

INCH POUNDS

MIL-P-82944(OS)
24 April 1995

MILITARY SPECIFICATION

PROPELLANT, SOLID, COMPOSITE

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 a solid composite propellant designated as NSWC/IH-EC-03 that is used in Aircrew Escape Propulsion Systems.

2. APPLICABLE DOCUMENTS**2.1 Government documents.**

2.1.1 Specifications and standards. The following specifications and standards form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATIONS**MILITARY**

MIL-P-217	Potassium Perchlorate
MIL-I-706	Iron Oxide; Ferric, Red Dry (Natural and Synthetic)
MIL-A-23950	Aluminum Powder, Spherical
MIL-R-82657	Resin, Epoxy, Trifunctional
MIL-P-82658	Polymer, Liquid, Polybutadiene, Carboxyl Terminated
MIL-L-82661	Lecithin, Technical
MIL-A-82667/2	Ammonium Perchlorate, Conditioned

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Indian Head Division, Naval Surface Warfare Center, Standardization Branch (Code 8420), 101 Strauss Avenue, Indian Head, MD 20640-5035, by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by sending a letter.

AMSC N/A

FSC 1377

Distribution Statement A: Approved for public release; distribution is unlimited.

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STANDARDS

MILITARY

MIL-STD-286 Propellants, Solid: Sampling, Examination and Testing

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Standardization Documents Order Desk, Bldg 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

2.1.2 Other Government publications. The following other government publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues are those cited in the solicitation (see 6.2).

PUBLICATIONS

NAVAL SEA SYSTEMS COMMAND (Code Ident 10001)

OD 12652 Density of Viscous Material, Determination of

(Application for copies should be addressed to Commanding Officer, Naval Ship Weapons Systems Engineering Station, NAVSEA Data Support Activity (Code 5H30), Port Hueneme, CA 93043.)

NAVAL AIR SYSTEMS COMMAND (Code Ident 30003)

AS 2328 Isodecyl Pelargonate

(Application for copies should be addressed to the Commander, Naval Air Systems Command, Code AIR-51122E, Washington, D.C. 20361)

2.2 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DOD adopted are those listed in the issue of the DODISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS are the issues of the documents cited in the solicitation (6.2).

CHEMICAL PROPULSION INFORMATION AGENCY (CPIA)

Publication No. 21 JANNAF Solid Propellant Mechanical Behavior Manual

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

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D600 Standard Specification for Liquid Paint Driers

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

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2.3 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, 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 First article sample. When specified (see 6.2), a sample shall be subjected to first article inspection (see 6.4) in accordance with 4.4.

3.2 Material. The material shall be a solid composite propellant as described herein.

3.3 Chemical composition and ingredients. The chemical composition and ingredients shall be in accordance with Table I.

TABLE I. Chemical composition and ingredients.

Ingredient	Specification	Weight Percent
Ammonium Perchlorate, Conditioned, 200 micron (see 3.3.1)	MIL-A-82667/2, Type III, Class 1	12.16
Ammonium Perchlorate, Conditioned, 13 micron (see 3.3.1)	MIL-A-82667/2, Type III	33.77
Ammonium Perchlorate, Conditioned, 6 micron (see 3.3.1)	MIL-A-82667/2, Type III	28.36
Polybutadiene, Linear, Carboxyl Terminated	MIL-P-82658	9.847
Resin, Epoxy, Low Viscosity	MIL-R-82657	0.503
Aluminum Powder, Spherical	MIL-A-23950, Type I, Class 2	1.5
Iron Oxide, Ferric, Red Dry	MIL-I-706 Type I, Class 2	2.25
Iron Napthenate (6%)	ASTM D600, Class B	0.06
Isodecyl Pelargonate	AS 2328	3.45
Technical Lecithin	MIL-L-82661	0.3
Potassium Perchlorate	MIL-P-217, Grade A, Class 2	7.8

3.3.1 Ammonium perchlorate ratio of particle sizes. Control of the propellant burning rate shall be maintained by varying the ratio of weight fractions of the three kinds of ammonium perchlorate. The weight fractions are the weights of each kind of ammonium perchlorate divided by the total weight of all three kinds of ammonium perchlorate. The total amount of ammonium perchlorate shall be 74.29 percent of the formulation by weight.

