

MIL-G-82682 (OS)
30 October 1978
Superseding
(See 6.3)

MILITARY SPECIFICATION

GRAPHITE BILLETS, EXTRUDED
(FOR HIGH TEMPERATURE APPLICATION)

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 one type of extruded graphite billets for use in high temperature application.

2. APPLICABLE DOCUMENTS

2.1 Issues of documents. 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.

STANDARDS

MILITARY

MIL-STD-129 Marking for Shipment and Storage

DRAWINGS

NAVAL SEA SYSTEMS COMMAND (Code Ident. 10001)

SA 268115 Specific Resistance Testing
 Apparatus Assembly

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

Beneficial comments (recommendations, additions, deletions), and any pertinent data which may be of use in improving this document, should be addressed to: Commanding Officer, Naval Ordnance Station, Standardization Division (611), Indian Head, MD 20640, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document, or by letter.

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2.2 Other 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 or request for proposal shall apply.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 78-75 Flexural Strength of Concrete (Using Simple
Beam with Third-Point Loading)

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

NATIONAL MOTOR FREIGHT TRAFFIC ASSOCIATION, INC., AGENT
National Motor Freight Classification

(Application for copies should be addressed to the American Trucking Associations, Attn: Traffic Department, 1616 P Street, Washington, DC 20036.)

UNIFORM CLASSIFICATION COMMITTEE, AGENT
Uniform Freight Classification Rules

(Application for copies should be addressed to the Uniform Classification Committee, Room 1106, 222 South Riverside Plaza, Chicago, IL 60606.)

(Technical society and technical association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal agencies.)

3. REQUIREMENTS

3.1 Preproduction. Unless otherwise specified in the contract (see 6.2), the contractor shall furnish samples for preproduction inspection and approval (see 4.4, 6.4 and 6.5).

3.2 Material. The material shall be graphite billets of a size specified in the contract (see 6.2), formed by the extrusion process from a petroleum coke having a particle size not greater than .032 inch.

3.3 Physical properties. The physical properties of the material shall conform to the requirements specified in Table I.

3.4 Identification. The ends of each billet shall be color-coded in white as specified in the contract (see 6.2). The grain direction shall be indicated on the cylindrical surface of each billet by an arrow.

3.5 Workmanship. The graphite shall be manufactured to ensure uniform billets free from visual cracks, contaminants, or any defects which would prevent its use for the purpose intended.

Table I. Physical properties.

Property	Unit of Measure	VALUE	
		Maximum	Minimum
Apparent density	grams per cubic centimeter (g/cm ³)	1.64	1.50
Resistivity with grain	ohm - centimeters x 10 ⁻⁴	12.5	---
Flexural strength with grain across grain	pounds per square inch (psi)	---	1100
		---	980
Ash content	weight percent (wt%)	0.33	---

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 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.

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

- a. Preproduction inspection (see 4.4).
- b. Quality conformance inspection (see 4.5).

4.3 Inspection conditions. Unless otherwise specified (see 6.2), all inspections shall be performed under the following conditions:

- a. Temperature: Room ambient 18 to 35°C (65° to 95°F)
- b. Altitude: Normal ground
- c. Vibration: No requirement
- d. Humidity: Room ambient to 95 percent, maximum

4.4 Preproduction inspection. When required (see 6.2), a preproduction sample consisting of two billets selected in accordance with 4.5.2 shall be subjected to the preproduction inspection consisting of the tests and examination of 4.6. Failure to pass any test or examination shall be cause for rejection of the preproduction sample. The preproduction inspection

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shall be performed by the contractor, after award of contract and prior to production, at a location acceptable to the Government. Preproduction inspection shall be performed on sample billets which have been produced with equipment and procedures normally used in production. Preproduction approval is valid only on the contract under which it is granted, unless extended by the Government to other contracts (see 6.4).

