

INCH-POUND

MIL-DTL-32298 (OS)
08 July 2008
SUPERSEDING
(see 6.6)

DETAIL SPECIFICATION

CASTING POWDER, PROPELLANT

This specification is approved for use by the Naval Sea 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 covers three types of casting powder for cast double base propellants.

1.2 Classification. Casting powder covered by this specification will be of the following types as specified (see 6.2):

Type I – Nitrocellulose to nitroglycerin ratio of 4.394

Type II – Nitrocellulose to nitroglycerin ratio of 4.094

Type III – Nitrocellulose to nitroglycerin ratio of 4.786

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3, 4, or 5 of this specification. This section does not include documents cited in other sections of this specification, or documents 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 for documents referenced in sections 3, 4, or 5 of this specification, whether or not they are listed.

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.

Comments, suggestions, or questions on this document should be addressed to DEPARTMENT OF THE NAVY, Indian Head Division, NSWC, Code E11G3, Document Control, 4072 North Jackson Road, Suite 106, Indian Head, MD 20640-5115 OFFICIAL BUSINESS, or emailed to amanda.penn@navy.mil. Since contact information can change, you may want to verify the currency of this information using the ASSIST Online database at <http://assist.daps.dla.mil>.

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DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-G-155	Graphite, Dry (For Use in Ammunition)
MIL-DTL-244	Nitrocellulose
MIL-N-246	Nitroglycerine
MIL-T-301	Triacetin (Glyceryl Triacetate)
MIL-N-3399	2-Nitrodiphenylamine
MIL-L-13788	Lead Salicylate

DEPARTMENT OF DEFENSE STANDARDS

MILITARY

MIL-STD-286	Propellants, Solid: Sampling, Examination, and Testing
MIL-STD-1171	Acceptance and Description Sheets (For Propellants and Explosives)

(Copies of these documents are available online at <http://assist.daps.dla.mil/quicksearch/> or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.2.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues are those cited in the solicitation or contract.

DOCUMENTS

NAVAL SEA SYSTEMS COMMAND

WS 23141	Carbon Black (Powdered)
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PUBLICATIONS

NAVAL SEA SYSTEMS COMMAND

OD 17118	Preparation of Casting Solvent for Solid Propellant
OD 19477	Density Determination, Mercury Method, Casting Powder

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OD 19544	Determination of Burning Rate Versus Pressure from Propellant Test Slabs
OD 19555	Manufacture of Solid Propellant Test Grain
OD 24654	Evaluation Grain, 4.5-Inch Solid
OD 25216	Screen Loading Density, Determination of
OD 26254	Density of Casting Powder (Mercury-Macro Method), Determination of
OD 27923	Nitroglycerin Determination Specific Gravity Method

(Application for copies should be addressed to the DEPARTMENT OF THE NAVY, Indian Head Division, NSWC, Code E11G7, Document Control, 4072 North Jackson Road Suite 106, Indian Head, MD 20640-5115 OFFICIAL BUSINESS.)

2.3 Non-Government publications. The following document forms a part of this document to the extent specified herein. Unless otherwise specified, the issue of these documents are those cited in the solicitation or contract.

CHEMICAL PROPULSION INFORMATION AGENCY

CPIA/PP8, March 1956, Part I, Nitrocellulose Base Propellants: Method of Determining the Tensile Properties of Solid Rocket Propellants.

(Application for copies should be addressed to the Chemical Propulsion Information Agency, Applied Physics Laboratory, Johns Hopkins University, Johns Hopkins Road, Laurel, MD 20810.)

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 herein (except for related specification sheets), 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 Preproduction requirement. Before beginning casting powder manufacture, the contractor shall prepare a detailed description of manufacturing processes and equipment proposed for use. The contractor shall receive written approval of processes and equipment prior to use (see 6.2).

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3.2 Materials. The materials used in the manufacture of the casting powder shall conform to the requirements of applicable specifications unless specific approval in writing, covering a departure there from, has been obtained from the procuring activity prior to manufacture.

