

MIL-P-387C
8 December 1976
SUPERSEDING
MIL-P-00387B
7 November 1967 AND
MIL-P-387A
9 January 1957
(See 6.6)

MILITARY SPECIFICATION

PENTAERYTHRITE TETRANITRATE (PETN)

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Pentaerythrite tetranitrate (PETN) covered by this specification is a high explosive intended for use in ammunition (see 6.1).

1.2 Classification.-PETN shall be of the following classes as specified:

- Class 1 - For use in detonating cord
- Class 2 - For use in primers for small arms ammunition
- Class 3 - For use in pentolite
- Class 4 - For use in blasting caps and detonators

2. APPLICABLE DOCUMENTS

2.1 The following documents of the issue in effect on date of invitation for bids, or request for proposal, form a part of this specification to the extent specified herein.

SPECIFICATIONS

FEDERAL

RR-S-366 - Sieves, Standard for Testing
Purposes

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Picatinny Arsenal, Dover, New Jersey 07801 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

FSC: 1376

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STANDARDS

MILITARY

- MIL-STD-105 - Sampling Procedures and Tables
for Inspection by Attributes
- MIL-STD-109 - Quality Assurance Terms and
Definitions
- MIL-STD-129 - Marking for Shipment and Storage
- MIL-STD-650 - Explosives: Sampling, Inspection
and Testing
- MIL-STD-1168- Ammunition Lot Numbering
- MIL-STD-1235- Single and Multilevel Continuous
Inspection by Attributes

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

2.2 Publications.-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.

AMERICAN SOCIETY FOR TESTING AND MATERIALS PUBLICATION

- ASTM Procedures E300-73 - Recommended Practice for
Sampling Industrial Chemicals

(Application for copies of ASTM Standards should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania, 19103).

CODE OF FEDERAL REGULATIONS

- 49 CFR 100-199 - Department of Transportation Rules
and Regulations for Transportation of
Explosives and Other Dangerous Articles

(The Department of Transportation Rules are a part of the Code of Federal Regulations available from the Superintendent of Documents, Government Printing Office, Washington, D.C. 20402. Orders for the above publications should cite "49 CFR 100-199 (latest revision)").

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3. REQUIREMENTS

3.1 Melting Point.-The melting point of PETN shall be 141 degrees Centigrade ($^{\circ}\text{C}$) plus or minus 1.0°C when determined as specified in 4.5.3.

3.2 Nitrogen Content.-The nitrogen content of PETN shall be 17.50 percent minimum (min.) when determined as specified in 4.5.4.

3.3 Acetone insoluble material.-The acetone insoluble material of PETN shall be 0.10 percent maximum (max.) when determined as specified in 4.5.5.

3.4 Insoluble particles.-There shall be no evidence of insoluble particles in PETN when determined as specified in 4.5.5.

3.5 Acidity or Alkalinity (see 6.5).-The acidity or alkalinity shall not exceed 0.01 percent max. when determined as specified in 4.5.6.

3.6 120°C vacuum stability.-The maximum amount of gas evolved in 20 hours test time when determined as specified in 4.5.7 shall be 5 milliliters (ml).

3.7 Granulation.-The PETN shall comply with the granulation requirements shown in Table I when tested as specified in 4.5.8, except that the granulation requirements for Class 3 PETN shall not apply to PETN used in co-precipitated pentolite.

TABLE I
Granulation Requirements

U.S. Standard Sieve No.	Percent Passing Specified Sieve			
	<u>Class 1</u>	<u>Class 2</u>	<u>Class 3</u>	<u>Class 4</u>
30	---	---	95 min.	100 min.
80	100 min.	---	---	---
100	---	---	---	20 max.
100	85 min.	96. min.	---	5 min.
140	55 max.	---	---	---
200	30 max.	80 max.	30 max.	---
200	---	65 min.	---	---

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3.8 First article testing.-This specification makes provisions for first article testing. Submission of first article quantity by the contractor shall be as specified in the contract.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection.-Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or order, the supplier may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. In addition 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. Reference shall be made to MIL-STD-109 in order to define the terms used herein.

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

- a. First Article Inspection (see 4.3).
- b. Quality Conformance Inspection (see 4.4)

4.3 First Article Inspection

4.3.1 Submission.-Prior to initiation of regular production the contractor shall submit a first article sample consisting of 2 lbs of PETN in accordance with instructions issued by the Contracting Officer for evaluation in accordance with paragraph 4.3.2. All samples submitted shall have been produced by the contractor using the same production processes, procedures, and equipment as will be used in fulfilling the contract. All materials, including packaging and packing, shall be obtained from the same sources of supply as will be used in regular production. The sample shall be accompanied by certificates of analysis. A first article quantity, or portion thereof, as directed by the Contracting Officer, shall also be submitted whenever there is a lapse in production for a period in excess of 90 days, or whenever a change occurs in manufacturing process, material used, drawing, specification or source of supply as to significantly affect product uniformity as determined by the Government. Prior to submission, the contractor shall inspect the sample to the degree necessary to assure that it conforms to the requirements of the contract and submit a record of this inspection with the sample. A sample containing known defects will not be submitted unless specifically authorized by the Contracting Officer.

