

INCH-POUND

MIL-DTL-13169C
27 October 2000
SUPERSEDING
MIL-W-13169B
1 August 1959

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 documents cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 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

FEDERAL

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

Beneficial comments (recommendations, additions, deletions) and any pertinent data that may be of use in improving this document should be addressed to: Defense Logistics Agency, Defense Supply Center, Columbus (DSCC-VAI), P.O. Box 3990, Columbus, OH 43216-5000, by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A
DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

FSC 6145

DEPARTMENT OF DEFENSE

- MIL-C-572 - Cords, Yarns and Monofilaments Organic Synthetic Fiber
- MIL-I-3930 - Insulating and Jacketing Compounds, Electrical (For Cables, Cords, and Wires), General Specification For

STANDARDS

FEDERAL

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

DEPARTMENT OF DEFENSE

- MIL-STD-104 - Limits For Electrical Insulation Color

(Unless otherwise indicated, copies of the above specifications and standards are available from the Document Automation and Production Service, Building 4/D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

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 the documents that 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 (see 6.2).

NATIONAL CONFERENCE OF STANDARDS LABORATORIES (NCSL)

- ANSI/NCSL Z540-1 - Calibration Laboratories and Measuring and Test Equipment, General Requirements

(Application for copies should be addressed to the National Conference of Standards Laboratories, 1800 - 30th Street, Suite 305B, Boulder, CO 80301-1032.)

2.4 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 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.

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 of 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

Notes: ^{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 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 60 Hz, 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 per 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.

4. VERIFICATION

4.1 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 military standard) shall be in accordance with ANSI/NCSL Z540-1 or equivalent.

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

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	4.3.2.1 ^{2/}

Notes: 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/}	Accept on zero 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

Notes: 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.

4.3 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. The physical properties of insulation shall be tested in accordance with MIL-I-3930, except that the low-temperature cabinet test temperature shall be maintained at -40 ± 2 °C.

4.3.2.1 Cold bend. One specimen of each color of finished wire shall be attached to a mandrel .188 inch 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.
- 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.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When actual packaging of materiel is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Point packaging activity within the Military Department or Defense Agency, or within the Military Department's Systems Command. Packaging data retrieval is available from the managing Military Department or Defense Agency 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 Ordering data. Acquisition documents should specify the following:

- 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 2.2.1 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).

- 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
Test lead wire

6.4 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue, due to the extent of the changes.

CONCLUDING MATERIAL

Custodians:
Army - CR
Air Force - 11
DLA - CC

Preparing activity:
DLA - CC
(Project 6145-2269)

Review activities:
Army - MI
DTRA - DS

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, and send to preparing activity.
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-DTL-13169C	2. DOCUMENT DATE (YYYYMMDD) 20000929
3. DOCUMENT TITLE Wire, Electrical (For Instrument Test Leads)		
4. NATURE OF CHANGE (<i>Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.</i>)		
5. REASON FOR RECOMMENDATION		
6. SUBMITTER		
a. NAME (<i>Last, First, Middle Initial</i>)		b. ORGANIZATION
c. ADDRESS (<i>Include zip code</i>)	d. TELEPHONE (<i>Include Area Code</i>) (1) Commercial: (2) DSN: (<i>if applicable</i>)	7. DATE SUBMITTED (YYYYMMDD)
8. PREPARING ACTIVITY		
a. NAME Defense Logistics Agency Defense Supply Center, Columbus		b. TELEPHONE (<i>Include Area Code</i>) Commercial: 614-692-0538 DSN: 850-0538
c. ADDRESS (<i>Include Zip Code</i>) DSCC-VAI P.O. Box 3990 Columbus, Ohio 43216-5000		IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT: Defense Standardization Program Office (DLSC-LM) 8725 John J. Kingman Road, Suite 2533 Fort Belvoir, Virginia 22060-6621 Telephone: 703-767-6888 DSN 427-6888