3.2.1 Nitrocellulose. The nitrocellulose shall conform to MIL-DTL-244, grade A, type I except that the nitrocellulose shall be made from cotton linters.

3.2.2 Nitroglycerin. The nitroglycerin shall conform to MIL-N-246, type I.

3.2.3 2-Nitrodiphenylamine. The 2-nitrodiphenylamine shall be in flake form and conform to MIL-N-3399. The purity shall be determined by the titanous chloride method (4.3.2.1) or the bromination method (4.3.2.2).

3.2.4 Lead salicylate. The lead salicylate shall conform to MIL-L-13788.

3.2.5 Lead beta resorcyate. The lead beta resorcyate shall conform to the following:

- a. Total lead content on a dry basis shall be not greater than 41.3 or less than 39.7 percent.
- b. Beta-resorcylic anhydride on a dry basis shall be not greater than 56.5 or less than 53.7 percent.
- c. The drying loss shall be not greater than 3.00 percent.

3.2.6 Carbon black. The carbon black shall conform to Grade D of WS 23141.

3.2.7 Graphite. The graphite shall conform to MIL-G-155, grade III or IV.

3.3 Casting powder composition (volatile-free basis). The casting powder composition shall conform to requirements shown in TABLE I.

3.3.1 Total lead content. The total lead content, derived from lead salicylate and lead beta resorcyate added to casting powder composition, shall be not greater than 2.75 or less than 2.25 percent.

3.4 Total volatiles. The total volatiles shall be not greater than 1.00 percent.

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TABLE I. Casting powder compositions (volatile-free basis).

Type I			Type II	Type III	Type II & III
Ingredient	Percent (by weight)	Permissible Variation	Percent (by weight)	Percent (by weight)	Permissible Variation
Nitrocellulose	74.70	By difference	73.70	76.10	By difference
Nitroglycerine	17.00	±1.00	18.00	15.90	±1.00
2-Nitrodiphenylamine	2.00	±0.15	2.00	1.80	±0.20
Lead salicylate	3.00	±0.25	3.00	2.90	±0.30
Lead beta resorcyate	3.00	±0.25	3.00	2.90	±0.30
Carbon black	0.30	+0.10, -0.00	0.30	0.40	±0.10
Graphite (added basis)	0.04	±0.01	0.04	0.04	±0.01

3.5 Density. The density shall be not less than 1.625 grams per cubic centimeter (g/cc).

3.6 Granule dimensions. The granule dimensions shall be an average length and diameter of 0.035 ± 0.005 inch. The length-to-diameter (L/D) ratio of the granules shall be 1.00 ± 0.08 . The granules shall be nonperforated cylinders.

3.7 Chemical stability. The chemical stability shall be as follows:

- a. The slope at 100 minutes shall be less than 1.00.
- b. The time to 100 millimeters shall be more than 100 minutes.

3.8 Screen loading density. The screen loading density shall be not less than 1.030 g/cc for Type I and shall not be less than 1.050 g/cc for Types II and III.

3.9 Heat of explosion. The heat of explosion shall be 930 ± 20 calories per gram for each type.

3.10 Evaluation grains (test specimens).

3.10.1 Physical properties. The physical properties at $77 \pm 3^\circ$ Fahrenheit (F) shall conform to the requirements shown in TABLE II.

TABLE II. Physical properties.

	Type I	Types II & III
Physical property	Minimum Value	Minimum Value
Tensile strength	400 psi	350 psi
Elongation	40%	35%

3.10.2 Burning rate. The burning rate at 1000 pounds per square inch absolute (psia) pressure shall conform to the requirements shown in TABLE III.

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TABLE III. Burning rate.