4.5 Quality conformance inspection. The quality conformance inspection shall consist of the tests and examinations of 4.6 performed on samples selected in accordance with 4.5.2. The ash content test of 4.6.5 shall be performed after all other tests have been conducted. Failure of any billet to pass any test or examination shall be cause for rejection of the lot.

4.5.1 Lot. A lot shall consist of material manufactured during a single production run, without change in process, and to be offered for acceptance on one contract at one time. The maximum lot size shall be as specified in the contract (see 6.2).

4.5.2 Sampling. Unless otherwise specified in the contract (see 6.2), the sample billet size shall be in accordance with Figure 1. All billets shall be subjected to the visual examination of 4.6.1. Ten percent of the lot, but in no case more than ten or less than 2 billets, shall be randomly selected for destructive testing.

4.5.2.1 Billet specimens. Two 1.50-inch slabs shall be cut across the grain from the top and bottom of each sample billet. Three 1.25 by 1.25 by 7-inch test specimens shall be cut from each slab. Where the sample diameter is not of sufficient size to obtain a 7-inch specimen, a shorter specimen shall be prepared. From the remaining cylindrical material, six test specimens, 1.25 by 1.25 by 7 inches, shall be cut lengthwise with the grain.

4.5.2.2 Testing of specimens. Specimens from each billet shall be tested in accordance with the following:

- a. Randomly select three test specimens for apparent density evaluation.
- b. The six "with grain" specimens shall be tested for resistivity.
- c. Each "across grain" and each "with grain" specimen shall be evaluated for flexural strength.
- d. Three "with grain" and three "across grain" test specimens shall be selected for ash content determination.

4.6 Inspection methods.

4.6.1 Visual examination. Each billet shall be visually examined to verify conformance to the requirements of 3.2, 3.4 and 3.5.

4.6.2 Apparent density. The apparent density shall be determined in accordance with the following procedure:

a. Procedure. Measure each dimension of the test specimen in three or more places to the nearest millimeter and average each dimension. Calculate the volume based on these average dimensions. Weigh to the nearest 0.01 gram(g). Report a minimum of three determinations and their average.

b. Calculation. Apparent density = $\frac{M}{V}$

Where: M = weight of sample, g
V = volume of sample, cubic centimeters (cm³)

4.6.3 Resistivity. Resistivity shall be determined in accordance with either Method A or Method B. In the case of a dispute, Method A shall be determinative.

4.6.3.1 Method A. Method A shall be performed in accordance with the following equipment and procedure:

a. Apparatus:

1. Specific Resistance Testing Apparatus Assembly, SA 2681115
2. Leeds and Northrup Potentiometer, number 7553, or equivalent
3. 3.0 volt direct current (Vdc) source

b. Procedure: Assemble the apparatus as shown on Figure 2. Balance the potentiometer according to the manufacturer's instructions. Place a weight of approximately 5 pounds on the center of the specimen to ensure contact of the potential points. Determine the current passing through the test specimen. Report a minimum of six determinations and their average.

c. Calculation: Resistivity (ohm · cm) = $\frac{EA}{IL}$

Where: A = cross-sectional area, square centimeters (cm²)
L = length of conductor, cm
E = potential difference, V
I = current, amperes (A)

4.6.3.2 Method B. Method B shall be performed in accordance with the following equipment and procedure:

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a. Apparatus:

1. Low voltage dc power source
2. Weston dc ammeter (range of 0 to 100) or equivalent
3. Weston dc millivoltmeter (range of 0 to 100) or equivalent

b. Procedure. Assemble the apparatus as shown on Figure 3 and bring the current carrying compression heads into tight contact with the stock. Adjust the rheostat to achieve desired current level and determine the mV drop between points C and D as shown on Figure 3. Report a minimum of six determinations and their average.

c. Calculation. Resistivity (ohm · cm) = $\frac{EA}{IL}$

Where: A = cross-sectional area, cm²
 L = length of conductor, cm
 E = potential difference, V
 I = current, A

