

MIL-C-3884A

5 November 1970

SUPERSEDING

MIL-C-3884

18 May 1953

MILITARY SPECIFICATION

CORD, ELECTRICAL (SHORT LAY)

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

1. SCOPE

1.1 Scope. This specification covers 2-, 3-, and 4-conductor, extra-flexible electrical cords in which all conductors under the same jacket are of the same AWG wire size. The cord insulation is styrene butadiene rubber (SBR), and the jacket is SBR or polychloroprene. These cords are suitable at low temperatures (-55°C), and are for use in applications where severe flexing is a major consideration. (See 3.1 for individual cord types.)

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

QQ-W-343 Wire, Electrical (Uninsulated).

MILITARY

MIL-C-572	Cords, Yarns and Monofilaments, Organic Synthetic Fiber.
MIL-I-3930	Insulating and Jacketing Compounds, Electrical (For Cable, Cord, and Wire).
MIL-C-12000	Cable, Cord and Wire, Electric; Packaging and Packing For.
MIL-C-45662	Calibration System Requirements.

FSC 6145

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STANDARDS

FEDERAL

FED-STD-228

Federal Test Method Standard; Cable and Wire,
Insulated; Method of Testing.

MILITARY

MIL-STD-104

Limits for Electrical Insulation Color.

MIL-STD-105

Sampling Procedures and Tables for Inspection By
Attributes.

(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.)

3. REQUIREMENTS

3.1 General. The cord types and related dimensions shall be as specified in table I.

Table I. Cord types and dimensions.

Type designation		Size of conductors	Number of conductors	Conductor length of lay (max.)	Outside dia. of cord (+0.010 in.)
SBR jacket	Polychloroprene jacket				
		<u>AWG</u>		<u>Inch</u>	<u>Inch</u>
COSL-2(23)	COPL-2(23)	23	2	0.200	0.225
COSL-2(22)	COPL-2(22)	22	2	.250	.280
COSL-3(22)	COPL-3(22)		3	.375	
COSL-4(22)	COPL-4(22)		4	.500	
COSL-2(20)	COPL-2(20)	20	2	.250	.280
COSL-3(20)	COPL-3(20)		3	.375	
COSL-4(20)	COPL-4(20)		4	.500	
COSL-2(18)	COPL-2(18)	18	2	.375	.290
COSL-3(18)	COPL-3(18)		3	.500	

3.2 Construction. Each conductor shall be a stranded, tinned-coated copper wire (size as specified in table I), covered with a separator and insulated with styrene butadiene rubber (SBR). (The separator may be omitted if a free-stripping insulating compound is used.) The insulated conductors shall be wound around a staycord or staycords in a left hand direction, using fillers where necessary to form a compact round core. The length of lay of the insulated conductors shall be as specified in table I. A closely woven binder shall be applied over the cabled conductors, and an SBR or polychloroprene jacket, as applicable, applied over the binder. The cord ends shall be sealed.

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3.3 Materials. The materials used in the fabrication of cords shall be as hereinafter specified.

3.3.1 Conductors. Conductors shall be stranded, soft or drawn-and-annealed tin-coated copper wire conforming to QQ-W-343, Type B; Class M for sizes 18, 20 and 22 AWG, and Class O for size 23 AWG. The conductor size for each type cord shall be as specified in table I.

3.3.2 Yarn.

3.3.2.1 Separators and binders. All yarn employed as separators and binders shall be synthetic fiber conforming to MIL-C-572, type P or CTA, or polyester yarn. The yarn used shall be clean, dry, and substantially free from all foreign particles, knots, lumps, or any substance that might impair the insulation of the wire.

3.3.2.2 Fillers. Filler materials shall be a ply yarn conforming to MIL-C-572, type P or CTA; or polyester fiber, polypropylene yarn or polypropylene filament. Fillers shall be used in the interstices between the conductors to form an essentially round core prior to jacketing.

