

C-MIL-P-17689 (NOrd)

30 July 1953

Superseding

NAVORD OS 5043

23 October 1952

23 March 1953

MILITARY SPECIFICATION

PROPELLANT, DOUBLE-BASE SHEET, TYPE N-5

1. SCOPE

1.1 Scope.--This specification sets forth the requirements for the manufacture and inspection of double-base sheet rocket propellant, Type N-5, in order that a standard product may be obtained.

1.2 Classification.--The propellant sheet shall be furnished in the following classes as specified (See 6.2):

Class 1 Sheet.

Class 2 Carpet Roll.

2. APPLICABLE SPECIFICATIONS, STANDARDS, DRAWINGS, AND PUBLICATIONS

2.1 The following specifications, standards, and publications of the issue in effect on the date of invitation for bids, form a part of this specification:

SPECIFICATIONS

MILITARY

JAN-N-244	- Nitrocellulose
JAN-N-246	- Nitroglycerin
JAN-D-242	- Diethyl Phthalate
JAN-W-181	- Candelilla Wax
MIL-N-3399	- 2-Nitrodiphenylamine
C-MIL-C-17701	- Compound H-101
C-MIL-C-17702	- Compound S-202

NAVY

General Specifications for Inspection of Material.

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STANDARDS

MILITARY

- MIL-STD-129 - Marking of Shipments
- MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes

BUREAU OF ORDNANCE

- NAVORD OSTD 2 - Method of Marking Ordnance Material
- NAVORD OSTD 80 - Sampling Procedures and Tables for Inspection by Variables

PUBLICATIONS

ORDNANCE PAMPHLETS

- OP 5 - Ammunition Ashore
- OP 400 - General Instructions for the Design, Manufacture, and Inspection of Naval Ordnance Equipment

ORDNANCE DATA

- NAVORD OD 7904 - Taliani Test for Determination of Stability of Double-Base Rocket Propellants
- NAVORD OD 7939 - Standard Methods and Procedures for the Evaluation of Rocket Propellant Powder (Ballistite) Type N-4
- NAVORD OD 9375 - Standard Methods and Procedures for the Heat of Explosion Determination of Rocket Propellant Powder
- NAVORD OD 9376 - Standard Methods and Procedures for the Strand Burning-Rate Evaluation of Rocket Propellant Powder
- NAVORD OD 9377 - Standard Methods and Procedures for the Chemical Analysis of Rocket Propellant Powder (Confidential)

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

2.2 Other publications.--The following publications, of the issue in effect on date of invitation for bids, form a part of this specification:

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Code of Federal Regulations, Title 49, Transportation,
Chapter 1, Interstate Commerce Commission, Part 71-90;
Explosives and other Dangerous Articles, Code 49 CFR 71.1.

(Copies of the Code of Federal Regulations may be obtained upon application, accompanied by money order, coupon, or cash, to the Superintendent of Documents, Government Printing Office, Washington 25, D. C. Prices may be obtained from the Superintendent of Documents.)

3. REQUIREMENTS

3.1 Materials.--The raw materials used in the manufacture of rocket propellant under this specification shall conform to the requirements given in the specifications listed in 2.1. In addition the following material shall be of the grade and type indicated:

A. Nitrocellulose:

Military Specification, JAN-N-244, Grade A, Type 1,
Processed from cotton linters cellulose unless otherwise
specified.

3.2 Composition.--The product shall contain, in approximately the specified proportions, all of the ingredients listed below:

Nitrocellulose (12.6% Nitrogen) . . .	50.0% (by weight)
Nitroglycerin	34.9
Diethyl Phthalate	10.5
2-Nitrodiphenylamine	2.0
Compound S-202	1.2
Compound H-101	1.2
Candelilla Wax	0.2
Total	100.0%

3.3 Test Requirements.--The following conditions shall be satisfied.

3.3.1 Heat of Explosion.--

- A. A point shall be plotted in Fig. 1 corresponding to the mean heat of explosion, \bar{H}_O , and the computed standard deviation, S_H , both of which shall have been obtained according to the procedures outlined in NAVORD OD 9375.
- B. This point shall lie within the region bounded by the acceptance curve and the horizontal axis.
- C. The samples for the heat of explosion test shall be taken in accordance with 4.2.1.1.