4.6.4 Flexural strength. The flexural strength shall be determined in accordance with ASTM C78-75.

4.6.5 Ash content. The ash content shall be determined in accordance with the following procedure:

a. Procedure. Weigh a sample of approximately 10 g, to the nearest 0.1 mg, in a previously ignited, tared 100-mL platinum crucible. Place the weighed sample in a muffle furnace and heat to a temperature between 800 and 900°C for 24 hours (to prevent ash fusion, do not exceed 900°C.) Allow the crucible and sample to cool to room temperature and examine the residue for traces of carbon. If carbon is present, the ignition shall be continued until ashing is complete. Transfer the cool sample to a desiccator and allow to stand for a minimum of 1 hour before weighing to the nearest 0.1 mg. When there is no further evidence of carbon, repeat the ignition twice more for 1-hour periods at 800 to 900½C until a constant weight is obtained. Report a minimum of three determinations and their average.

b. Calculation. Ash content, wt% = $\frac{\text{ash weight} \times 100}{\text{sample weight}}$

4.7 Packaging, packing and marking inspection. The packaging, packing and marking shall be inspected to verify conformance to the requirements of section 5. Failure to meet any requirement shall be cause for rejection.

5. PACKAGING

5.1 Packaging and packing. Unless otherwise specified in the contract (see 6.2), packaging and packing shall be commercial.

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5.1.1 Commercial. Unless otherwise specified in the contract (see 6.2), packaging and packing of the graphite shall be in accordance with standard commercial practice applicable to the type of material. The packaging and packing shall be of such construction and materials that the contents will be adequately protected against loss or contamination. Containers shall conform to Uniform Freight Classification, National Motor Freight Classification or to rules of other carriers applicable to the mode of transportation.

5.2 Marking. In addition to any special marking required by the contract (see 6.2), each container shall be marked in accordance with MIL-STD-129. Marking shall include, but not be limited to, the following information:

- a. Title, number and date of this specification
- b. Manufacturer's name and location
- c. Material trade name
- d. Net weight and volume
- e. Lot number, batch number(s), billet identification (see 3.4), and date of manufacture
- f. Storage conditions
- g. Contract number

6. NOTES

6.1 Intended use. The graphite is intended for use as a rocket nozzle insert material in the Mk 12 missile booster for the standard missile.

6.2 Ordering data. Procurement documents should specify the following:

6.2.1 Procurement requirements.

- a. Title, number and date of this specification
- b. Manufacturer's grade designation (see 6.6)
- c. Quantity required
- d. Place of delivery
- e. Maximum lot size (see 4.5.1)
- f. When a preproduction sample is not required (see 3.1, 4.4, 6.4 and 6.5)
- g. Size of billets required and color code required (see 3.2 and 3.4)
- h. Inspection conditions, if other than as specified (see 4.3)
- i. Location of preproduction inspection (see 4.4)
- j. Packing and packaging requirements, if other than as specified (see 5.1)

6.2.2 Contract data requirements. Any data required for delivery in connection with this document shall be specified on a DD Form 1423 incorporated into the contract. Such data will be delivered as identified on completed (numbered) DIDs (Data Item Descriptions/DD Form 1664) which will be documented in the Applicable ADL (Authorized Data List).

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6.3 Supersession information. MIL-G-82682 includes the requirements of and supersedes Naval Sea Systems Command (Code Ident 10001) purchase description WS 2516A, dated 1 May 1967.

6.4 Preproduction sample waiver. Preproduction samples submitted and approved on a recent contract may be accepted by the procuring activity in lieu of an additional preproduction sample inspection. When the preproduction sample is waived (see 6.2.1 f), the procurement document should contain a statement specifying that the standards of workmanship exhibited by the previously approved preproduction sample shall determine the minimum requirements of the current contract or order.