3.3.2.3 Staycords. The staycords shall consist of two or more concentric braids of synthetic fiber yarn conforming to MIL-C-572, type P or PAA, or polyester yarn. The staycords shall be approximately 1/16 inch in diameter; shall be non-fraying, and shall not abrade or otherwise damage the insulation when the cord is bent or pulled. The staycords shall be at or near the center of the core, and shall not be twisted together with the insulated conductors during the cabling operation.

3.3.2.3.1 Staycord breaking strength. The staycord for the completed cord shall have a minimum breaking strength of 40 pounds when tested as specified in 4.5.2.

3.3.3 Insulation. A styrene butadiene rubber insulating compound conforming to MIL-I-3930, type IS-L, shall be applied concentrically over the conductor or separator, when present, to a nominal thickness of 0.015 inch, with a minimum thickness of 0.012 inch at any point along the insulated conductor prior to cabling. The insulation shall be well-centered; the minimum thickness of the insulation, measured at any cross-section along the length of the insulated conductor, shall be not less than 70 percent of the maximum thickness at that cross-section. The insulation shall be capable of being readily stripped from the conductor by standard methods, leaving the conductor clean for soldering. Insulated conductors shall be readily separable from each other.

3.3.4 Color coding. The conductors within the cord shall be clearly distinguishable by the color of the insulation. The coloring shall be solid, and may either extend through the thickness of the insulation or consist of a thin layer of colored compound applied over the insulation. In the latter case, the

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colored layer shall adhere firmly to the insulation wall. The color limits shall conform to MIL-STD-104, class 2. The color coding of the conductor insulation shall be in accordance with table II.

Table II. Color coding of conductor insulation.

No. of conductors	Color coding
2	Black and white
3	Black, white and red
4	Black, white, red and green

3.3.5 Jacket. A black colored jacket shall be applied over the core of insulated conductors to a minimum thickness of 0.025 inch. The jacket shall conform to MIL-I-3930, type JS-L for styrene butadiene rubber, or type JN-L for chloroprene rubber, as applicable. (See Table I.) The jacket shall be well-centered over the insulated conductors, and the minimum thickness of the jacket, measured at any cross-section along the length of the completed cord, shall be not less than 70 percent of the maximum thickness at that cross-section.

3.3.6 Outside diameter. The outside diameter of the completed cord shall be within the dimensions specified in table I.

3.4 Electrical requirements.

3.4.1 Dielectric withstanding voltage. The insulated conductors shall withstand for one minute an applied voltage of 750 volts (rms) when tested as specified in 4.5.3.1, and shall show no evidence of breakdown.

3.4.2 Insulation resistance. Immediately after the insulated conductors have withstood the dielectric withstanding voltage test, the insulation resistance shall be measured as specified in 4.5.3.2. The insulation resistance shall be not less than 500 megohms-1000 feet at 15.6°C minimum.

3.4.3 Conductor resistance. Each conductor in the finished cord shall be continuous and shall have a direct-current (dc) resistance as indicated in table III, when measured at a temperature of, or corrected to 20°C. If the resistance value is lower or equal to that specified when the measurement is made at a temperature greater than 20°C, no correction factor need be employed. (See 4.5.3.3.)

Table III. Conductor resistance.

Conductor size (AWG)	DC resistance (ohms, max./1,000 ft.)
23	23.80
22	19.20
20	11.57
18	7.52

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3.5 Physical properties.

3.5.1 Cold bend. Neither the jacket nor the insulation shall show evidence of cracks, flaws, or other damage when tested in accordance with 4.5.4.1 at a temperature of $-55^{\circ} \pm 2^{\circ}\text{C}$.

3.5.2 Flexing endurance. When tested as specified in 4.5.4.2, the completed cord shall withstand the number of bending and twisting cycles as specified below:

- 1,000 bending and twisting cycles at 75°C .
- 500 bending and twisting cycles at -30°C .

3.6 Lengths. Unless otherwise specified (see 6.2(c)), the completed cord shall be furnished wound on spools or reels in continuous lengths of not less than 250 feet.