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4.3.2 Inspections to be performed.-The sample will be subjected by the Government to any or all of the examinations or tests specified in 4.4 of 4.5 of this specification and any or all requirements of the applicable drawings.

4.3.3 Rejection.-If any sample fails to comply with any of the applicable requirements, the first article quantity shall be rejected. The Government reserves the right to terminate its inspection upon any failure of a sample to comply with any of the stated requirements.

4.4 Quality Conformance Inspection

4.4.1 Lot formation.-A lot shall consist of one or more batches of PETN 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 PETN that has been subjected to the same unit chemical or physical mixing process intended to make the final product homogeneous. The product shall be submitted for inspection in accordance with MIL-STD-105. The criteria and procedures for the assignment of lot numbers shall be in accordance with MIL-STD-1168.

4.4.2 Examination.-Sampling plans and procedures for the following classifications of defects shall be in accordance with MIL-STD-105. Contractor's sampling plans, if used, shall be approved by the Government and shall provide, as a minimum, the protection afforded the Government by the sampling plans in MIL-STD-105. Continuous sampling plans in accordance with MIL-STD-1235 may be used if approved by the procuring activity. Also, at the option of the procuring activity, AQL's and sampling plans may be applied to the individual characteristics listed, using an AQL of 0.40 percent for each Major defect and an AQL of 0.65 percent for each Minor defect.

4.4.2.1 Container, prior to closing (see Sec. 5)

Categories	Defects	Method of Inspection
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Critical: None defined.

Major:	AQL 0.65 percent	
101.	Bags not type required.....	Visual
102.	Container not type required.....	Visual
103.	Wetting agent insufficient.....	(see 5.1)

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- Minor: AQL 1.50 percent
- 201. Cover gasket damaged.....Visual
 - 202. Contamination in container.....Visual
 - 203. Outer bags cut, punctured, torn
or have weak seams.....Visual/Manual
 - 204. Inner bags overweight.....Balance

4.4.2.2 Container, closed (see Sec. 5)

Categories	Defects	Method of Inspection
Critical: None defined.		

- Major: AQL 0.65 percent
- 101. Container not securely closed.....Visual/Manual
 - 102. Container leaking.....Visual
 - 103. DOT Marking missing, illegible
or incorrect.....Visual

- Minor: AQL 1.50 percent
- 201. Container damaged or severely
dented.....Visual
 - 202. Closing bolt improper.....Visual
 - 203. Rust or corrosion on surfaces
of container.....Visual
 - 204. Marking incorrect or illegible....Visual

4.4.3 Sampling for test 4.5.3 through 4.5.8. Approximately 300 grams of the composition shall be selected from each batch to be sampled using ASTM Procedures E300-73 for solids. Samples shall be selected for inspection in accordance with MIL-STD-1235, CSP-1 Plan, AQL 6.5 percent using a batch as a unit of product. If any sample fails to meet any requirement the batch represented by the sample shall be rejected. All batches produced between the time that the batch was tested and accepted and the batch which failed shall be tested in accordance with the applicable methods given in paragraph 4.5. If any of these batches fail to meet any of the test requirements, that batch shall also, be rejected. In addition, after any failure of a batch the contractor will return to 100 percent inspection until "1" successive batches are accepted as required by MIL-STD-1235. The classification of defects shall be as given in Table II.

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TABLE II
CLASSIFICATION OF DEFECTS

<u>Property</u>	<u>Type of Defect</u>	<u>Test Paragraph</u>
Melting Point	Major	4.5.3
Nitrogen Content	Major	4.5.4
Acetone Insoluble Material	Major	4.5.5
Insoluble Particles	Major	4.5.5
Acidity or Alkalinity	Major	4.5.6
120°C Vacuum Stability	Major	4.5.7
Granulation	Major	4.5.8

4.5 Test Methods and Procedures (see 6.3).--The tests in 4.5.3 through 4.5.8 shall be performed using prescribed analytical procedures for replicate determinations given in standard analytical textbooks.

4.5.1 Air dried sample.--The wet sample shall be air dried only if there is evidence of free liquid on top of the sample. The sample of wet PETN shall be mixed to insure uniform distribution of the various size particles and then a portion of the sample consisting of approximately 120 grams (gm) of PETN (dry basis) shall be transferred to a Buchner funnel previously fitted with a Number 42 Whatman filter paper or equivalent. Air shall be drawn through the funnel and contents for approximately 10 minutes. The PETN shall be transferred to a large sheet of paper and mixed again with a wooden spatula to insure uniform moisture content.

