any sample fails to meet any test requirement, the batch represented by the sample shall be rejected.

4.3.2.2	Composition A-3 and A-4	Requirement Paragraph	Inspection Method Reference
<u>Critical</u>	None defined		
<u>Major</u>			
101	RDX	3.2.1	4.4.1
102	Desensitizing wax	3.2.2	4.4.2
103	Composition	3.2.3	4.5.2
104	Moisture	3.3	4.5.1
105	Acidity	3.4	4.5.3
106	Insoluble particles	3.5	4.5.4
107	Granulation	3.6	4.5.5
108	Bulk density	3.7	4.5.6
109	Workmanship	3.9	4.5.8
<u>Minor</u>			
201	Ammunition lot numbering	3.8	4.5.7

#### 4.4 Materials.

4.4.1 RDX. Verify that RDX complies with MIL-DTL-398, Type II.

4.4.2 Desensitizing wax. Verify that desensitizing wax complies with MIL-W-20553.

#### 4.5 Test methods and procedures. (See 6.3.1)

4.5.1 Determination of moisture content. Determine the moisture content in accordance with ASTM E203. The solvents used shall be a mixture of 80% of anhydrous methanol and 20% of aliphatic naphtha by volume. Failure to meet the moisture content shall result in batch rejection.

4.5.1.1 Determination of moisture content (alternate). Determine the moisture content in accordance with Method 101.4.1 of MIL-STD-650 except that the special solvent shall consist of equal volumes of anhydrous methanol and benzene thoroughly mixed. If necessary the solvents shall be dried by distillation.

4.5.2 Determination of composition.

4.5.2.1 RDX content.

- a. Weigh approximately 5 grams of Composition A-3 or A-4 using a tared 100 mL beaker. Use analytical balance and record sample weight (*S*) to the nearest 0.0001 g.
- b. Add 60 mL of aliphatic naphtha to the beaker and insert small stirring rod and cover with watch glass.
- c. Place beaker containing the sample on steam heated hot plate for 30 minutes at  $85^{\circ} \pm 5^{\circ}$  C temperature. Stir sample every 5 minutes. Check the temperature of the hot plate with a thermometer in a 400 mL beaker containing 100 mL of naphtha solvent. Cover top of beaker with aluminum foil. During this 30 minute interval perform Step d.
- d. Obtain the weight of a clean, dry, medium porosity, filtering crucible using the analytical balance. Record the weight of the filtering crucible (*C*) to the nearest 0.0001 g. Heat the crucible on the hot plate until filtration step is performed.
- e. Place the heated crucible from Step d above on the vacuum flask; remove the beaker containing the sample from the hot plate and immediately decant the solvent-wax solution through the crucible. (Pour the solution at a rate to not fill the crucible as the solution is filtering.)  
  
\*Return the beaker to the hot plate between decants.  
\*\*During filtration do not aspirate crucible to dryness until final wash.
- f. Wash remaining residue and solvent from the beaker into the crucible with approximately 40 mL of very warm naphtha solvent from a wash bottle.
- g. Remove the crucible from the vacuum flask; wash the residue with approximately 10 mL of hexane. Stir the residue with the stirring rod; aspirate the hexane.
- h. Repeat step g and rinse the residue from the stirring rod into the crucible.
- i. Aspirate the residue until the solvent odor is no longer detectable.
- j. Dry the crucible and residue in the steam heated oven at  $95^{\circ} \pm 10^{\circ}$  C for approximately 15 minutes or until a constant weight within 0.0002 g is obtained.
- k. Remove from heat; cool to ambient temperature in a desiccator.
- l. Determine the weight of the residue (*R*) to the nearest 0.0001 g.
- m. Calculate the percent RDX as follows:

$$\% RDX = \frac{R - C}{S * (1 - M)}$$

Where:

$R$  = Weight of RDX residue plus crucible, grams

$C$  = Weight of crucible, grams

$S$  = Weight of sample, grams

$M$  = Moisture percentage in material, expressed as a decimal (See 4.5.1)

Failure to meet the RDX content shall result in batch rejection.

4.5.2.2 Desensitizing wax. The percentage of desensitizing wax shall be calculated on a moisture free basis by subtracting from 100 percent the percentage of RDX obtained as specified in 4.5.2.1.

