

Terminals, Lug: Splices, Conductor: Crimp Style,
Copper, General Specification For

FSC 5940

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1. SCOPE:

1.1 Scope:

This specification covers insulated and uninsulated crimp-style copper terminal lugs and conductor splices for stranded conductors.

1.2 Classification:

Terminals and conductor splices covered by this specification shall be of the following types and classes, as specified (see 6.3):

Type I - Uninsulated

Type II - Insulated

Class 1 - Terminals and conductor splices which conform to all of the requirements of this specification when installed with the crimping tool or crimping dies shown on the applicable MS standard or specification sheet.

Class 2 - Terminals and conductor splices which conform to the material and marking requirements of this specification are replaceable by class 1 terminals, and conform to the performance requirements of this specification when crimped with a tool having crimping dies and motion conforming to the terminal manufacturer's control drawing required by 3.6 (see 6.1.5).

2. APPLICABLE DOCUMENTS:

2.1 Issues of documents:

The following documents, of the issue in effect on date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein:

SPECIFICATIONS

FEDERAL

L-P-378	- Plastic Film (Polyethylene Thin Gage).
QQ-C-502	- Copper Rods and Shapes; and Flat Products with Finished Edges (Flat Wire, Strips and Bars).
QQ-C-576	- Copper Flat Products with Slit, Slit and Edge-Rolled, Sheared, Sawed or Machined Edges, (Plate, Bar, Sheet & Strip).
QQ-S-781	- Strapping, Steel, Flat and Seals.
TT-I-735	- Isopropyl Alcohol.
PPP-B-566	- Boxes, Folding, Paperboard.
PPP-B-585	- Boxes, Wood, Wirebound.
PPP-B-601	- Boxes, Wood, Gleaned-Plywood.
PPP-B-621	- Boxes, Wood, Nailed and Lock-Corner.

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2.1 (Continued):

- | | |
|-----------|--|
| PPP-B-636 | - Box, Fiberboard. |
| PPP-B-665 | - Boxes, Paperboard, Metal Edged and Components. |
| PPP-B-676 | - Boxes, Setup. |
| PPP-T-60 | - Tape, Pressure-Sensitive Adhesive, Waterproof for Packaging. |
| PPP-T-76 | - Tape, Pressure-Sensitive Adhesive Paper, (for Carton Sealing). |

MILITARY

- | | |
|--------------|--|
| MIL-P-116 | - Preservation-Packaging, Methods of. |
| MIL-H-5606 | - Hydraulic Fluid, Petroleum Base, Aircraft, Missile, and Ordnance. |
| MIL-T-5624 | - Turbine Fuel, Aviation, Grades JP-4 and JP-5. |
| MIL-L-7808 | - Lubricating Oil, Aircraft Turbine Engine, Synthetic Base. |
| MIL-T-7928/1 | - Terminal, Lug, Crimp Style, Copper, Insulated, Ring Tongue, for Thin Wall Wire, Type II, Class 1 |
| MIL-T-7928/2 | - Terminal, Lug, Crimp Style, Copper, Insulated, Rectangular Tongue, for Thin Wall Wire, Type II, Class 1 |
| MIL-T-7928/3 | - Splice, Conductor, Electric, (Permanent, Crimp Style, Copper, Insulated, Type II, Class I) |
| MIL-T-7928/4 | - Terminal, Lug, Crimp Style, Copper, Insulated, Ring Tongue, Bell-Mouthed, Type II, Class 1 (For 150°C Total Conductor Temperature) |
| MIL-T-10727 | - Tin Plating, Electrodeposited or Hot-Dipped, for Ferrous and Nonferrous Metals. |
| MIL-L-23699 | - Lubricating Oil, Aircraft Turbine Engines, Synthetic Base. |
| MIL-C-45662 | - Calibration System Requirements. |

STANDARDS

MILITARY

- | | |
|--------------|--|
| MIL-STD-105 | - Sampling Procedures and Tables for Inspection by Attributes. |
| MIL-STD-129 | - Marking for Shipment and Storage. |
| MIL-STD-202 | - Test Methods for Electronic and Electrical Component Parts. |
| MIL-STD-454 | - Standard General Requirements for Electronic Equipment. |
| MIL-STD-1188 | - Commercial Packaging of Supplies and Equipment. |
| MS17143 | - Terminal, Lug, Crimp Style, Copper, Insulated, Rectangular Tongue, Type II, Class 1 |
| MS20659 | - Terminal, Lug, Crimp Style, Copper, Uninsulated, Ring Tongue, Type I, Class 1 |
| MS21003 | - Terminal, Lug, Uninsulated, Rectangular Tongue, Crimp Style, Copper, Type I, Class 1 |
| MS21004 | - Terminal, Lug, Uninsulated, Rectangular Tongue, Crimp Style, Copper, Type I, Class 1 |
| MS21005 | - Terminal, Lug, Uninsulated, Rectangular Tongue, Two Stud, Crimp Style, Copper, Type I, Class 1 |
| MS21006 | - Terminal, Lug, Uninsulated, Flag Tongue, Crimp Style, Copper, Type I, Class 1 |

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2.1 (Continued):