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3.3.1.1 Ammonium perchlorate particle size. The two kinds of ground ammonium perchlorate shall be made from ammonium perchlorate that meets the requirements of MIL-A-82667/2, Type III, Class 1. The ground ammonium perchlorate used in the propellant shall also meet the following particle size requirements (see 4.6.5):

13 micron:

	<u>Min</u>	<u>Max</u>
Microtrac (micron) 50%	6.0	19.0

6 micron:

	<u>Min</u>	<u>Max</u>
Microtrac (micron) 50%	3.0	8.0

The interval of time elapsed between the analysis of the ground ammonium perchlorate and propellant mixing shall not exceed 48 hours.

3.3.2 Binder. The control of the physical properties of the propellant shall be maintained by varying the amount polybutadiene polymer and epoxy resin. The amounts of each of these components shall be determined by adjusting the ratio of chemical equivalents of the epoxy resin to the chemical equivalents of polybutadiene polymer. The value of this ratio should nominally be $(0.90/1.00) \pm (0.10)$ based on the functional equivalence values from the vendor's ingredient certifications. The curing rates of the propellant may be adjusted by varying the percent of the iron napthenate. The total amount of the epoxy resin, polymer, and iron napthenate shall remain constant at 10.41 parts by weight.

3.3.3 Formulation. The nominal values and nominal limits of the ammonium perchlorate ratio and the epoxy resin to polybutadiene polymer equivalents ratio were determined experimentally. Decisions to vary these ratios from their nominal values and nominal limits shall be based on results of ballistic and physical properties obtained from previous batch history, trends indicated by statistical control charts or lot changes of raw materials. The nominal limits of these ratios shall not be criteria for accepting or rejecting a propellant batch; only the resultant physical properties specified herein and the ballistic performance in the end item (rocket motor, rocket catapult, etc.) shall be propellant accept/reject criteria.

3.4 Physical properties. The physical properties of the cured propellant shall conform to Table II when cured in accordance with 4.5.1. Test specimens shall be tested within 30 days after the end of cure (see 4.6.3).

TABLE II. Physical properties of cured propellant.

Property	Temperature, °F	Minimum	Maximum
Elongation at maximum stress, %	-65 ± 5	10	—
	77 ± 5	10	—
	165 ± 5	10	—
Tensile Strength, psi	-65 ± 5	440	—
	77 ± 5	90	—
	165 ± 5	70	—
Density, g/cm ³	77 ± 5	1.725	1.765

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3.5 Workmanship. The material shall be uniform, and free from contamination and foreign matter that would prevent its use for the purpose intended.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract, the contractor is responsible for the performance of all inspection requirements (examinations and tests) as specified herein. Except as otherwise specified in the contract, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure that supplies and services conform to prescribed requirements.

4.1.1 Responsibility for compliance. All items shall meet all requirements of sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of manufacturing operations, is an acceptable practice to ascertain conformance to requirements; however, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to accept defective material.

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

- a. First article inspection (4.4)
- b. Quality conformance inspection (4.5)

4.3 Inspection conditions. Unless otherwise specified (see 6.2), all inspections shall be performed as specified in the applicable test method of 4.6.

4.4 First article inspection. First article inspection shall consist of the examinations and tests of 4.6

4.4.1 Sampling. Unless otherwise specified in the contract (see 6.2), a first article sample shall consist of one propellant batch produced with equipment and procedures intended for use in production. Propellant grains and samples shall be cured together in the same location at $170 \pm 5^{\circ}\text{F}$ for a minimum of 240 hours and until two consecutive Shore A hardness measurements, taken at least 24 hours apart, show no more than a 2 Shore A unit change. Test samples shall be forwarded to an activity designated by the procuring activity (see 6.2) for first article testing. The sample shall be tested to determine, prior to starting production, that the contractor's production methods are capable of producing propellant that complies with the technical requirements of the contract. No process changes shall be made, subsequent to approval of the first article sample, without prior written approval of the procuring activity. Process changes shall include but not be limited to:

- a. A change in mixing vessel size or type
- b. A change in an ingredient manufacturer or ingredient manufacturer's process

4.4.2 Failure. Failure of the sample to pass any test shall result in rejection of the first article sample.

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4.5 Quality conformance inspection. Quality conformance inspection shall consist of the tests of 4.6.