Temperature, °F	Rate, Inches Per Second	
-10	Not more than 0.06 below 70° rate	
70	Type I	Types II and III
	0.77 ± 0.04	0.78 ± 0.04
130	Not more than 0.05 above 70° rate	

3.11 Data. The contractor shall prepare a test report with description sheets in accordance with MIL-STD-1171 giving a history of ingredients and manufacture, including process control and summary sheets and evaluation and processing data (see 6.2).

4. VERIFICATION

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

a. Conformance inspection (see 4.4)

4.2 Lot. A lot shall consist of material from one supplier manufactured under operating and processing conditions that shall make the final product a uniform blend.

4.3 Sampling. The minimum sample size shall be three containers. The containers selected shall be the primary samples representing the lot. A composite sample, of sufficient size to perform the tests required by this specification, shall be made by blending equal portions from each of the selected containers in a blending barrel for a minimum of 30 minutes. The composite sample shall be placed in airtight containers and labeled with powder designation, manufacturer, plant, contract number, lot number, and lot size. However, if it becomes apparent during sampling that the lot is not uniform, the inspector may require that any primary sample be tested for conformance to this specification. All primary samples shall be retained for further testing should the composite sample fail to meet requirements (see 6.2).

4.4 Quality conformance tests. The following quality conformance tests shall be performed on each lot. Failure of any sample to conform to any requirement of this specification shall be cause for rejection of the lot. Where two test methods are referenced, the first one listed shall take precedence. The percentage of all ingredients shall be calculated on a volatile-free basis.

4.4.1 Nitrocellulose. The nitrocellulose shall be determined in accordance with MIL-STD-286, method 209.2.

4.4.2 Nitroglycerin. The nitroglycerin shall be determined in accordance with MIL-STD-286, method 208.1. or by Liquid Chromatography, method 208.3.1.

4.4.3 2-Nitrodiphenylamine. The 2-nitrodiphenylamine shall be determined in accordance with MIL-STD-286, method 218.4, or by Liquid Chromatography, method 208.3.1.

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4.4.4 Carbon black and graphite. The carbon black and graphite contents shall be determined in accordance with the following procedure:

a. Procedure.

1. Weigh a 3 gram(g) sample to ± 0.05 mg. Transfer to a 400 ml beaker
2. Add 50 ml of concentrated nitric acid to the beaker and sample and place on hot plate. Heat solution about 45 minutes or until sample is completely decomposed.
3. Remove beaker from hot plate, allow beaker to cool, add 50 ml of water and reheat. Continue heating until carbon black and graphite coagulate in bottom of beaker.
4. Filter through a tared fine selsa crucible (Weight A). Wash with 2/1 ether/acetone solution.
5. Place crucible in 100° C drying oven for 2 hours. Allow crucible to cool and reweigh the crucible (Weight B). Weight gain (Weight B-A) is the total carbon black and graphite in the sample.
6. Place crucible on filtering apparatus and fill crucible with 20% sodium hydroxide solution. Turn vacuum on and the carbon black will flow through the crucible. Rinse crucible twice with additional sodium hydroxide solution and then with water.
7. Place crucible in 100° C drying oven for 2 hours. Allow crucible to cool and reweigh (Weight C).

b. Calculation:

$$\% \text{ Carbon black} = \frac{\text{Weight}(B) - \text{Weight}(A)}{3.0(\text{Sample weight})} \times 100 - \% \text{ graphite}$$

$$\% \text{ Graphite} = \frac{\text{Weight}(C) - \text{Weight}(A)}{3.0(\text{Sample weight})} \times 100$$

4.4.5 Total lead content. The total lead content shall be determined in accordance with MIL-STD-286, method 311.1. The equivalence factor shall be 0.6833.

4.4.6 Total volatiles. The total volatiles shall be determined in accordance with MIL-STD-286, method 103.3 or by method 103.1.3.

4.4.7 Density. The density shall be determined in accordance with OD 19477, OD 26254, or by MIL-STD-286, method 510.3.1..

