

INCH-POUND

MIL-T-13513B(AT)
~~24 May 1989~~
 SUPERSEDING
 MIL-T-13513A(AT)
 9 November 1971

MILITARY SPECIFICATION

TERMINALS, LUG; AND SPLICES, CONDUCTOR
 (ELECTRICAL, SOLDERLESS, FOR AUTOMOTIVE USE)
 (DUAL DIMENSIONS)

This specification is approved for use by the US Army Tank-Automotive Command, Department of the Army, and is available for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers crimp-type, solderless, electrical terminals and splices for use with insulated electrical cable and wire for automotive vehicles (see 6.1).

1.2 Classification. Terminals and splices shall be of the following types, as specified (see 6.2):

Type I	- Terminals, Nonwaterproof.
Type II	- Terminals, Waterproof.
Type III	- Splices.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: US Army Tank-Automotive Command, ATTN: AMSTA-GDS, Warren, MI 48397-5000, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A

FSC 5940

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

MIL-T-13513B(AT)

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 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 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

- QQ-C-450 - Copper-Aluminum Alloy (Aluminum Bronze) Plate, Sheet, Strip, and Bar (Copper Alloy Numbers 606, 610, 613, 614, and 630).
- QQ-C-465 - Copper-Aluminum Alloys (Aluminum Bronze) (Copper Alloy Numbers 606, 614, 630, 632M, and 642); Rod, Flat Products with Finished Edges (Flat Wire, Strip, and Bar), Shapes, and Forgings.
- QQ-C-502 - Copper Rods and Shapes; and Flat Products with Finished Edges (Flat Wire, Strips, and Bars).
- QQ-P-416 - Plating, Cadmium (Electrodeposited).

MILITARY

- MIL-T-10727 - Tin Plating; Electrodeposited or Hot-Dipped, for Ferrous and Nonferrous Metals.

STANDARDS

MILITARY

- MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes.
- MIL-STD-45662 - Calibration Systems Requirements.

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Naval Publications and Forms Center, (ATTN: NPODS), 5801 Tabor Avenue, Philadelphia, PA 19120-5099.)

MIL-T-13513B(AT)

2.1.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues are those cited in the solicitation.

DRAWINGS

ARMY

7056700 - Terminal, Special, Waterseal.

(Copies of drawings required by contractors in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting activity.)

2.2 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. Unless otherwise specified (see 6.2), the contractor shall furnish terminals and splices which shall be subjected to first article inspection (see 4.4). First article inspection samples, properly marked with identifying information, shall be representative of the units to be furnished to the Government. All subsequent terminals and splices delivered to the Government shall conform to these samples in all of their pertinent physical and performance attributes.

3.2 Materials. Materials shall be as specified herein and in referenced specifications, standards, and drawings. Materials shall be free from defects which adversely affect performance or serviceability of the finished product (see 4.6.1).

3.2.1 Types I and III. Type I terminals and type III splices shall be fabricated of copper or aluminum bronze conforming to QQ-C-450, QQ-C-465, or QQ-C-502 (see 4.6.1).

3.2.2 Type II. Type II terminals shall be fabricated of materials as specified on Drawing 7056700 (see 4.6.1).

3.2.3 Recycled, virgin, and reclaimed materials. There are no requirements for the exclusive use of virgin materials. The use of recycled or reclaimed (recovered) materials is acceptable provided that all other requirements of this specification are met (see 4.6.1 and 6.3.1).

MIL-T-13513B(AT)

3.3 Construction.

3.3.1 Type I and III. Type I terminals and type III splices shall be constructed as specified herein and in accordance with the applicable drawing, standard, or instructions [including the applicable Part or Identifying Number (PIN)] specified by the acquisition activity (see 4.6.1, 4.6.2, and 6.2).

3.3.2 Type II. Type II terminals shall be constructed as specified herein and in accordance with the applicable PIN specified on Drawing 7056700 (see 4.6.1, 4.6.2, and 6.2).

3.4 Performance. Terminals or splices, when connected to the intended cable(s) by the applicable crimping tool, shall meet the performance requirement specified herein.

3.4.1 Voltage drop.

3.4.1.1 Terminals. The terminals shall meet the "initial" voltage drop as specified in table I (see 4.6.3.1).

3.4.1.2 Splices. The splices shall meet the "initial" voltage drop as specified in table I except the "initial" voltage drop values shall be increased by 33 percent (%) (see 4.6.3.2).

TABLE I. Test requirements.