4.5.1 Sampling. A quality conformance inspection sample shall consist of sufficient material from each propellant batch to perform the tests of 4.6. Samples shall be cast as specified in the contract (see 6.2). Propellant grains and samples shall be cured together in the same location at $170 \pm 5^\circ\text{F}$ for a minimum of 240 hours and until two consecutive Shore A hardness measurements, taken at least 24 hours apart, show no more than a 2 Shore A unit change.

4.5.2 Inspection lot. An inspection lot shall consist of a single propellant batch where a batch is defined as a blend of propellant ingredients manufactured at one time in one mixer.

4.5.3 Failure. Failure of the sample to pass any test shall be cause for rejection of the lot.

4.6 Test methods. Unless an alternative inspection method is proposed, tests shall be performed using apparatus and procedures specified herein. Alternative inspection methods must be approved by the contracting activity prior to use in acceptance testing.

4.6.1 Formulation. Each ingredient shall be weighed to determine compliance with table I prior to mixing. Weights shall be measured with equipment having an accuracy of ± 1.0 percent of the ingredient weight specified in table I.

4.6.2 Density. The density of the cured propellant shall be determined in accordance with OD 12652.

4.6.3 Mechanical properties. The mechanical properties of the cured propellant shall be determined in accordance with CPIA Publication No. 21, Uniaxial Tensile Tests at Constant Strain Rate. The class of test and specimen used shall be Class C. Test specimens shall be prepared and pulled at the applicable temperature and a crosshead rate of 2.0 inches per minute (see 3.4).

Temperature conditioning: All test specimens shall be conditioned for a minimum of 3 hours at the applicable test temperature specified in Table II, prior to testing. The time from cutting the specimens to testing the specimens shall be no greater than 72 hours.

Humidity conditioning: Stress specimens shall be conditioned for a minimum of 24 hours at less than 50 percent relative humidity prior to test. Tests shall be conducted at less than 50 percent relative humidity. Specimens stored for future testing shall be stored at less than 50 percent relative humidity. The time from cutting the specimens to testing the specimens shall be no greater than 72 hours.

4.6.3.1 Defective specimens. Defective specimens which fail at the site of a void, a polymer rich pocket, or specimens which break outside the necked down straight section shall be discarded and replaced with another specimen. The replacement specimen will be used when making average data computations.

4.6.3.2 Calculations. Calculate and record the average values of the mechanical properties for a minimum of five test specimens at each temperature.

4.6.3.3 Data reduction. Data reduction shall be in accordance with CPIA Publication No. 21.

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4.6.4 Raw materials. Prior to mixing the ingredients, each raw material shall be tested in accordance with the applicable ingredient specification to determine compliance with 3.3.

4.6.5 Ammonium perchlorate particle size (ground ammonium perchlorate only). The particle size of ground ammonium perchlorate shall be determined by a light scattering technique (Leeds and Northrup Microtrac) in accordance with the manufacturer's procedures using heptane as the solvent and lecithin or twitchell base for the surfactant. Measure the particle size distribution, in microns, at 10, 50 and 90 percentile points and the mean value or diameter.

5. PACKAGING

This section is not applicable to this specification.

6. NOTES

6.1 Intended Use. This solid composite propellant in accordance with this specification is intended for use in the CKU-10/A and CKU-11/A Rocket Catapults.

6.2 Acquisition requirements.

- a. Title, number and date of this specification.
- b. Issue of DODISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.1.1, 2.1.2, and 2.2)
- c. Whether a first article sample is required (see 3.1).
- d. Inspection conditions if other than as specified (see 4.3).
- e. Assigned activity for first article inspection (see 4.4.1).
- f. Instructions for casting of test samples (see 4.5.1).
- g. That the safety precaution requirements of "Contractors' Safety Manual for Ammunition and Explosives, and Related Dangerous Material" (DOD 4145.26M) are applicable and should be specified in the contract or order as required by the Federal Acquisition Regulation (FAR) 23.3. 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) are applicable.