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3.3.2 Strand Burning Rate.--

- A. The sum of the squares of those deviations of the average burning rates which occur in the undesired direction from the specified minimum desired burning rates at 10°F and maximum desired burning rates at 130°F (see 3.3.2 C 3) shall not be greater than 0.000700 (in/sec.)². The average burning rates shall have been obtained according to the procedure given in NAVORD OD 9376.
- B. The average of the ranges of burning rate levels for each of the eight sets of five shots shall not exceed 0.050 in/sec. (see 3.3.2 C 4).
- C. Computation
 1. Procedures for computing the average burning rate of individual strands and for determining the necessity of partial retesting of lots of propellant powder are outlined in 3.2 G of NAVORD OD 9376.
 - a. Provided that strands are divided into three equal increments of length, by the insertion of four fuse wires, the critical value of Δr_0 (the difference between the burning rates of the fastest and the slowest burning increments of any strand) as referred to in NAVORD OD 9376 is 0.024 in/sec. for N-5 propellant. The critical value of $\Delta r'_0$ (the difference between the burning rates of the two increments which agree most closely) is 0.018 in/sec. for N-5 propellant. If both values are exceeded a second strand may be burned to replace faulty data, as provided for in NAVORD OD 9376.
 - b. Regardless of the number of increments per strand the following criterion may be used (in addition to procedure (a) when three-increment strands are employed) whenever the range of burning rates for any group of five complete strands appears excessive. The range of the four closest burning rates shall be divided by the range of all five burning rates. If the dimensionless ratio so obtained is less than 0.358 an extra strand may be burned to replace the faulty data.
 2. The mean burning rate at each of the eight conditions of temperature and pressure is determined from the five shots at each condition.