Cable size (AWG 1/)	Test current (amperes \pm 5%)	Maximum voltage drop (millivolts)		Minimum mechanical strength [pounds (kilograms)]
		Initial	After test	
20	11	7	12	19 (8.62)
18	16	7	12	28 (12.70)
16	22	7	12	37 (16.78)
14	32	6	11	45 (20.41)
12	44	5	8	95 (43.09)
10	69	5	8	150 (68.04)
8	95	5	8	195 (88.45)
6	139	5	8	270 (122.47)
4	165	5	8	350 (158.76)
2	226	5	8	555 (251.75)
1	264	5	8	650 (294.84)
0	307	5	8	760 (344.74)
00	353	5	8	860 (390.10)
0000	460	5	8	1000 (453.60)

1/ American Wire Gage (AWG).

MIL-T-13513B(AT)

3.4.2 Current rating. The terminal or splice temperature shall not exceed by more than 9 degrees Fahrenheit(^oF) [5 degrees Celsius (^oC)], the temperature of the attached conductor stranding when tested as specified in 4.6.4.

3.4.3 Current overload. The terminal or splice temperature shall not exceed by more than 18^oF (10^oC), the temperature of the attached conductor stranding when tested as specified in 4.6.5. The value recorded in the subsequent voltage drop test shall meet the "after test" requirements specified in table I.

3.4.4 Mechanical strength. The terminals or splices, when tested as specified in 4.6.6, shall withstand the minimum mechanical strength requirements specified in table I without breaking or becoming distorted to the extent of being unfit for further use.

3.5 Environmental.

3.5.1 Vibration. The terminals or splices, when tested as specified in 4.6.7.1, shall show no evidence of mechanical or electrical failure. Subsequent to the vibration test, the terminals or splices shall meet the requirements specified in 3.4.1 and 3.4.4.

3.5.2 Waterproofness. Type II terminals, when tested as specified in 4.6.7.2, shall show no evidence of leakage.

3.6 Protective finish. The terminals or splices shall be tin plated in accordance with type II, 0.0003 inch [0.0072 millimeter (mm)] minimum plate thickness - 200 hours, salt spray test of MIL-T-10727, or cadmium plated in accordance with type I, class 2 of QQ-P-416 (see 4.6.1).

3.7 Identification marking. Each terminal or splice shall have molded or stamped on its surface the manufacturer's name or symbol, and the cable (conductor) size or limiting sizes for which it is designed (see 4.6.2).

3.8 Workmanship. Workmanship employed in fabricating the terminals or splices shall be of a quality necessary to produce terminals or splices free of rust, burrs, cracks, dirt, faulty or incomplete connection, or any other defects which would affect safety of personnel, serviceability, or appearance (see 4.6.2).

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order (see 6.2), the contractor is responsible for the performance of all inspection requirements (examinations and tests) as specified herein. Except as otherwise specified in the contract or purchase order (see 6.2), the contractor may use his own or any other facilities

MIL-T-13513B(AT)

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 this specification where such inspections are deemed necessary to ensure 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.

4.1.2 Inspection equipment. Unless otherwise specified in the contract (see 6.2), the contractor is responsible for the provision and maintenance of all inspection equipment necessary to assure that supplies and services conform to contract requirements. Inspection equipment must be capable of repetitive measurements to an accuracy of 10% of the measurement tolerance. Calibration of inspection equipment shall be in accordance with MIL-STD-45662.

4.1.2.1 Crimping tools. The crimping tools used to crimp the terminals or splices onto the conductor wire shall be provided by the terminal manufacturer. The terminals or splices shall be properly crimped onto test cables in accordance with the manufacturers recommended procedure.

4.2 Inspection conditions. Unless otherwise specified herein or in the acquisition documents (see 6.2), all inspections shall be conducted under the following conditions:

- a. Air temperature: $73 \pm 18^{\circ}\text{F}$ ($23 \pm 10^{\circ}\text{C}$).
- b. Barometric pressure: 28.5 ± 2 inches of mercury
- 3
(725 ± 50 mm of mercury).
- 75
- c. Relative humidity: $50 \pm 30\%$.

4.3 Classification of inspections:

- a. First article inspection (see 4.4).
- b. Quality conformance inspection (QCI) (see 4.5).
 - (1) Examination (see 4.5.2).
 - (2) Acceptance tests (see 4.5.3).

MIL-T-13513B(AT)

4.4 First article inspection. Unless otherwise specified (see 6.2), the Government shall select one terminal or splice produced under the production contract for first article inspection. The first article sample shall be inspected as specified in table II. Approval of the first article sample by the Government shall not relieve the contractor of his obligation to supply terminals or splices that are fully representative of that inspected as a first article sample. Any changes or deviation of the production units from the first article sample shall be subject to the approval of the contracting officer.