4.5.2 Oven dried and steam grid dried sample

4.5.2.1 Oven dried sample.--Approximately 1-2 gms of the PETN as received or air dried sample shall be transferred to a glass weighing dish. The dish and its contents shall be weighed and then dried in an oven at $43^{\circ} \pm 2^{\circ}\text{C}$ for 3 hours and then at $100^{\circ} \pm 2^{\circ}\text{C}$ until constant weight is obtained. The dish and contents shall be cooled in a desiccator. This dried sample is to be used for the nitrogen content determination (see 4.5.4).

4.5.2.2 Steam grid dried sample.--The remainder of the sample, approximately 118 gms, shall be dried on a steam grid. Transfer the sample to a suitable glass container and weigh. Dry the sample in its container on the steam grid at $53^{\circ} \pm 2^{\circ}\text{C}$ in a well ventilated area for approximately 16 hours or longer until constant weight is obtained. The dried sample shall then be used for all tests except the nitrogen content determination (see 4.5.2.1).

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4.5.3 Melting point.-The melting point shall be determined as specified in MIL-STD-650, Method 209.1 with the exception of the following paragraph:

Apparatus.-The bath shall consist of a suitable beaker that is about three-fourths full of an appropriate oil.

4.5.4 Nitrogen content.-The nitrogen content shall be determined as specified in MIL-STD-650, Method 414.1

4.5.5 Acetone insoluble material and insoluble particles.-A weighed portion of approximately 50 gm of the dried sample shall be placed in a beaker and dissolved in 500 mls. of acetone at room temperature. The solution shall be filtered through a tared filtering crucible, and the residue washed 3 times with acetone. The crucible shall be dried in an oven at $100^{\circ} \pm 2^{\circ}\text{C}$, cooled in a desiccator and weighed. The increase in weight shall be calculated as percentage of insoluble material in the sample. The crucible shall be shaken over a U.S. Standard Sieve Number 40 to release any particles retained in the crucible. Count any particles that do not pass through the sieve.

4.5.6 Acidity and Alkalinity

4.5.6.1 Acidity.-Weigh exactly $10\text{g} \pm 0.01\text{g}$ of dried PETN and place it in a 500 ml extraction flask. Add 100 ml of ACS grade acetone measured in a 100 ml test tube. Shake by hand from time to time until the PETN is completely dissolved. Pour in slowly (20 to 30 seconds) 100 ml of distilled water measured in a 100 ml test tube and wait until the explosive settles (1 to 2 minutes). Add 8 to 10 drops of methyl red/methylene blue indicator (0.1g of methyl red and 0.05g of methylene blue in 100 ml of 95 percent ethyl alcohol) and titrate at once, without filtering, using 0.05N sodium hydroxide. For this purpose, use a 5 ml semi-microburette graduated in $1/50$ ml, 1 ml corresponding to a length of 70 to 80 mm. Add the 0.05N sodium hydroxide solution drop by drop to the flask, shaking until the indicator end-point is reached. Note the volume V_1 of solution used. Carry out a blank test simultaneously under identical conditions to those of the actual determination. For this purpose, place in a 500 ml or larger extraction flask 100 ml of ACS grade acetone, 100 ml of distilled water and 8 to 10 drops of

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methyl red/methylene blue indicator. Titrate with 0.05N sodium hydroxide solution. Note the volume V_2 of solution used. The acidity of the PETN expressed as percentage of nitric acid shall be calculated as follows:

$$\text{Acidity, as \% HNO}_3 = \frac{6.3 (V_1 - V_2) N}{W}$$

Where:

V_1 = ml of sodium hydroxide used in sample
 V_2 = ml of sodium hydroxide used in blank
 N = normality of sodium hydroxide
 W = weight of sample, in gm

4.5.6.2 Alkalinity.-Dissolve 10g \pm 0.01g of the dried PETN in 50 ml of neutral ACS grade acetone, add 2 ml N/50 sulphuric acid and allow to stand for 1 hour in the cold. Back titrate the excess acid with N/50 sodium hydroxide solution using methyl red as indicator. Carry out a blank on the acetone. The alkalinity of the PETN expressed as percentage of sodium carbonate shall be calculated as follows:

$$\text{Alkalinity, as \% Na}_2\text{CO}_3 = \frac{5.3 (V_2 - V_1) N}{W}$$

Where:

V_1 = ml of sodium hydroxide used in sample
 V_2 = ml of sodium hydroxide used in blank
 N = normality of sodium hydroxide
 W = weight of sample, in gm

4.5.7 120° Vacuum stability.-Stability shall be determined as specified in MIL-STD-650, Method 503.1, with the exception of the following paragraphs:

Sample preparation.-Place a weighed portion of approximately 5 gm. of the sample in a mortar with an equal weight of distilled water. Grind the material with a pestle to such fineness that all will pass through a U.S. Standard No. 200 sieve. WARNING-Grinding of the material should be carried out remotely behind a barricade and local safety procedures must be observed. Pass the wet ground material through the sieve using a minimum amount of distilled water. (Approximately 100 ml. of water has been found to be sufficient.) Transfer the PETN and water to a Buchner-type funnel, apply suction to remove the water, aspirate to near dryness, and finally dry at 100° to 105°C for 4 hours.