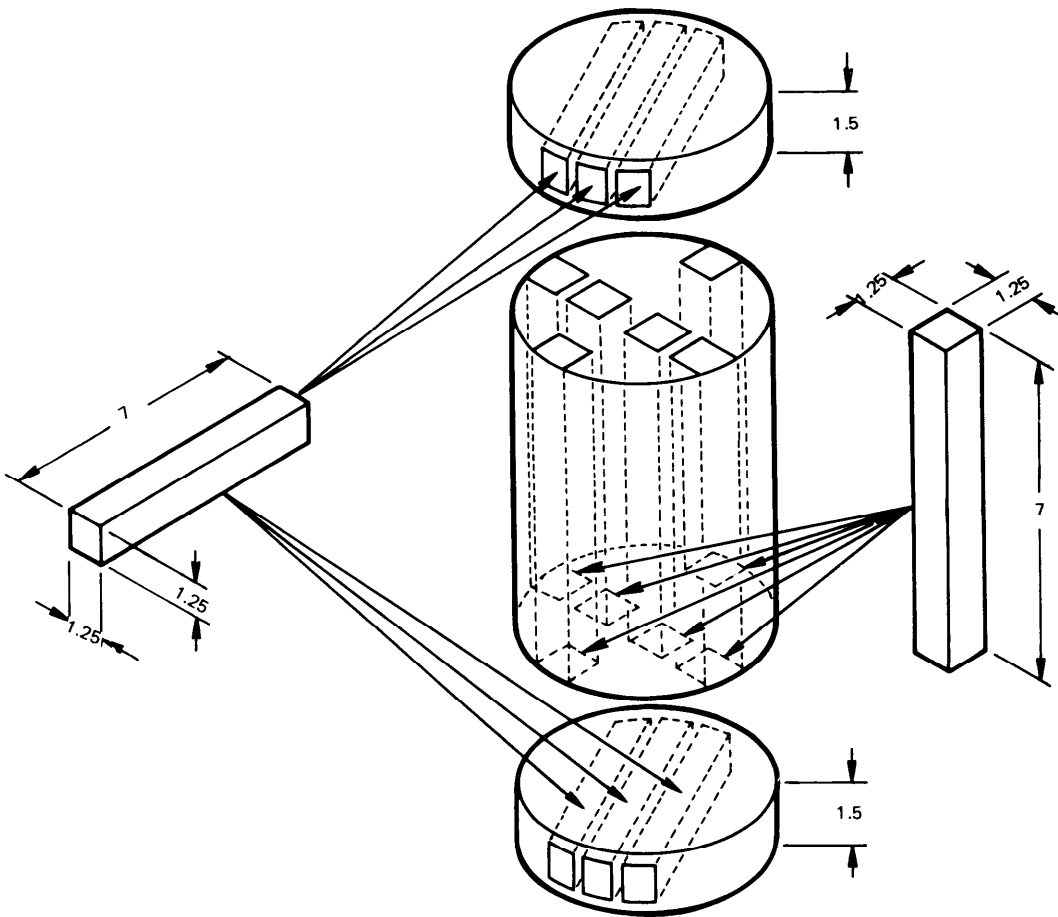
6.5 Preproduction sample. When a preproduction sample is required, it shall be tested and approved under the appropriate provisions of 7-104.55 of the Armed Services Procurement Regulations (ASPR). The contracting officer should include specific instructions in all procurement instruments regarding arrangements for examinations, test and approval of the preproduction sample.

6.6 Suggested source of supply. Products that have met the requirements of this specification in past procurement actions are 873S, 3383 or 896G Graphite manufactured by Airco Speer Carbon-Graphite, Division of AIRCO, INC., Carbon-Products Department, P. O. Box 387, St. Mary's PA 15857 This information is for the convenience of the procuring activity and is not to be construed as a waiver of any requirement of this specification nor as any limitation of additional potential sources of supply.

Custodian:
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Project Number
9620-N011



- NOTES:
1. All dimensions are in inches and tolerance is $\pm .032$.
 2. Minimum billet dimensions shall be 9 inches diameter by 10 inches long (see 4.5.2).

FIGURE 1. Extruded graphite test specimens.