4.4.1 First article inspection failure. Deficiencies found during, or as a result of, first article inspection shall be cause for rejection of the items until evidence has been provided by the contractor that corrective action has been taken to eliminate the deficiency. Any deficiency found during, or as a result of, first article inspection shall be evidence that all items already produced prior to completion of first article inspection are similarly deficient unless contrary evidence satisfactory to the contracting officer is furnished by the contractor. Such deficiencies on all items shall be corrected by the contractor. The Government will not accept products until first article inspection is completed to the satisfaction of the Government.

TABLE II. Classification of inspections.

Title	Requirement	Inspection	First article	QCI	
				Examination	Acceptance tests
Materials and construction	3.2 thru 3.3 and 3.6	4.6.1	X		
Defects (see table III)	3.3, 3.7, and 3.8	4.6.2	X	X	
Voltage drop-terminals	3.4.1.1	4.6.3.1	X		X
Voltage drop-splices	3.4.1.2	4.6.3.2	X		X
Current rating	3.4.2	4.6.4	X		X
Current overload	3.4.3	4.6.5	X		X
Mechanical strength	3.4.4	4.6.6	X		X
Vibration	3.5.1	4.6.7.1	X		X
Waterproofness	3.5.2	4.6.7.2	X 1/		X 1/

1/ Type II only.

MIL-T-13513B(AT)

4.5 QCI.4.5.1 Sampling.

4.5.1.1 Lot formation. An inspection lot shall consist of all the terminals or splices of one type and PIN, from an identifiable production period, from one manufacturer, submitted at one time for acceptance.

4.5.1.2 Sampling for examination. Samples for examination shall be selected in accordance with MIL-STD-105.

4.5.1.3 Sampling for acceptance tests. Samples for acceptance tests shall be selected in accordance with level S-3 of MIL-STD-105 from each lot that has passed the examination specified in 4.5.2.2.

4.5.2 Examination.

4.5.2.1 Acceptable quality level (AQL). Each sample selected in accordance with 4.5.1.2 shall be examined to determine conformance to the AQL's on the basis of percent defective:

<u>Classification</u>	<u>AQL</u>
Major	1.0
Minor	2.5

4.5.2.2 Classification of defects. For examination purposes, defects shall be classified as listed in table III.

TABLE III. Classification of defects.

Category	Defect	Method of inspection
<u>Critical</u>	None	
<u>Major</u>	<u>AQL 1.0% Defective</u>	
101	Dimensions affecting interchangeability, not within tolerance (see 3.3).	SIE 1/
102	Faulty workmanship affecting performance (see 3.8).	Visual
<u>Minor</u>	<u>AQL 2.5% Defective</u>	
201	Dimensions not affecting interchangeability, not within tolerance (see 3.3).	SIE
202	Identification marking, improper (see 3.7).	Visual
203	Faulty workmanship affecting appearance (see 3.8).	Visual

1/ SIE = Standard Inspection Equipment.

MIL-T-13513B(AT)

4.5.3 Acceptance tests. Each sample selected in accordance with 4.5.1.3 shall be subjected to the acceptance tests specified in table II, in the order listed in table IV, using an AQL of 2.5 on the basis of percent defective.

TABLE IV. Order of acceptance tests.

Paragraph	Test
4.6.3	Voltage drop
4.6.4	Current rating
4.6.5	Current overload
4.6.6	Mechanical strength
4.6.7.1	Vibration
4.6.7.2	Waterproofness (type II only)

4.6 Methods of inspection.

4.6.1 Materials and construction. Conformance to 3.2 through 3.3 and 3.6 shall be determined by inspection of contractor records providing proof or certification that design, construction, processing, and materials conform to requirements. Applicable records shall include drawings, specifications, design data, receiving inspection records, processing and quality control standards, vendor catalogs and certifications, industry standards, test reports, and rating data.

4.6.2 Defects. Conformance to 3.3, 3.7, and 3.8 shall be determined by examination for the defects listed in table III. Examination shall be visual or by measurement with standard inspection equipment.

4.6.3 Voltage drop. (Voltage drop measurements shall be made only after temperature stabilization of the terminal or splice and attached cable stranding.)