4.4.8 Granule dimensions. The granule dimensions shall be determined in accordance with one of the following procedures:

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- a. Sample preparation. Coat approximately three-fourths of one side of a microscope slide with a thin layer of light lubricating oil or petroleum jelly. Place a minimum of 20 granules, selected at random from a blended sample, on coated surface of microscope slide.
- b. Procedure. Use a Bausch and Lomb Illuminator, catalogue No. 42-63-58, or an optical comparator, mounted so that granule shadow will project upon a flat surface perpendicular to axis of light beam. Adjust projector for sharp focus and calibrate projector magnification with a wire of diameter known to ± 0.0005 inch. Measure length and diameter of each granule to nearest 0.001 inch by measuring from knife-cut entrance to knife-cut entrance.
- c. Alternate procedure. Use a Bausch and Lomb Model MA chemical microscope, or equivalent, equipped with a calibrated 100 division ocular micrometer and with incident lighting on sample, to measure length and diameter of granules to nearest 0.001 inch. When ends of granules are irregular, determine average length by measuring from knife-cut entrance to knife-cut entrance.
- d. Calculation. Calculate and report average length and diameter dimensions of granules and L/D.

$$L/D = \frac{\text{Average length}}{\text{Average diameter}}$$

4.4.9 Chemical stability. The chemical stability test shall be determined in accordance with MIL-STD-286, method 406.1 after the specimen has been desiccated for a minimum of 16 hours.

4.4.10 Screen loading density. The screen loading density shall be determined in accordance with OD 25216.

4.4.11 Heat of explosion. The heat of explosion shall be determined in accordance with MIL-STD-286, method 802.1 except that prepurified argon gas shall be used.

4.4.12 Evaluation grains (test specimens). Evaluation grains shall be manufactured in accordance with OD 24654 or OD 19555 (with exceptions). The following exceptions apply only to OD 19555:

- a. Step 11.1 shall read, "Prepare a minimum of 75 pounds of casting solvent in accordance with OD 17118."
- b. Step 12.5 shall read, "Apply 45 ± 2 psig of pressure to air cylinder by slowly opening the air pressure regulator."
- c. Step 12.6 shall read, "Apply 30 ± 2 psig of pressure to solvent head by slowly opening the air pressure regulator."

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d. Step 12.7 shall read, "Allow cast grain to remain at ambient room temperature for a minimum of 72 hours."

e. Step 12.16 shall read, "Cure cast grain at $140 \pm 10^{\circ}F$ for a minimum of 120 hours."

4.4.12.1 Casting solvent composition. The casting solvent composition, on a moisture-free basis, shall conform to the requirements shown in TABLE IV.

4.4.12.1.1 Moisture content. The moisture content shall be not greater than 0.10 percent when determined in accordance with MIL-STD-286, method 101.5.

4.4.12.2 Physical properties. Physical properties of propellant evaluation grains, manufactured in accordance with OD 24654 or OD 19555, shall be determined in accordance with CPIA/PP8, part I, at a temperature of $77 \pm 3^{\circ}F$ with a strain rate of 0.1 inch per minute per inch. The effective gage length for calculation purposes shall be 2.7 inches. Specimens shall be tested not later than 72 hours after final machining.

TABLE IV. Casting, solvent composition.

Ingredient	Specification	Percent by Weight	Test Method
Nitroglycerin	MIL-N-246, Type I	75.00 ± 0.20	OD 27923
2-Nitrodiphenylamine	MIL-N-3399, Flake-form	1.00 ± 0.10	MIL-STD-286, method 218.4
Triacetin	MIL-T-301	24.00	By difference

4.4.12.3 Burning rate. The burning rate shall be determined in accordance with OD 19554 by firing four rounds each at -10, 70, and $130^{\circ}F$ and approximately 1000 psia.

4.5 Packaging and marking inspection. The inspector shall ascertain that packaging and marking conform to requirements of Section 5 by visual examination.

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.