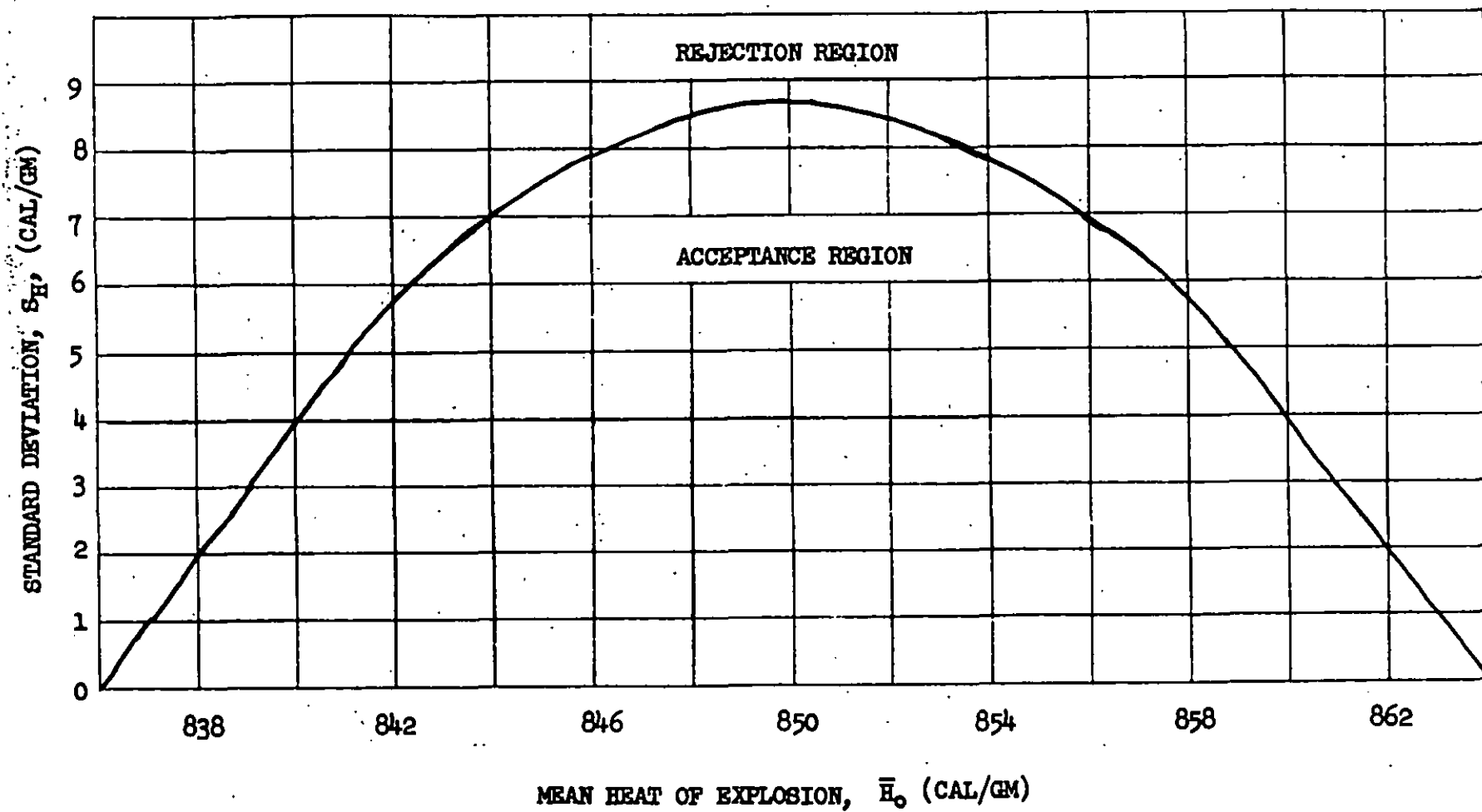


Fig. 1 Acceptance Chart for Heat of Explosion Requirement

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3. The mean burning rates obtained in 2 above are compared with the following respective minimum desired burning rates in the case of 100°F firings, and maximum desired burning rates in the case of 130°F firings:

Bomb Pressure, psia	700	900	1100	1300	1500	Bomb Temp., °F
Desired Burning Rate, in/sec.						
Lower Limit	0.404	0.437	0.454	0.443	10
Upper Limit	0.481	0.472	0.421	0.425	130

Wherever the mean burning rate at 100°F and at any of the four test pressures is less than the above respective minimum desired value, the difference shall be squared; wherever the mean burning rate at 130°F and at any of the four test pressures is greater than the above respective maximum desired value, the difference shall be squared; the sum of the squares of the differences which occur in the undesired direction shall be obtained.

4. The range of individual values for strand burning rate at each of the eight conditions of firing shall be determined by subtracting the lowest rate in each set of five shots from the highest rate in the respective set. The average range for the eight sets of five shots shall be computed.

D. The samples for strand burning rate tests shall be taken in accordance with 4.2.1.2.

3.3.3 Taliani Stability.--The slope of the pressure-time curve at 100 min. as determined by the procedure in NAVORD OD 7939 and 7904, shall not be greater than 1.10 mm of mercury per minute. The sample for the Taliani test shall be taken in accordance with 4.2.1.4.

3.3.4 Moisture.--The moisture content shall be determined by the method outlined in NAVORD OD 9377. The resulting moisture content should normally be 0.30 + 0.10 per cent. No lot shall have a moisture content greater than 0.60 per cent. The sample for moisture determination shall be taken in accordance with 4.2.1.3.

3.3.5 Chemical Analysis.--A chemical analysis shall be carried out on each submitted lot. The methods and procedures shall be those indicated in NAVORD OD 9377. No lot shall have a mean nitrocellulose content greater than 52.0 per cent nor less than 48.5 per cent. No lot shall have a mean 2-nitrodiphenylamine content less than 1.5 per cent. The sample for chemical analysis shall be taken in accordance with 4.2.1.4.