4.6.3.1 Terminals. To determine conformance to 3.4.1.1, the terminal and attached cable shall be connected into a circuit adjusted to pass the current specified in table I. The millivolt drop shall be measured from the intersection of the tongue and barrel to a point on the cable 1/4 inch (6.35 mm) from the open end of the barrel. When terminals have cable insulation supports, this point shall be 1/8 inch (3.175 mm) from the end of the support. The voltage drop and test current values shall be recorded.

4.6.3.2 Splices. To determine conformance to 3.4.1.2, the splice and attached cable shall be connected into a circuit adjusted to pass the current specified in table I. The millivolt drop shall be measured from a point 1/4 inch (6.35 mm) from the barrel of one conductor to a point 1/4 inch (6.35 mm) distant from the barrel on the other conductor. The voltage drop and test current values shall be recorded.

MIL-T-13513B(AT)

4.6.4 Current rating. To determine conformance to 3.4.2, the terminal or splice and attached cable shall be connected into a test circuit adjusted to pass the current specified in table I. The current shall be continued until the temperature of the terminal or splice and attached cable stranding have stabilized. These stabilized temperature values shall be recorded. The temperature of the splice or terminal shall be measured by means of a thermocouple at the barrel diametrically opposite the crimp. The temperature of the cable stranding shall be measured by means of a thermocouple installed in the stranding at a minimum distance of 24 inches [61 centimeters (cm)] from the terminal or splice and the power source.

4.6.5 Current overload. To determine conformance to 3.4.3, 125% of the current specified in table I shall be passed through the terminal or splice and attached cable for 2 hours and the stabilized temperatures recorded (see 4.6.4). The samples shall then be allowed to return to room temperature after which 200% of the current specified in table I shall be passed through the terminal or splice and attached cable for 5 minutes and the stabilized temperatures recorded (see 4.6.4). The samples shall then be allowed to return to room temperature and tested as specified in 4.6.3.

4.6.6 Mechanical strength. To determine conformance to 3.4.4, the test specimens shall be placed in a standard tensile testing machine and sufficient force shall be applied to pull the cable out of the terminal or splice, or break the cable, terminal, or splice. The condition of the terminal or splice shall be examined as the minimum mechanical strengths, as specified in table I, are reached. Testing shall be performed at room temperature with the speed of the machine head not less than 4 inches (10.2 cm) per minute.

4.6.7 Environmental.

4.6.7.1 Vibration. To determine conformance to 3.5.1, the terminal or splice and an attached 15-inch (38.1-cm) length of cable shall be mounted on a vibration table with the end of the cable secured to a stable support 12 inches (30.5 cm) from the terminal. The terminal or splice shall be vibrated for 1 hour in each of three perpendicular planes at an amplitude of 0.030 inch (0.762 mm) [0.060 inch (1.524 mm) in total excursion] and a frequency of 10 to 55 to 10 cycles per second, with the frequency range to be accomplished once each minute. The terminals or splices shall then be subjected to the tests specified in 4.6.3 and 4.6.6.

4.6.7.2 Waterproofness. To determine conformance to 3.5.2, a type II terminal shall be attached to one end of a 6-inch (15.2-cm) length of cable. No less than 3 inches (7.6 cm) of the terminal end of the cable shall be immersed in water, in such a manner that hydrostatic pressure can be applied. Hydrostatic pressure of 6 pounds per square inch (41.37 kiloPascals) shall be applied to the water for 6 hours. The cable shall then be cut apart and examined for evidence of leakage through the terminal end.

MIL-T-13513B(AT)

5. PACKAGING

5.1 ~~Preservation, packaging, packing, and marking.~~ Preservation, packaging, packing, and marking for the desired level shall be in accordance with the applicable packaging requirements specified by the contracting authority (see 6.2).

6. NOTES

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

6.1 Intended use. Terminals or splices covered by this specification are commonly known as solderless cable lugs and are used with electrical cable for automotive vehicles.

6.1.1 Type I. Type I terminals are intended for use with cable conforming to MIL-C-13486 and similar electrical cable specifications.

6.1.2 Type II. Type II terminals are intended for use with waterproof cable conforming to MIL-C-13486.

6.1.3 Type III. Type III splices are primarily intended for use in permanently splicing two conductors.

6.2 Acquisition requirements. Acquisition documents must specify the following:

- a. Title, number, and date of this specification.
- b. Type and size (see 1.2 and 3.3).
- c. Issue of DODISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.1.1).
- d. If first article inspection is not required (see 3.1).
- e. Applicable drawing, standard, or instructions for types I and III (see 3.3.1).
- f. Applicable PIN (see 3.3 and 6.4).
- g. Responsibility for inspection and place of inspection, if other than as specified (see 4.1).
- h. Responsibility for inspection equipment, if other than as specified (see 4.1.2).
- i. Inspection conditions, if other than as specified (see 4.2).
- j. First article sample size, if other than as specified (see 4.4).
- k. Selection of applicable level and packaging requirements (see 5.1).