#### 4.5.3 Acidity.

a. A 6 g specimen shall be weighed accurately and transferred to a 400 mL beaker. Use analytical balance and record sample weight to the nearest 0.0001 g.

b. A 25 mL portion of aliphatic naphtha shall be added and the beaker and contents covered with a watch glass and heated on a steam bath until the desensitizer coating on the RDX crystals has completely dissolved. The aliphatic naphtha solution shall be decanted carefully into a clean small beaker, covered with a watch glass, and kept warm.

c. Seventy five milliliters (75 mL) of acetone shall be added to the RDX crystals remaining in the 400 mL beaker, covered and heated on a steam bath until all the crystals are in solution.

d. The aliphatic naphtha solution shall then be poured carefully, back into the acetone solution, the small beaker shall be washed thoroughly with about 5 mL of aliphatic naphtha and this shall be added to the acetone mixture.

e. The two solutions shall be heated a little to mix them thoroughly and then, while stirring, 200 mL of cool distilled water shall be added. The solution shall be titrated with 0.05N NaOH solution, using either methyl red or bromothymol blue as an indicator. A blank determination shall be made using the same amounts of the reagents. The percentage of acidity as acetic acid shall be calculated as follows:

$$\% \text{Acidity} = \frac{6.005 * (V - v) * N}{W * (1 - M)}$$

Where:

$V$  = NaOH used in titrating specimen, mL.

$v$  = NaOH used in blank, mL.

$N$  = Normality of NaOH solution.

$W$  = Weight of specimen, grams.

$M$  = Moisture percentage in material, expressed as a decimal (See 4.5.1)

Failure to meet the percent acidity shall result in batch rejection.

4.5.4 Insoluble particles. Determine the insoluble particles in accordance with Method 106.1 of MIL-STD-650 except sieves shall be in accordance with ASTM E11. The solvent extraction method procedure steps to wash all the insoluble matter from the beaker onto the sieve with a stream of the solvent, to wash the residue on the sieve with additional solvent, and to dry the sieve may be repeated in sequence for both sieves. Failure to meet the insoluble particles shall result in batch rejection.

4.5.5 Granulation. Determine the granulation in accordance with Method 204.1 of MIL-STD-650 except 300 +15/-32 gyrations and sieves shall be in accordance with ASTM E11. Failure to meet the granulation shall result in batch rejection.

4.5.6 Bulk density. Determine the bulk density in accordance with Method 201.1.1 of MIL-STD-650. Failure to meet the bulk density shall result in batch rejection.

4.5.7 Ammunition lot numbering. Visually verify that an ammunition lot number has been assigned to each lot as described in MIL-STD-1168.

4.5.8 Workmanship. Take approximately 200 to 300 grams of the material and spread the composition out on a clean sheet of white paper and examine visually for the presence of visible impurities, extraneous foreign matter, and workmanship. Failure to meet the workmanship inspection and/or visual inspection of workmanship during the test methods of 4.5 shall result in batch rejection.

4.5.9 Energetic material qualification. Verify by examination of objective evidence that the Army Qualification Authority has qualified all energetic materials for use (see 6.5).

## 5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When packaging of materiel is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activities within the Military Service or Defense Agency, or within the military service's system commands. 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 that may be helpful, but is not mandatory.)

6.1 Intended use. Compositions A-3 and A-4 furnished under this specification are intended to be used as high energy explosive fillers in press loaded ammunition.

6.2 Acquisition requirements. Acquisition documents should specify the following:

- a. Title, number and date of this specification.

- b. Requirements for submission of first article sample.
- c. Composition required (See 1.2).
- d. Type and Class required (if applicable).
- e. Bulk density of Composition whether by specification, drawing, contract, or purchase order.
- f. Special marking, when specified.
- g. Serialization requirements, if applicable.
- h. Certificate of conformance for each lot or shipment of product (if applicable).
- i. Acceptance Inspection Equipment (AIE) requirements.
- j. Acceptance and description sheet for propellants and explosives in accordance with MIL-STD-1171.
- k. Certificate of Analysis.
- l. Packaging requirements (see 6.6).

6.3 Equivalent test methods. Prior approval of the Contracting Officer is required for use of equivalent test methods. A description of the proposed method should be submitted thru the Contracting Officer to the technical agency (see 6.4). This description should include but not be limited to the procedures used, the accuracy and precision of the method, test data to demonstrate the accuracy and precision and drawings of any special equipment required.

6.3.1 Aliphatic naphtha. Aliphatic naphtha used in testing should have a boiling point above 100°C.

6.4 Technical agency. The technical agency responsible for the preparation of this specification is ARDEC, ATTN: RDAR-EIQ-MG, Picatinny, NJ 07806 and ARDEC, ATTN: RDAR-MEE-W, Rock Island, IL 61299.

6.5 Energetic material qualification. When a contract is awarded to a manufacturer of Composition A-3 and/or A-4 for the Government, qualification of energetic materials by the Army Qualification requires demonstration that the energetic material meets the requirements of AOP-7 and STANAG 4170. Point of contact for the Army Qualification Authority and list of qualified sources can be obtained from the Technical Agency (see 6.4).

6.6 Packaging requirements. Drawing 7548645 may be used to package Composition A-3 and/or A-4.

6.7 Subject term (key word) listing.

RDX  
Desensitizing wax

6.8 Incorporated changes. This revision of the specification incorporates ECP R15Q2001.

6.9 Changes from previous revision. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extent of the changes.

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Custodian:  
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