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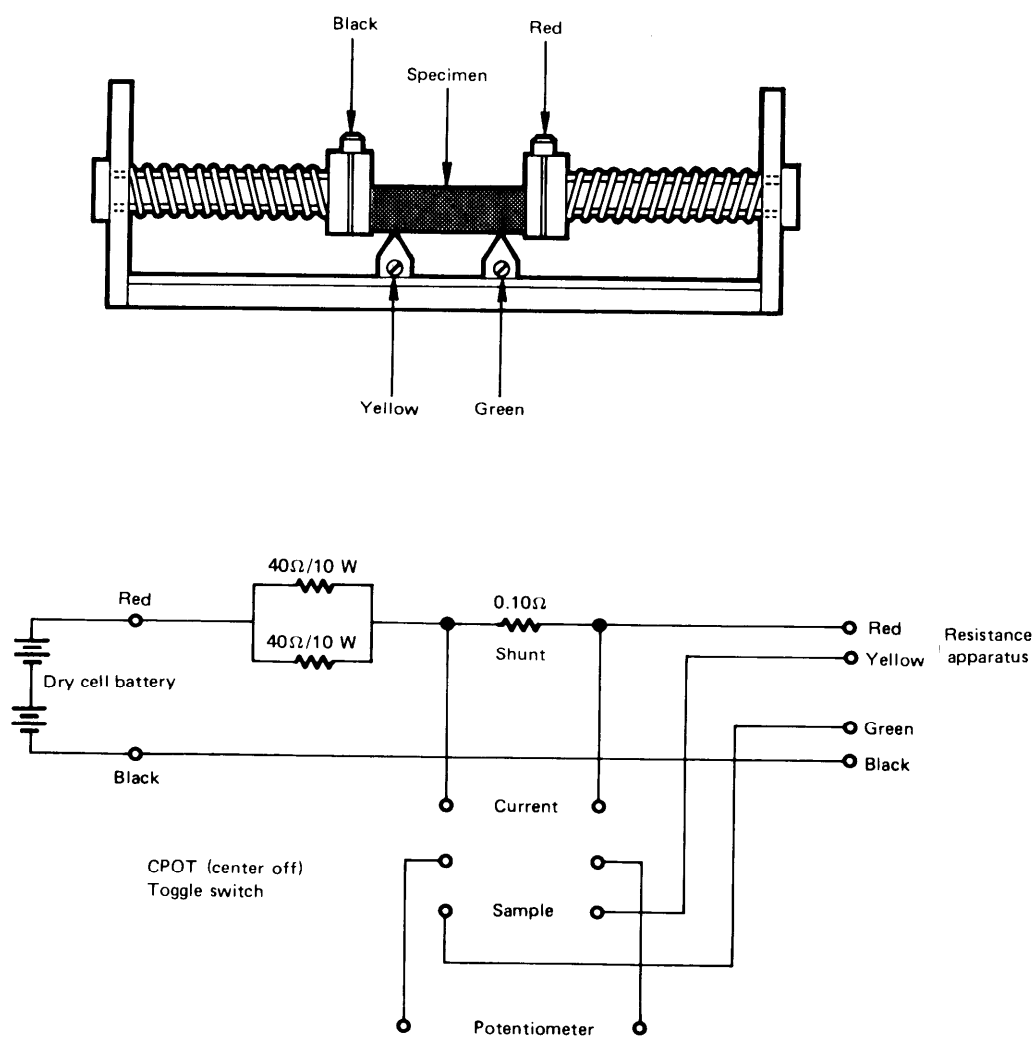


FIGURE 2. Resistivity test arrangement (Method A).