MIL-T-13513B(AT)

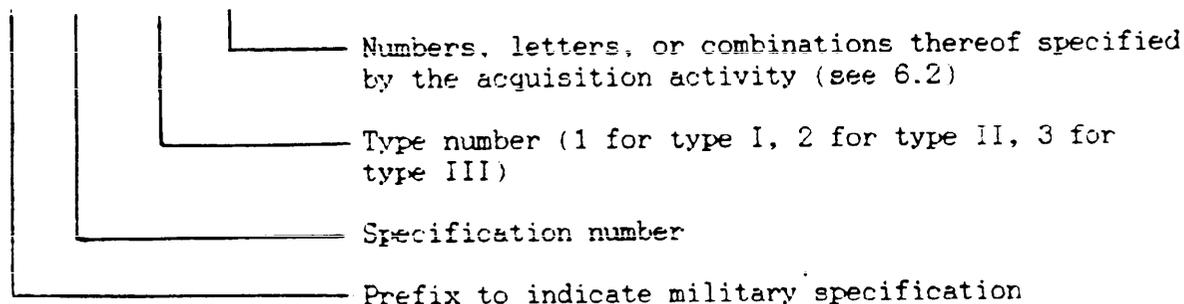
6.3 Definitions.

6.3.1 Recovered materials. "Recovered materials" means materials that have been collected or recovered from solid waste (see 6.3.2).

6.3.2 Solid waste. "Solid waste" means (a) any garbage, refuse, or sludge from a waste treatment plant, water supply treatment plant, or air pollution control facility; and (b) other discarded material, including solid, liquid, semisolid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations, and from community activities. It does not include solid or dissolved material in domestic sewage, or solid or dissolved material in irrigation return flows or industrial discharges which are point sources subject to permits under section 402 of the Clean Water Act, (33 U.S.C. 1342 et seq.), or source, special nuclear, or byproduct material as defined by the Atomic Energy Act of 1954 (42 U.S.C. 2011 et seq.) (Source: Federal Acquisition Regulations, section 23.402).

6.4 PIN. Since this revision does not affect the interchangeability characteristics of the items covered, the items should retain their existing part numbers but the part numbers should be designated as PIN's. However, when there is no existing part number for an item, the PIN should be developed as follows:

M 13513- X (XXXX)

6.5 Subject term (key word) listing.

Aluminum bronze
Cadmium plating
Copper bronze
Recovered materials
Tin plating
Waterproofness

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

MIL-T-13513B(AT)

Custodian:
Army - AT

Review activities:
Army - AR, EA, MI
DLA - GS

Preparing activity:
Army - AT

(Project 5940-A003)

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL	
<p>INSTRUCTIONS: This form is provided to solicit beneficial comments which may improve this document and enhance its use. DoD contractors, government activities, manufacturers, vendors, or other prospective users of the document are invited to submit comments to the government. Fold on lines on reverse side, staple in corner, and send to preparing activity. 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. A response will be provided to the submitter, when name and address is provided, within 30 days indicating that the 1426 was received and when any appropriate action on it will be completed.</p> <p>NOTE: This form shall not be used to submit requests for waivers, deviations or clarification of specification 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. FSC 5940</p>	
DOCUMENT IDENTIFIER (Number) AND TITLE MIL-T-13513B(AT); Terminals, Lug; and Splices, Conductor (Electrical, Solderless, for Automotive Use) (Dual Dimensions)	
NAME OF ORGANIZATION AND ADDRESS OF SUBMITTER	
<input type="checkbox"/> VENDOR <input type="checkbox"/> USER <input type="checkbox"/> MANUFACTURER	
1. <input type="checkbox"/> HAS ANY PART OF THE DOCUMENT CREATED PROBLEMS OR REQUIRED INTERPRETATION IN PROCUREMENT USE? <input type="checkbox"/> IS ANY PART OF IT TOO RIGID, RESTRICTIVE, LOOSE OR AMBIGUOUS? PLEASE EXPLAIN BELOW.	
A. GIVE PARAGRAPH NUMBER AND WORDING	
B. RECOMMENDED WORDING CHANGE	
C. REASON FOR RECOMMENDED CHANGE(S)	
2. REMARKS	
SUBMITTED BY (Printed or typed name and address - Optional)	TELEPHONE NO.
	DATE