3.7 Sealing of cord ends. To prevent moisture from entering the completed cord, both ends of each shipping length of all cords shall be dipped in a sealer which shall completely seal the ends. No treatment is required over that part of the cord covered by the jacket.

3.8 Workmanship. Cords shall be constructed and finished in a thoroughly workmanlike manner in accordance with accepted high grade production techniques. The cords shall be a uniform and consistent product and shall be free from any defects which will adversely affect the serviceability of the product, such as lumps, kinks, splits, abrasions, scrapes, corroded surfaces, skin impurities and faulty extruded surfaces.

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. 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 Inspection equipment and facilities. Inspection equipment and facilities shall be established and maintained in accordance with MIL-C-45662.

4.2 Classification of inspections. The examinations and tests of cords are classified as follows:

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- (a) Materials inspection. (See 4.3.)
- (b) Quality conformance inspection. (See 4.4.)
 - 1. Inspection of product for delivery. (See 4.4.1.)
 - 2. Inspection of preparation for delivery. (See 4.6.)

4.3 Materials inspection. Materials inspection shall consist of certification supported by verifying data that the materials listed in table IV, used in fabricating the designated cord type (see 3.1), are in accordance with the applicable referenced specification or requirements prior to such fabrication.

Table IV. Materials inspection.

Material	Requirement paragraph	Applicable specification
Conductors	3.3.1	QQ-W-343
Separators and binders	3.3.2.1	MIL-C-572
Fillers	3.3.2.2	MIL-C-572
Staycords	3.3.2.3	MIL-C-572
Insulation	3.3.3	MIL-I-3930
Jacket	3.3.5	MIL-I-3930

4.4 Quality conformance inspection.

4.4.1 Inspection of product for delivery. Inspection of product for delivery shall consist of groups A, B and C inspection.

4.4.1.1 Inspection lot. An inspection lot shall consist of all cords of the same type (see 3.1) produced under essentially the same conditions and submitted for inspection at the one time.

4.4.1.2 Unit of product. Unless otherwise specified in the contract or order, the unit of product for purposes of sampling shall be each continuous length of cord contained on a reel or spool.

4.4.1.3 Sample. The sample shall consist of that number of randomly selected units of product required by the applicable sampling plan for the presented lot.

4.4.1.4 Selection of sample units. Sample units for inspection shall be taken from each unit of product which forms part of the sample. A sample unit is defined as a length of cord drawn from a unit of product.

4.4.1.5 Test specimen. A test specimen may be the entire sample unit (length of cord) or any portion of the sample unit which is to be tested.

4.4.2 Group A inspection. Group A inspection shall include the examinations and tests of table V, sub-groups I and II. Major and minor defects shall be as defined in MIL-STD-105.

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4.4.2.1 Sub-group I. For sub-group I, the acceptable quality level (AQL) shall be as specified in table V and the inspection level shall be level II in accordance with MIL-STD-105. Sub-group I tests may be performed in any order.

4.4.2.2 Sub-group II. For sub-group II, every length of cord shall be subjected to the tests. Sub-group II tests shall be performed in the order shown in table V. The entire lot shall be rejected if more than 3 defects per 1000 feet in a lot are found. All electrical defects are considered major.

Table V. Group A inspection.

Examination or test	Requirement paragraph	Test method paragraph	AQL (Percent defective)	
			Major	Minor
<u>Sub-group I</u>				
<u>Visual and dimensional</u>				
Construction	3.2	4.5.1	1.0% for the sub-group	4.0% for the sub-group
Conductors	3.3.1			
Separators and binders	3.3.2.1			
Fillers	3.3.2.2			
Staycords	3.3.2.3			
Insulation	3.3.3			
Color coding	3.3.4			
Jacket	3.3.5			
Outside diameter	3.3.6			
Lengths	3.6			
Sealing of cord ends	3.7			
Workmanship	3.8			
<u>Sub-group II</u>				
<u>Electrical</u>				
Dielectric withstanding voltage	3.4.1	4.5.3.1	See 4.4.2.2	
Insulation resistance	3.4.2	4.5.3.2		
Conductor resistance	3.4.3	4.5.3.3		

4.4.2.3 Rejected lots. If an inspection lot is rejected, the supplier may withdraw the lot from further inspection. The supplier may also rework a rejected lot to correct the defects or screen out the defective units and reinspect the lot using tightened inspection. Rejected lots shall be kept separate from new lots and shall not lose their identity.