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6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. These casting powders are intended to be blended with MIL-P-82698 casting powder to produce MIL-P-82701 casting powder for use in the manufacture of solid propellants for Mk 12 boosters for Terrier and Standard (ER) surface to air missiles. Type II casting powder is also blended with JCM-1915 casting powder to produce POU-2 casting powder for use in the manufacture of solid propellant for MK 75 gas generators for Tomahawk missiles. Since the items that these casting powders are to be used in were designed for military ordnance, there is no commercial application.

6.2 Acquisition requirements. Acquisition documents should specify the following.

- a. Title, number, and revision letter of this specification.
- b. Data to be submitted or retained (see 3.1, 3.3.1.1, and 6.3.2).
- c. Place of acceptance inspection (see 4.1).
- d. Lot size (see 4.2).
- e. Provisions for retest (see 4.3).
- f. Delivery location.
- g. Procuring activity lot number (see 6.5.2).
- h. Type of casting powder (see 1.2).

6.2.1 Consideration of data requirements. The following data requirements should be considered when this specification is applied on a contract. The specific acquisition should be reviewed to ensure that only essential data are requested/provided. To ensure correct contractual application of the data requirements, a Contract Data Requirements List (DD Form 1423) must be prepared to obtain the data, except where DOD FAR Supplement 27.475-1 exempts the requirement for a DD Form 1423.

<u>Paragraph no.</u>	<u>Data requirement title</u>
3.1	Processing Procedure Report
3.11	Test Report (Four copies)

6.3 Safety precautions. The safety precaution requirements of the “Contractor’s Safety Manual for Ammunition, Explosives, and Related Dangerous material” (DOD 4145.26M) are applicable and should be specified in the contract as required by the Defense Acquisition Regulation (DAR) 1-323.

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NOTE: When this specification is used as part of the description of work to be accomplished by a Government activity, the safety precaution requirements of "Ammunition and Explosives Ashore" (OP 5) should be made applicable.

6.4 Type similarity. The casting powder compositions Types I and II specified herein are similar to, but not identical with ABL type 917 casting powder composition for ARP propellant.

6.5 Packaging and marking.

6.5.1 Packaging. Packaging should be in containers conforming to Naval Ordnance Station, Indian Head drawing 5755. Electrical continuity between top and bottom chimes and between bottom liner and bottom chime should be subjected to 100 percent testing. In all tests, electrical resistance should not be greater than 5.0 ohms.

6.5.2 Marking. Containers should be marked in accordance with MIL-STD-129, Army Drawing 20-4-77, and 49 CFR 171-177. Permanent marking in accordance with MIL-STD-129 should be placed on three sides of each container. Marking should include, but not be limited to, the following:

- a. Title, number, and revision letter of this specification.
- b. Name of manufacturer and location.
- c. Date of manufacture.
- d. Procuring activity lot number (placed 2 inches above the permanent markings in 1-inch capital letters and numbers).
- e. Contract number.
- f. Type of casting powder material therein (see 1.2).

6.6 Supersession information. No official documentation exists for MIL-P-22504B(OS), therefore, this document has been created using MIL-P-22504B(OS) as a guide. References to MIL-P-22504B (OS) should be replaced by this document. MIL-DTL-32298 Type I material meets the requirements of material conforming to MIL-P-22504A(OS), dated 13 June 1967. MIL-DTL-32298 Type II material meets the requirements of material conforming to Naval Sea Systems Command purchase description WS 2531A dated 25 March 1966.

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6.7 Subject term (key word) listing.

MIL-P-82701 casting powder
Solid propellants
Mk 12 boosters
Terrier
Standard (ER)
POU-2 casting powder
Gas generators
Tomahawk

6.8 Changes from previous issue. Contents of MIL-P-22504B (OS) were rewritten to include updated test methods and material specifications. Marginal notations are not used in this rewrite to identify changes with respect to the superseded document due to the extent of the changes.

Custodians:
Navy-OS

Preparing Activity:
Navy-OS
(Project 1376-2008-011)

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at <http://assist.daps.dla.mil>.