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Apparatus.-Constant temperature bath. An aluminum heating block may be substituted as an alternate method.

Procedure.-Place 2.3 grams of the dried specimen in the heating tube.

Procedure.-Calculate the volume of gas (at standard temperature and pressure) liberated during the test as follows:

$$\text{Vol. of gas, ml.} = (A + CB) \left[\frac{273 (P-H)}{760(273+t)} \right] - (A + C_1B) \left[\frac{273 (P_1 - H_1)}{760(273+t_1)} \right]$$

Where:

A = Volume of heating tube minus $\frac{(\text{sample weight})}{(1.773)}$ in cubic centimeters, to allow for the specimen.

4.5.8 Granulation.-Prepare a 75 percent alcohol solution saturated with PETN by mixing 7500 ml of 95 percent 2B ethyl alcohol and 2500 ml of distilled water and then adding 25 grams of PETN. Allow the mixture to stand for 8 to 16 hours with occasional shaking. Filter to remove any undissolved PETN. Weigh the individual sieves (three-inch diameter, U.S. Standard sieves conforming to Specification RR-S-366) to the nearest 0.01 gram. Nest one into the other, the finest on the bottom, the next finest, etc., with the coarsest on top. Weigh five grams of the dried sample and transfer it to the top screen. Set the rest of the screens on a Buchner funnel (Coors No. 2, with a 75MM plate.) Wash the material back and forth across the screen with ethyl alcohol solution using a wash bottle and gentle suction. Wash with a total of about one liter of alcohol solution or until no more material seems to pass through the screen. Remove the top screen and wash the PETN in the next screen with about one liter of the washing alcohol in a similar manner. Remove each screen in succession and continue the process. Place the sieves on sheets of clean paper and dry for two to four hours at 40° - 50°C. A steam grid is convenient for this drying. When dry, beginning with the coarsest screen, tap it gently over the next finer screen to sift through any fine adhering particles, then weigh the screen and its contents. Repeat with each successive screen. Obtain the weight of the material retained on each of these screens by difference from their respective tares. Calculate the percentages retained on each sieve. Obtain the percentage through the finest screen by difference from 100 percent after determining the sum of the percentages retained on all the sieves. Wet the screened material down immediately and dispose of it in an approved manner. Report the percentage retained on each sieve and the percentage through the finest sieve.

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5. PREPARATION FOR DELIVERY

5.1 Packaging and Packing-Level A.-PETN shall be packaged and packed in accordance with Code of Federal Regulation 49 CFR 173.77 in Specification 5 or 5B containers. Inner bags shall be limited to 50 pounds maximum dry weight each. All shipments shall be made with a water-alcohol mixture adjusted to a freezing point not higher than 0°F. Denatured ethyl alcohol, isopropyl alcohol or other suitable alcohol shall be used. The wetting agent shall be not less than 40 percent by weight of the PETN (see 6.4).

5.2 Packaging and Packing-Level C.-PETN shall be packaged and packed in any container approved under 49 CFR 173.77. Weight and wetting agent requirements of 5.1 shall apply.

5.3 Marking.-Marking shall be in accordance with Military Standard MIL-STD-129 and 49 CFR 173.77.

6. NOTES

6.1 Intended use.-PETN is intended for use in the manufacture of detonating cord, primers for small arms ammunition, pentolite, blasting caps and detonators.

6.2 Ordering data.-Procurement documents should specify the following:

- a. Title, number and date of this document.
- b. Description sheets shall be prepared for each lot in accordance with MIL-STD-1171.
- c. Provisions for submission of first article samples.
- d. Packing required (see 5.2)
- e. Class of the PETN

6.3 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: Commander, ATTN: SARPA-QA-A-P, Picatinny Arsenal, Dover, New Jersey 07801. 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.

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6.4 The required quantity of wetting agent can be determined by subtracting the dry weight of explosive and the packaging material weight from the total gross weight. For this purpose an established average weight of packaging materials may be used. .

6.5 The acidity or alkalinity shall not exceed 0.003 percent maximum when determined as specified in 4.5.6 for Navy procurement only.

6.6 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.

Custodians:

Army-PA
Navy-OS
Air Force - 70

Preparing Activity:

Army-PA

Review Activities:

Army-PA, MI
Navy-OS
Air Force-70

User Activity:

Navy-AS

Project Number: 1376-0122