3.4 Dimensions.--

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3.4.1 Class 1 Sheet.--When delivered in the form of flat sheets, the sheet shall have the following dimensions unless otherwise specified in the applicable requisition, contract, or order:

Length 33 inches \pm 3 inches
 Width 4 inches \pm 1/8 inches
 Thickness 0.070 to 0.090 inches.

The thickness and width may vary within these tolerances in any single sheet.

3.4.2 Class 2 Carpet Rolls.--When delivered in the form of "carpet rolls" which are made by forming sheets into rolls, these rolls shall have the following dimensions unless otherwise specified in the contract:

Thickness of component sheet, same as in 3.4.1 above.
 Width of roll (parallel to axis) 4 \pm 1/8 inches.
 Diameter of roll shall be specified in the applicable requisition, contract, or order.

3.5 Appearance.--The sheet or carpet rolls must be substantially homogeneous and free from contamination.

3.6 Workmanship.--The workmanship shall be that required by the best commercial practices governing the quantity production of analogous materials, and shall conform to the requirements designated in this specification.

3.7 Rework.--Rework, identified as rejected extruded grain blanks and known as "press scrap", shall be added to the virgin stock during rolling in a quantity to be specified in the applicable requisition, contract, or order. Scrap sheet from the slitter operation shall be also incorporated uniformly with virgin stock during rolling. Scrap sheet propellant is not considered to be rework in this specification.

4. SAMPLING PROCEDURES

4.1 Lot.--Unless otherwise specified each lot of Class 1 sheet or Class 2 carpet rolls shall consist of not more than 100,000 pounds.

4.2 Sampling.--The Contractor shall provide samples taken under the direction of the Inspector and selected in a random manner from each lot submitted for acceptance. The samples shall consist of one individual section at least 11 inches long by 4 inches wide cut from each of 50 individual even-speed rolled sheets selected at random from each lot of sheet propellant submitted for acceptance. Each sample shall have the long axis of the section parallel to the direction of the final (even-speed) rolling. The sheet samples shall be numbered from 1 to 50.