6.3 Consideration of data requirements. The following data requirements should be considered when this specification is applied on a contract. The applicable Data Item Descriptions (DID) should be reviewed in conjunction with the specific acquisition to ensure that only essential data are requested/provided and that the DIDs are tailored to reflect the requirements of the specific acquisition. 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.

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<u>Reference paragraph</u>	<u>DID Number</u>	<u>DID Title</u>	<u>Suggested Tailoring</u>
4.6	DI-T-2702	Reports, Tests	—

The above DID was cleared as of the date of this specification. The current issue of DOD 5010.12-L, Acquisition Management Systems and Data Requirements Control List (AMSDL), must be researched to ensure that only current, cleared DIDs are cited on the DD Form 1423.

6.4 First article. When first article inspection is required, the contracting officer should provide specific guidance to offerors whether the item(s) should be a preproduction sample, a first article sample, a first production item, a sample selected from the first production items, a standard production item from the contractor's current inventory (see 3.1), and the number of items to be tested as specified in 4.4. The contracting officer should also include specific instructions in acquisition documents regarding arrangements for examinations, approval of first article test results, and disposition of first articles. Invitation for bids should provide that the Government reserves the right to waive the requirement for samples for first article inspection to those bidders offering a product which has been previously acquired or tested by the Government, and that bidders offering such products, who wish to rely on such production or test, must furnish evidence with the bid that prior Government approval is presently appropriate for the pending contract. Bidders should not submit alternate bids unless specifically requested to do so in the solicitation.

6.5 Linear burning rate. Propellants meeting the following burning rate guidelines have provided successful ballistic performance in the past:

- a. The linear burning rate of the cured propellant should be determined in accordance with Method T803.1 of MIL-STD-286 for each pressure-temperature combination specified in Table III.
- b. Test specimens should have a 0.250 X 0.125 in. rectangular cross section rather than the 0.125 in. diameter circular cross section specified in Method T803.1.

The nominal linear burning rate range of the inhibited strands of propellant at each of the conditions of temperature and pressure is shown in Table III. Equivalent methods of determining burn rates may be used.

TABLE III. Nominal linear burning rate range (information only).

Bomb pressure, psia	Burn rate (inches per second) 77 ± 5°F
500	0.80 to 0.95
1000	1.30 to 1.45
2000	1.80 to 2.10

6.5.1 Burn rate indicators. Strand burn rates may be used as indicators of the propellant burn rate, but the final determination should be made according to the burn rate in the actual end items (rocket motor, rocket catapult, etc.).

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6.6 Heat of Explosion. Propellants with a heat of explosion of 1290 calories/gram minimum have provided successful ballistic performance in the past. The heat of explosion should be determined in accordance with Method 802.1 of MIL-STD-286.

6.7 Ingredient lot set evaluation. Ingredient lot set evaluation tests should be performed to qualify a new lot set of ingredients or to verify the acceptability of ingredient lot changes.

6.8 Subject term (keyword) listing.

Aircraft ejection seat

Rocket catapult

Preparing activity:
Navy - OS
(Project 1377-012)

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4, 5, 6, and 7.
3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

I RECOMMEND A CHANGE:

1. DOCUMENT NUMBER
MIL-P-82944 (OS)

2. DOCUMENT DATE (YYMMDD)
950424

3. DOCUMENT TITLE

PROPELLANT, SOLID, COMPOSITE

4. NATURE OF CHANGE (Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME (Last, First, Middle Initial)

b. ORGANIZATION

c. ADDRESS (Include Zip Code)

d. TELEPHONE (Include Area Code)

7. DATE SUBMITTED
(YYMMDD)

(1) Commercial

(2) AUTOVON
(If applicable)

8. PREPARING ACTIVITY

a. NAME

COMMANDER, INDIAN HEAD DIVISION
NAVAL SURFACE WARFARE CENTER

b. TELEPHONE (Include Area Code)

(1) Commercial

(2) AUTOVON

301-743-4358/4510

354-4358/4510

c. ADDRESS (Include Zip Code)

101 STRAUSS AVE., (CODE 8420)
INDIAN HEAD, MD 20640-5035

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