4.4.3 Group B inspection. This inspection, including sampling, shall conform to table VI and to the procedures for small-sample inspection of MIL-STD-105, using special inspection levels. Group B inspection shall be performed on inspection lots that have passed group A inspection and on specimens selected from units of product that have been subjected to and met the group A inspection. The AQL shall be 6.5 (percent defective), and the special inspection level shall be S-2.

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Table VI. Group B inspection.

Examination or test	Requirement paragraph	Test method paragraph
Staycord breaking strength	3.3.2.3.1	4.5.2

4.4.3.1 Disposition of samples. Samples subjected to group B tests shall not be delivered on contract or order.

4.4.4 Group C inspection. This inspection shall consist of the tests specified in table VII and shall be performed periodically as indicated in 4.4.4.1. Samples shall be selected from lots that have passed group A and B inspection.

4.4.4.1 Sampling for inspection. One sample shall be selected per each 5,000 feet of cord or fraction thereof, not to exceed a total of five samples per order. Samples shall be selected periodically through the life of the contract to assure representative results.

Table VII. Group C inspection.

Examination or test	Requirement paragraph	Test method paragraph
Cold bend	3.5.1	4.5.4.1
Flexing endurance	3.5.2	4.5.4.2

4.4.4.2 Noncompliance. No failures shall be allowed in group C inspection. If a sample unit fails to pass group C inspection, the supplier shall take corrective action on the material or process or both, as warranted, and on all units of product which can be corrected and which were manufactured under essentially the same conditions, with essentially the same materials, processes, etc., and which are considered subject to the same failure. Acceptance of the product shall be discontinued until corrective action, acceptable to the government, has been taken. After the corrective action has been taken, group C inspection shall be repeated on additional sample units (all inspections or the inspection that the original sample failed, at the option of the government). Groups A and B inspection may be reinstituted, however, final acceptance shall be withheld until the group C reinspection has shown that the corrective action was successful. In the event of failure after reinspection, information concerning the failure and the corrective action taken shall be furnished to the cognizant inspection activity and the qualifying activity.

4.5 Test methods.

4.5.1 Visual and dimensional inspection. The finished cords shall be given a visual and dimensional inspection for conformance with the applicable requirements of 3.2 to 3.3 inclusive, 3.6, 3.7 and 3.8. Visual and dimensional defects shall be classified as major or minor in accordance with the definitions of MIL-STD-105.

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4.5.2 Staycord breaking strength. One specimen of the staycord shall be selected from each sample unit of the finished cord for testing on a tensile strength machine of the type specified in FED-STD-228, Method 3021. The breaking load of the specimen shall meet the requirements of 3.3.2.3.1.

4.5.3 Electrical tests.

4.5.3.1 Dielectric withstanding voltage (see 3.4.1). The finished cord shall be tested as specified in FED-STD-228, Method 6111, except for the following:

- (a) The test shall be performed on finished cord only.
- (b) The immersion period shall be not less than 9 hours.
- (c) One terminal shall be each conductor in turn, and the other terminal shall be all the remaining conductors tied together in electrical contact with the water.

4.5.3.2 Insulation resistance (see 3.4.2). The insulation resistance of the finished cord shall be determined as specified in FED-STD-228, Method 6031 except for the following:

- (a) The test shall be performed on finished cord only.
- (b) The immersion period shall be not less than 9 hours.
- (c) The test voltage shall be not less than 100 volts nor more than 500 volts dc.
- (d) The polarity of the conductor shall be maintained negative with respect to the water. One terminal shall be each conductor in turn, and the other terminal shall be all the remaining conductors tied together in electrical contact with one another and the water.
- (e) If the measurement is made at a temperature lower than 15.6°C, the supplier shall correct the measured value of insulation resistance to the resistance at 15.6°C.