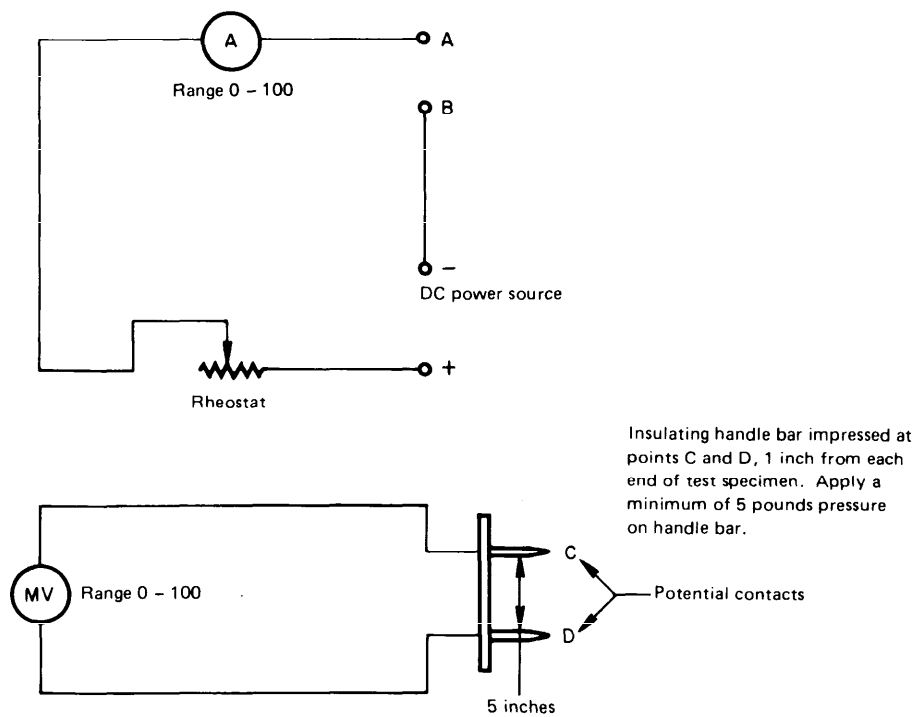
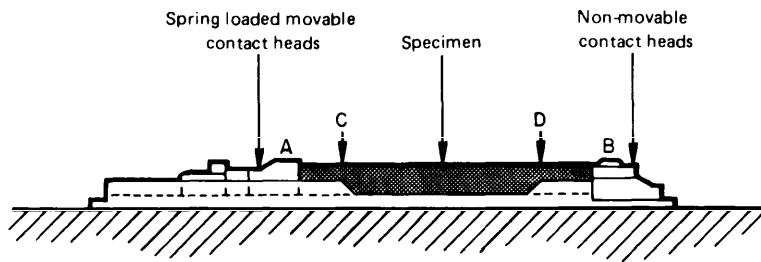


FIGURE 3. Resistivity test arrangement (Method B).

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL		OMB Approval No. 22-R255
<p>INSTRUCTIONS: The purpose of this form is to solicit beneficial comments which will help achieve procurement of suitable products at reasonable cost and minimum delay, or will otherwise enhance use of the document. DoD contractors, government activities, or manufacturers/vendors who are prospective suppliers of the product are invited to submit comments to the government. Fold on lines on reverse side, staple in corner, and send to preparing activity. 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. Attach any pertinent data which may be of use in improving this document. If there are additional papers, attach to form and place both in an envelope addressed to preparing activity.</p>		
DOCUMENT IDENTIFIER AND TITLE "GRAPHITE BILLETS, EXTRUDED (FOR HIGH MIL-G-82682(OS). TEMPERATURE APPLICATION)"		
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	<input type="checkbox"/> DIRECT GOVERNMENT CONTRACT <input type="checkbox"/> SUBCONTRACT	
<p>1. HAS ANY PART OF THE DOCUMENT CREATED PROBLEMS OR REQUIRED INTERPRETATION IN PROCUREMENT USE?</p> <p style="padding-left: 20px;">A. GIVE PARAGRAPH NUMBER AND WORDING.</p> <p style="padding-left: 20px;">B. RECOMMENDATIONS FOR CORRECTING THE DEFICIENCIES</p>		
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	DATE	

DD FORM 1426
1 JAN 72

REPLACES EDITION OF 1 JAN 66 WHICH MAY BE USED

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