

DETAIL SPECIFICATION

WIRE, ELECTRICAL

(FOR INSTRUMENT TEST LEADS)

Inactive for new design after 16 June 1997.

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

1. SCOPE

1.1 Scope. This specification covers one type of single-conductor, AWG No 18, stranded, electrical wire, insulated for voltages up to and including 1,000 volts root mean square (rms) with Buna-S compound. Wire covered by this specification is classified as type TL-G. This wire is primarily intended for use as instrument test leads.

2. APPLICABLE DOCUMENTS

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

2.2 Government documents.

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.

FEDERAL STANDARD

FED-STD-228 - Cable and Wire, Insulated; Methods of Testing

COMMERCIAL ITEM DESCRIPTION

A-A-59551 - Wire, Electrical, Copper, (Uninsulated)

Comments, suggestions, or questions on this document should be addressed to: DLA Land and Maritime, Columbus, Attn: VAI, P.O. Box 3990, Columbus, Ohio, 43218-3990 or emailed to WireCable@dla.mil. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at <https://assist.dla.mil/>.

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DEPARTMENT OF DEFENSE SPECIFICATION

MIL-C-572 - Cords, Yarns and Monofilaments Organic Synthetic Fiber

DEPARTMENT OF DEFENSE STANDARD

MIL-STD-104 - Limits for Electrical Insulation Color

(Copies of these documents are available online at <https://assist.dla.mil/>.) -

2.3 Non-Government publications. The following documents 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.

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION

ISO/IEC 17025 - General requirements for the competence of testing and calibration laboratories

(Copies of these documents are available online at <https://www.iso.org>.)

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, 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 Material. The material for the wire shall be as specified herein. The best material commercially available for the intended purpose shall be used when a definite material is not designated.

3.1.1 Recycled, recovered, or environmentally preferable materials. Recycled, recovered, or environmentally preferable materials should be used to the maximum extent possible, provided that the material meets or exceeds the operational and maintenance requirements, and promotes economically advantageous life cycle costs.

3.1.2 Copper strands. The strands used in the manufacture of the conductor shall be tin-coated, soft or drawn and annealed copper wire conforming to [A-A-59551](#).

3.1.3 Separator. A separator may be used to provide free stripping of the insulation. If used, the separator shall completely cover the conductor. The separator shall be type AR, form Y (acetate-rayon) or type P (polyamide) thread, conforming to [MIL-C-572](#). The separator may be omitted if a free stripping insulation is used.

3.1.4 Insulation compound. The insulation compound shall be Buna-S made with such fillers, antioxidants, organic accelerators, and curing agents as are necessary to provide a compound having long life in service and in storage. The compound used shall contain no more than .5 percent of free sulfur. The material shall be homogeneous, tough, and elastic, and shall be properly vulcanized (cured). The insulation shall be free of blisters, wrinkles, cracks, or other defects that could affect the end use of the finished wire.

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3.1.4.1 Sun-proofing wax. For each 100 pounds of Buna-S polymer, a minimum of 4 pounds of sun-proofing wax shall be used.

3.1.4.2 Color. The color of the insulation shall be black, red, or green (see 6.2), and the color shade shall fall within the light and dark limits conforming to MIL-STD-104.

3.2 Construction.

3.2.1 Conductor. The conductor shall be AWG size 18, type B, class 0 (for severe flexing service) wire conforming to A-A-59551.

3.2.2 Insulation thickness. The insulation over the conductor shall be centered and shall have a thickness of not less than 40 mils.

3.2.3 Outside diameter. The outside diameter of the finished wire shall not exceed 150 mils.

3.3 Physical properties of insulation. The vulcanized Buna-S insulation shall conform to the physical property requirements listed in table I.

TABLE I. Physical property requirements of Buna-S insulation.

Physical property	Requirement
Unaged:	
Tensile strength, minimum, psi	1,000
Elongation, minimum, inches	8 ^{1/}
Set, maximum, inch	.5 ^{1/}
After 94 hours in an oxygen-bomb at 70 °C:	
Tensile strength, minimum, percent of original	75
Elongation, minimum, inches	6 ^{1/}
Cold-tension recovery, minimum, percent	20

^{1/} See applicable test method for specimen length.