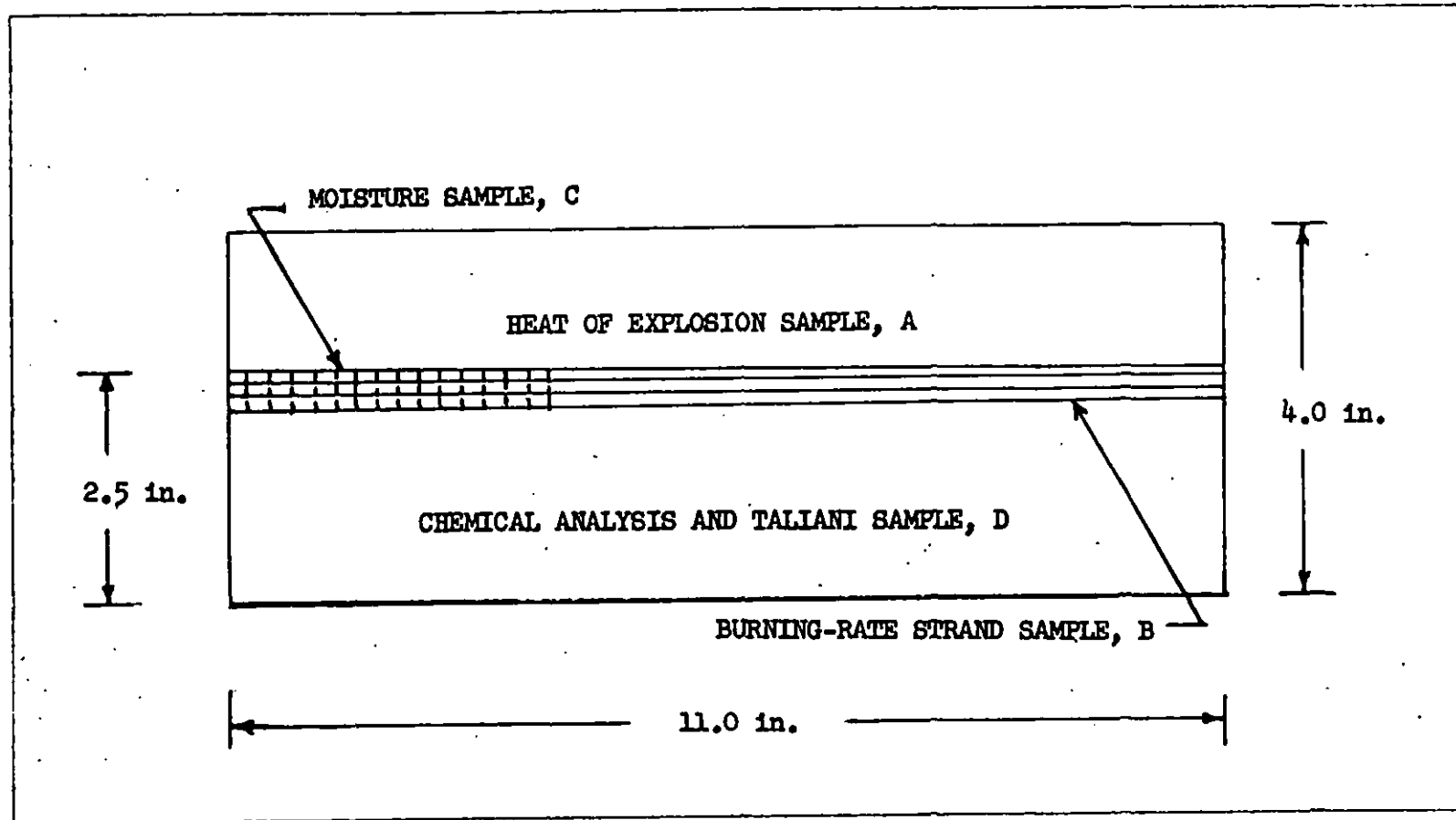


Fig. 2 Division of sheet sample into four individual test samples. Test Sample A for heat of explosion determination, Test Sample B for strand burning-rate determination, Test Sample C for moisture determination, and Test Sample D for general chemical analysis and Taliani test.

4.2.1 Laboratory Test Samples.--From each of the sheet sections selected in 4.2 there shall be prepared four individual test specimens, which shall be designated as follows:

Test Sample A. For the heat of explosion determination. (The dimensions of these specimens will be approximately 1.5 inches by 11 inches.)

Test Sample B. For the strand burning-rate determination.

Test Sample C. For the moisture determination.

Test Sample D. For the general chemical analysis and Taliani test.

The division of the sheet sample into four individual test samples is illustrated in Fig. 2. Further details are given in the following sections.

4.2.1.1 Test Sample A - Heat of Explosion Determination.--From the 50 specimens (see Fig. 2) obtained from the sheet samples, eight individual specimens shall be selected at random. From each specimen, a portion weighing at least 20.0 grams shall be reduced in size in a Wiley mill (or equivalent) to pass a U. S. No. 20 mesh screen. Each of the resulting samples (8 in number) shall be stored in a separate moisture-tight container and properly identified, for example,

Test Sample A
No. 5
N-5 Lot 1917

Test Sample A shall be used for the heat of explosion determinations.