4.5.3.3 Conductor resistance. The direct current (dc) resistance of each conductor in a finished cord shall be determined in accordance with FED-STD-228, Method 6021, and shall meet the requirements of 3.4.3.

4.5.4 Physical tests.

4.5.4.1 Cold bend (see 3.5.1).

4.5.4.1.1 Specimens. One specimen shall be cut from each sample unit. Each specimen so cut shall be divided into two parts, one for checking the cord as a whole, and the other for checking the insulation apart from the cord.

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4.5.4.1.2 Procedure. The specimens selected for checking cord as a whole shall be attached to a mandrel of the proper size as specified in 4.5.4.1.3. The specimens selected for checking the insulation apart from the cord shall have the jacket removed, and each insulated conductor therefrom shall be attached to a mandrel of the proper size as specified in 4.5.4.1.4. The specimens shall be suspended vertically, with their lower ends weighted sufficiently to keep the specimens taut and to permit bending them without handling. The mandrels and specimens shall be placed for at least 20 hours in a cold chamber at a temperature of $-55^{\circ} \pm 2^{\circ}\text{C}$ and, while at this temperature, the specimens bent for five close turns around the mandrels at the rate of 15 ± 3 turns per minute. After the test has been completed, the jacket and insulation of each specimen shall be examined through a magnifying glass of at least 3-diameter magnification, and shall comply with the requirements of 3.5.1.

4.5.4.1.3 Mandrels for cord. The mandrel for testing the cord as a whole shall be selected from the following list of standard-size mandrels:

Mandrel diameters (inches)

0.68
0.84
1.05
1.31
1.66
1.90

The size selected shall be the largest size which does not exceed three times the specified maximum over-all diameter of the cord. (See 3.1.)

4.5.4.1.4 Mandrels for conductors. Unless otherwise specified, the mandrel for testing the insulation apart from the cord shall be selected according to the size of the conductor, as follows:

<u>Conductor size (AWG)</u>	<u>Mandrel diameter (inches)</u>
23	0.062
22	0.062
20	0.062
18	0.094

4.5.4.2 Flexing endurance (see 3.5.2).

4.5.4.2.1 Specimens. One specimen shall be cut from each sample unit. For bending, the length of the specimen shall be 30 inches. For twisting, the length of the specimen shall be 24 inches for cords $5/8$ inch or less in diameter, and 10 times the cord diameter plus 18 inches for cords larger than $5/8$ inch in diameter.

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4.5.4.2.2 Apparatus. The bending and twisting apparatus may be built into a portable, compact assembly, powered by a single drive, and equipped with means for counting the number of cycles impressed upon a specimen. A suitable electric circuit should be provided to stop the apparatus in the event the series wire circuit of a specimen is broken.

4.5.4.2.3 Procedure.

4.5.4.2.3.1 Conditioning. Before testing, specimens shall be exposed to the specified temperature (see 3.5.2) until thermal equilibrium is reached. Specimens shall be tested in a controlled-temperature room held at the temperature specified. All conductors in each specimen shall be connected into a single-series circuit for the purpose of detecting breakage of the conductors.

4.5.4.2.3.2 Bending. A specimen shall be loosely inserted between a pair of rollers and subjected to a 90-degree bend in each direction at the rate of 12 to 14 complete 180-degree cycles per minute. The bends shall be made approximately midway along the length of the specimen, and the portion of the specimen not coming in contact with the rollers shall be loosely restricted to prevent appreciable bending at other points. The upper portion of the specimen shall be anchored to the bending apparatus. A weight which stresses the specimen in tension to approximately 40 pounds per square inch of cross section shall be attached to the lower free end. The grips or clamps shall be designed to apply uniform radial pressure to the core of the specimen. The diameter of the rollers shall be approximately, but not less than, two and one-half times the maximum over-all diameter specified (see 3.1) for the type of cord and size and number of conductors undergoing test.