3.3.1 Cold bend. The wire shall show no evidence of cracking of the outer surface of the insulation after being exposed to a temperature of -40 °C for 7 days and then bent around a .188-inch (4.78 mm) diameter mandrel.

3.4 Performance.

3.4.1 Insulation flaws. The finished wire shall withstand a spark-test potential of 8,000 V rms at 60Hz, without breakdown.

3.4.2 Dielectric strength. The finished wire shall withstand 4,000 V rms without breakdown.

3.4.3 Insulation resistance. The insulation resistance of the finished wire shall be not less than 1,000 megohms-1,000 feet.

3.4.4 Continuity. The finished wire shall have continuous continuity.

3.5 Workmanship. The wire shall be uniform in quality and free from defects that affect performance, serviceability, or appearance, such as lumps, kinks, splits, abrasions, scrapes, corroded surfaces, and skin impurities.

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4. VERIFICATION

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

Conformance inspection (see 4.2).

4.2 Conformance inspection. Conformance inspection shall consist of the inspections listed for groups A, B, and C inspection in tables II, III, and IV, respectively. Unless otherwise specified, conformance inspection shall be performed on every lot of wire procured under this specification (see 6.2).

TABLE II. Group A inspection.

Inspection	Requirement	Verification
Visual		
Materials		4.3.1
Copper strand	3.1.2	
Separator	3.1.3	
Insulation compound	3.1.4	
Construction		
Conductor	3.2.1	
Workmanship	3.5	
Performance		
Insulation flaws	3.4.1	4.3.6
Continuity	3.4.4	4.3.5

TABLE III. Group B inspection.

Inspection	Requirement	Verification
Insulation thickness	3.2.2	4.3.1.1
Outside diameter	3.2.3	4.3.1.2
Unaged physical property		
Tensile strength	3.3	4.3.2
Elongation	3.3	4.3.2
Set	3.3	4.3.2
Dielectric strength	3.4.2	4.3.3
Insulation resistance	3.4.3	4.3.4

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TABLE IV. Group C inspection.

Inspection	Requirement	Verification
Aged (oxygen bomb):		
Tensile strength	3.3	4.3.2 ^{1/}
Elongation	3.3	4.3.2 ^{1/}
Low temperature:		
Cold tension recovery	3.3	4.3.2 ^{2/}
Cold bend	3.3.1	4.3.2 ^{2/}

^{1/} Six specimens from the first lot presented for conformance inspection, and then six specimens from each 100,000 feet produced.

^{2/} Three specimens from the first lot presented for conformance inspection, and then three specimens from each 100,000 feet produced.

4.2.1 Inspection lot. Unless otherwise specified (see 6.2), an inspection lot shall consist of all wire of the same Part or Identifying Number (PIN), produced under essentially the same conditions on the same machine, that is presented for inspection and shipment at one time.

4.2.2 Unit of product. The unit of product for determining lot size for sampling shall be the quantity of wire offered for inspection on one coil, one reel, or one spool, as applicable.

4.2.3 Specimen length. Specimens for groups A, B, and C inspections shall be of the length specified in the applicable test method.

4.2.4 Group A inspection. Group A inspection shall consist of the inspections specified in table II and shall be performed on each lot of wire acquired under the specification. Group A inspections may be performed at an appropriate stage of the manufacturing operation rather than on the finished wire.

4.2.5 Group B inspection. Group B inspection shall consist of the inspections specified in table III. Group B inspection shall normally be performed on sample units that have been subjected to and have passed the group A inspection.

4.2.6 Sampling. A random sample shall be selected from the lot. The sample size shall be based on the inspection lot size from which the sample was selected for group B inspection. Sampling inspection shall be in accordance with table V.

TABLE V. Inspection sample.