4.2.1.2 Test Sample B - Strand Burning-Rate Determination.--From each of the sections remaining after removal of specimens for Test Sample A shall be cut as many 1/8 to 3/16-inch wide strands as are needed to obtain one satisfactory strand. The remainder of each of the sections plus unsatisfactory strands (if any) shall be saved for Test Sample D (see 4.2.1.4). The fifty 1/8-inch wide strands thus obtained shall be further cut to a length of about 7 1/2 inches and the remaining short lengths shall be retained for Test Sample C (see 4.2.1.3). The resulting 7 1/2-inch long strands shall be stored in moisture-tight containers and properly identified, for example,

Test Sample B
N-5 Lot 1917

4.2.1.3 Test Sample C - Moisture Determination.--Each of the short lengths of 1/8-inch wide strips remaining after the preparation of Test Sample B (see 4.2.1.2) shall be cut to a length of 3.0 inches.

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Then each of these lengths shall be further reduced in size by cutting into approximately 1/8-inch cubes. The resulting material (at least 20.0 grams in weight) shall be thoroughly blended, stored in a moisture-tight container, and properly identified, for example,

Test Sample C
N-5 Lot 1917

Test Sample C shall be used for the moisture determination.

4.2.1.4 Test Sample D.- General Chemical Analysis.--From the material remaining after the preparation of Test Sample B and Test Sample C, a section weighing about 4.0 grams shall be selected from each of the 50 samples. These sections shall be reduced in size by one of the methods described in NAVORD OD 9377 and blended thoroughly to give a uniform sample weighing at least 150 grams. Test Sample D shall be used for the general chemical analysis and the Taliani test.

4.3 Laboratory Tests.--Standard Laboratory test shall be made on each submitted lot of propellant at a laboratory designated by the Bureau of Ordnance. The methods and procedures shall be those indicated in the NAVORD OD's cited in previous sections. Alternate methods and procedures may be used at the discretion of the inspector or contractor provided that such methods shall have the approval of the Bureau of Ordnance. Moisture and nitrocellulose contents shall be determined by the methods specified in NAVORD OD 9377.

5. PREPARATION FOR DELIVERY

5.1 Packing.--The propellant shall be packed in a suitable box, constructed and labelled in conformance with applicable regulations of the Interstate Commerce Commission. The box shall be acceptable for transportation by common carrier. The shipping box and manner of packing shall be indicated in the applicable requisition, contract, or order. The Bureau of Ordnance may specify the type box and manner of packing to be used.

5.2 Marking.--Each shipping box shall be marked in conformance with applicable regulations of the Interstate Commerce Commission and shall be labelled "Smokeless Powder for Rockets", "Sheet Propellant, Type N-5, Lot No. _____", and shall in addition bear the contractor's name, the contract number, the net and gross weight.

5.3 Description sheets and Test reports.--A description sheet covering the manufacture of the sheet powder and including the results of all tests shall be prepared. Description sheets submitted by the contractor

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shall include only that portion of the manufacturing process for which the contractor is responsible. Three copies of the description sheet and test results shall be forwarded to the Bureau of Ordnance, Department of the Navy, Washington 25, D. C. Two copies shall be forwarded to each of the following:

- A. Commanding Officer
U.S. Naval Powder Factory
Indian Head, Maryland
- B. Commander
U.S. Naval Ordnance Test Station, Inyokern
China Lake, California

Attn: Code 40.

5.4 Shipping Destination.--Shipping destination shall be furnished by the Bureau of Ordnance upon acceptance of particular lots involved.

6. NOTES

6.1 Intended Use.--The rocket propellant powder covered by this specification is intended for use in the processing of propellant grains for various solid fuel rockets.

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

- a. Title, number, and date of this specification.
- b. Class required (see 1.2).

6.3 General Safety Precautions.--The manufacture and handling of this rocket propellant powder involve hazardous operations and, therefore, require suitable safety precautions. The contractor or manufacturer is referred to Volumes 1 and 2 of Bureau of Ordnance Pamphlet No. 5--Ammunition Ashore, for guidance in matters involving safety connected with ammunition and explosives. Use of this specification shall not be so construed as to relieve the contractor or the manufacturer of responsibility for the safety of his operations.

NOTICE.--When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission, to manufacture, use, or sell any patented invention that may in any way be related thereto.

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