4.5.4.2.3.3 Twisting. Specimens shall be clamped in cable grips and subjected to a 180-degree twist in each direction (360-degree total twist) at the rate of 12 to 14 complete cycles per minute. The distance between grips shall be 6 inches plus 10 times the maximum over-all diameter specified for the type of cord and size and number of conductors undergoing test. The upper grip shall be oscillated by the twisting apparatus. The lower grip shall be free to move vertically but shall be restrained from oscillation, and shall have a weight attached which stresses the specimen in tension to approximately 40 pounds per square inch of cross section.

4.5.4.2.3.4 Examination. During the tests, frequent visual inspection of the jacket shall be made for the purpose of detecting rupture. Upon completion of a test, the specimen shall be removed from the apparatus and checked for open or short circuits between conductors. The specimen shall then be opened, its internal condition examined, and record made of any evidence of damage caused by the tests. If, in the twisting test, failure occurs within 2 inches of either grip, the results shall be disregarded and the test shall be repeated.

4.6 Inspection of preparation for delivery. Sample packages or packs and the inspection of the preservation, packaging, packing and marking for shipment and storage shall be in accordance with the requirements of section 5.

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5. PREPARATION FOR DELIVERY

5.1 Preservation, packaging, packing, and marking shall be in accordance with MIL-C-12000. (See 6.2(d).)

6. NOTES

6.1 Intended use. The cords covered by this specification are intended for use as patchcords for telephone switchboards and for use with microphones, headsets, handsets, etc., where extreme flexibility is required.

6.2 Ordering data. Procurement documents should specify the following:

- (a) Title, number and date of this specification.
- (b) Type designation of cord required. (See 3.1.)
- (c) Length of finished cords to be delivered. (See 3.6.)
- (d) Level of packaging and level of packing required. (See 5.1.)

6.2.1 Indirect shipments. The preservation, packaging, packing and marking specified in section 5 apply only to direct purchases by or direct shipments to the government, and are not intended to apply to contracts or orders between the supplier and prime contractor.

Custodians:

Army - EL
Navy - SH
Air Force - 80

Preparing Activity:

Army - EL

Project No. 6145-0542

Review:

Army - AT, AV, ME
Navy - AS, SH
Air Force - 80
NSA
IS

Users:

Army - MU
Navy - MC

SPECIFICATION ANALYSIS SHEET

Form Approved
Budget Bureau No. 22-R255

INSTRUCTIONS: This sheet is to be filled out by personnel, either Government or contractor, involved in the use of the specification in procurement of products for ultimate use by the Department of Defense. This sheet is provided for obtaining information on the use of this specification which will insure that suitable products can be procured with a minimum amount of delay and at the least cost. Comments and the return of this form will be appreciated. Fold on lines on reverse side, staple in corner, and send to preparing activity. Comments and suggestions submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or serve to amend contractual requirements.

SPECIFICATION

ORGANIZATION

CITY AND STATE

CONTRACT NUMBER

MATERIAL PROCURED UNDER A

☐ DIRECT GOVERNMENT CONTRACT☐ SUBCONTRACT

1. HAS ANY PART OF THE SPECIFICATION CREATED PROBLEMS OR REQUIRED INTERPRETATION IN PROCUREMENT USE?

A. GIVE PARAGRAPH NUMBER AND WORDING.

B. RECOMMENDATIONS FOR CORRECTING THE DEFICIENCIES

2. COMMENTS ON ANY SPECIFICATION REQUIREMENT CONSIDERED TOO RIGID

3. IS THE SPECIFICATION RESTRICTIVE?

☐ YES☐ NO (If "yes", in what way?)

4. REMARKS (Attach any pertinent data which may be of use in improving this specification. If there are additional papers, attach to form and place both in an envelope addressed to preparing activity)

SUBMITTED BY (Printed or typed name and activity - Optional)

DATE

To detach this form, cut along this line

DD FORM 1426
1 JAN 66

REPLACES EDITION OF 1 OCT 64 WHICH MAY BE USED.

ESC-FM 1068-68