Inspection lot size ^{1/}	Sample size
1	1
2 to 8	2
9 to 90	3
91 to 150	12
151 to 280	19
281 to 500	21
501 to 1,200	27
1,201 to 3,200	36
3,201 to 10,000	38
10,001 to 35,000	46

^{1/} Lot size is based on the number of units of product

4.2.7 Group C inspection. Group C inspection shall consist of the inspections specified in [table IV](#). Group C inspection shall normally be performed on sample units that have been subjected to and have passed group A and B inspections.

4.2.8 Rejected lot. Failure to pass any of the tests and inspections constitutes failure of the lot and the lot shall be rejected. If an inspection lot is rejected, the contractor may rework the lot to correct the defects or screen out the defective units, and resubmit the lot for re-inspection. Such lots shall be separated from new lots and shall be identified as re-inspected lots.

4.2.9 Non-compliance. If a sample fails to pass group B or C inspections (see [4.2.5](#) and [4.2.7](#)), the contractor shall notify the cognizant inspection activity of such failure and take corrective action on the materials or processes, or both, as warranted, on all units of the product. Acceptance and shipment of the product shall be discontinued until corrective action has been taken. After the corrective action has been taken, group B or C inspection shall be repeated on the replacement articles. (This includes all tests and examinations, or only the test that the original sample failed, at the option of the cognizant inspection activity). Group A inspection may be re-instituted; however, final acceptance and shipment shall be withheld until group B or C inspection has shown that the corrective was successful. In the event of failure after re-inspection, information concerning the failure shall be provided to the cognizant inspection activity.

4.2.10 Test equipment and inspection facilities. Test and measuring equipment and inspection facilities of sufficient accuracy, quality, and quantity to permit performance of the required inspection shall be established and maintained by the contractor. The establishment and maintenance of a calibration system to control the accuracy of the measuring and test equipment (e.g., non-Government standard (NGS) or federal or defense standard) shall be in accordance with [ISO/IEC 17025](#) or equivalent.

4.3 Methods of inspection.

4.3.1 Visual and dimensional inspection. The finished wire shall be inspected to verify that the materials, construction, and workmanship are in accordance with the applicable requirements.

4.3.1.1 Insulation thickness. The insulation thickness shall be measured using method 1018 of [FED-STD-228](#).

4.3.1.2 Outside diameter. The outside diameter of the finished wire shall be measured by using method 1011 of [FED-STD-228](#).

4.3.2 Physical properties of insulation.

4.3.2.1. Condition and age. Specimens shall not be heat treated, immersed in water or subjected to any mechanical or chemical treatment not specified herein. No tests shall be made within 24 hours after manufacture unless agreed to by the manufacturer.

4.3.2.1.1 Tensile strength. Tensile strength shall be determined in accordance with method 3021 of [FED-STD-228](#), except that flat, smooth, steel grips of the self-aligning type may be used.

4.3.2.1.2 Elongation. Elongation shall be determined in accordance with method 3031 of [FED-STD-228](#), except that bench marks shall be 2 inches (50.8mm) apart, and flat, smooth, steel grips of the self-aligning type may be used. The elongation after aging shall be based on the bench marks applied before aging.

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4.3.2.1.3 Set. Set shall be determined in accordance with method 3161 of [FED-STD-228](#), except that the bench marks shall be 2 inches (50.8 mm) apart. The test specimens shall be stretched so that the distance between bench marks is 6 inches (152 mm); they shall be released within 5 seconds. The set shall be determined 1 minute after the beginning of release. Flat, smooth, steel, grips of the self-aligning type may be used.

4.3.2.1.4 Tensile stress. Apparatus and procedure shall be as specified in method 3041 of [FED-STD-228](#).

4.3.2.1.5 Tear resistance. Apparatus and procedure shall be as specified in method 3111 of [FED-STD-228](#). The specimens shall be cut and buffed from a section of the jacket under test except as indicated in [4.3.2.1](#).

4.3.2.1.6 Thin-walled jackets. For tear resistance tests of jackets having an allowed minimum thickness of less than 0.040 inch (1.02 mm), specimens may be cut from sheets specified in [4.3.2.1](#). Specimens shall be cut so that tear will occur in the direction of the calendar or mill grain.

4.3.2.1.7 Molded sheets. Molded sheets of 0.075 to 0.085 inch (1.9 to 2.2 mm) thick may be furnished for certain tests of small size cables when authorized in [4.3.2.1](#). The stock of these sheets shall be taken from the same batch as the insulation or jacket they represent. The sheets shall be at the same state of cure as the insulation or jacket that they represent. The state of cure shall be considered to be the same if the tensile stress of the sheet at 200 percent elongation is within 20 percent of that of the insulation or jacket it represents. The sheets shall be marked to show the direction of calendar or mill grain.

4.3.2.2 Cold bend. One specimen of each color of finished wire shall be attached to a mandrel .188 inch (4.78 mm) in diameter. The specimen shall be suspended vertically with the lower end weighted sufficiently to keep the specimen taut and to permit bending without handling. The mandrel and the specimen shall be conditioned in a low-temperature cabinet for 7 days at -40 ± 2 °C. While at this temperature, the specimen shall then be bent for 5 close turns around the mandrel at the rate of 15 ± 3 turns per minute. Upon completion of the test, the specimen shall be removed from the cabinet and the insulation shall be examined for cracks through a magnifying glass of at least 3-diameter magnification.

4.3.3 Dielectric strength. Finished wire shall be tested using method 6111 of [FED-STD-228](#), except as noted below:

- a. The test shall be performed on finished wire only.
- b. The test voltage shall be 4,000 V rms and shall be applied between the conductor and the water for a period of 60 +5, -0 seconds from the time the test voltage is reached.
- c. The source of power shall be not less than 5 kilovolt-amperes capacity.
- d. The crest factor of the test voltage shall not differ by more than ± 10 percent from that of a sinusoidal wave when the transformer is loaded with the test specimen.

4.3.4 Insulation resistance. Insulation resistance of the finished wire shall be tested by method 6031 of [FED-STD-228](#), except as noted below:

- a. The insulation resistance shall be measured within 2 minutes after the dielectric strength test.
- b. The test voltage shall be not less than 125 V nor more than 500 V dc.

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- c. The polarity of the conductor shall be maintained negative with respect to the water.
- d. If the measurement is made at a temperature other than 15.6 °C, the manufacturer shall correct the measured value of insulation resistance to the resistance at 15.6 °C. If the insulation resistance is equal to or greater than that required by 3.4.3 when the measurement is made at a temperature greater than 15.6 °C, no correction factor need be applied. The manufacturer shall demonstrate that the correction factor is accurate for the compound being used.
- e. The insulation resistance test may be terminated in less than 1 minute if the galvanometer has ceased fluctuating and the reading indicates that a steady insulation resistance value has been obtained.

4.3.5 Continuity. Continuity of the finished wire shall be verified by applying 10 V dc to one end of the wire and a 10-volt lamp at the other end as an indicator. The lamp shall remain lit as long as power is applied.

4.3.6 Spark test. All finished wire shall be subjected to spark testing using method 6211.1 of FED-STD-228. The spark test voltage shall be not less than 8,000 V rms at 60 Hz.

4.3.7 Inspection conditions. Unless otherwise specified, all inspections shall be performed in accordance with the test conditions specified in the contract or order (see 6.2).

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.

6. NOTES

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

6.1 Intended use. The wire covered by this specification is most commonly used as instrument test leads.

6.2 Acquisition requirements. Acquisition documents should specify the following:

- a. Title, number, and date of this specification.
- b. The specific issue of individual documents referenced (see 2.2.1 and 2.3).
- c. Wire insulation color (see 3.1.4.2) and wire length required.
- d. Conformance inspection requirements if other than specified (see 4.2).

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- e. Lot size if other than specified (see 4.2.1).
- f. Packaging and packing requirements, including spool and length thereon, when applicable (see 5.1).

6.3 Subject term (key word) listing.

Buna-S

6.4 Amendment notations. The margins of this specification are marked with vertical lines to indicate modifications generated by this amendment. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations.

CONCLUDING MATERIAL

Custodians:

Army - CR
Air Force - 85
DLA - CC

Preparing activity:

DLA - CC

(Project 6145-2017-025)

Review activities:

Army - MI
DTRA - DS

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