MS21007	- Terminal, Lug, Uninsulated, Rectangular (Bent 90°), Crimp Style, Copper, Type I, Class 1 (Special Applications)
MS21008	- Terminal, Lug, Uninsulated, Offset Rectangular Tongue, Crimp Style, Copper, Type I, Class 1
MS21009	- Terminal, Lug, Uninsulated, Rectangular Tongue, Lipped Side, Crimp Style, Copper, Type I, Class 1
MS21010	- Terminal, Lug, Uninsulated, Rectangular Tongue, Lipped End, Reinforced Boss, Crimp Style, Type I, Class 1
MS21011	- Terminal, Lug, Uninsulated, Rectangular Tongue, Reinforced Boss, Positioning Slot, Crimp Style, Copper, Type I, Class 1
MS21012	- Terminal, Lug, Uninsulated, Rectangular Tongue, Lipped End, Crimp Style, Copper, Type I, Class 1
MS21013	- Terminal, Lug, Uninsulated, Rectangular Tongue, Off-Center Hole, Lipped End, Crimp Style, Copper, Type I, Class 1
MS21014	- Terminal, Lug, Uninsulated, Rectangular Tongue, Two-Barrel, Crimp Style, Copper, Type I, Class 1
MS21015	- Terminal, Lug, Uninsulated, Square Tongue, Lipped End, Rectangular Stud Hole, Crimp Style, Copper, Type I, Class 1
MS25036	- Terminal, Lug, Crimp Style, Copper, Insulated, Ring Tongue, Bell-Mouthed, Type II, Class 1
MS25181	- Splice, Electric, Permanent, Crimp Style, Copper, Insulated, Type II, Class 1
MS25189	- Terminal, Lug, Flag Type, Crimp Style, Copper, Class 1
MS25274	- Cap, Electrical, (Wire End, Type II, Class 1)
MS27429	- Splice, Conductor, Disconnect, Crimp Style, Copper, Insulated Barrel, Type II, class 1
MS90404	- Lug, Terminal, Type I, Class 2

(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.)

2.2 Other publications:

The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply:

NATIONAL BUREAU OF STANDARDS PUBLICATION

Handbook H28 - Screw-Thread Standards for Federal Services.

(Application for copies should be addressed to the Superintendent of Documents, Government Printing Office, Washington, DC 20402.)

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2.2 (Continued):

AMERICAN SOCIETY FOR TESTING AND MATERIALS

ASTM B75-68 - Seamless Copper Tube.

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

3. REQUIREMENTS:

3.1 Detail requirements:

Detail requirements or exceptions applicable to particular styles of terminal lugs and conductor splices shall be as specified on the applicable MS standard or specification sheet. In the event of any conflict between requirements of this specification and the requirements of the MS standard or specification sheet, the latter shall take precedence.

3.2 Qualification:

The lug terminals and conductor splices furnished under this specification shall be products which are qualified for listing on the applicable qualified products list at the time set for opening of bids (see 4.5 and 6.4).

3.3 Material:

The material shall be as specified herein. However, when a material not specified is used, it shall be such that the lug terminals and conductor splices conform to the performance requirements of this specification. Acceptance or approval of any constituent material shall not be construed as a guaranty of the acceptance of the finished product.

3.3.1 Metals: The lug terminals and conductor splices shall be fabricated from copper conforming to QQ-C-502, QQ-C-576, ASTM B75-68 or as specified on the applicable MS standard or specification sheet.

3.3.2 Insulation material: The insulation material shall be permanently colored thermoplastic or as specified on the applicable MS standard or specification sheet. Conductor splices need not be totally colored, but a permanent identifying color shall be clearly distinguishable on some portion of the splice. The insulation material shall be noncorrosive, resistant to abrasion and fungus, and shall not support combustion.

3.3.3 Fungus-resistant material: Only fungus-resistant material shall be used on type II terminals. The manufacturer shall submit certification to this effect when submitting type II, class 1 terminals for qualification approval. For type II, class 2 terminals, the certification shall be included in the manufacturer's certified test report to the activity responsible for qualification (see 4.5.2.1).

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3.4 Design and construction:

Lug terminals and conductor splices shall conform in all respects to the design, dimensions and construction specified herein and on the applicable MS standard or specification sheet. Each terminal size shall be designed for attachment to wire sizes specified on the applicable MS standard or specification sheet by having the terminal receiving barrel reshaped around the conductor. For class 1 terminals and conductor splices, it shall be possible to perform the reshaping operation by means of a crimping tool or crimping dies conforming to the applicable MS standard or specification sheet. For class 2 terminals and conductor splices, it shall be possible to perform this reshaping operation by means of tooling detailed on the manufacturer's control drawings. Terminals and conductor splices shall exhibit no evidence of fracturing or spalling as a result of the reshaping operation. Wire insertion shall be facilitated by bell mouth or chamfer of wire barrel. There shall be no protruding sharp edges of the terminal or conductor splice when reshaping the crimp barrel to the contour of the wire during or after the crimping operation.

- 3.4.1 Wire facility: Each size lug terminal and conductor splice shall be designed for attachment to the wire diameter range or size specified in the applicable MS standard or specification sheet.
- 3.4.2 Mounting holes: The tongue of each size lug terminal shall be designed for attachment to the stud size specified. The diameter of the clearance hole for each stud size is listed in table I or on the applicable MS standard or specification sheet.

TABLE I. Clearance hole (reference).

Stud size ^{1/}	Clearance hole diameter		Clearance hole (reference)					
	Minimum	Maximum	INCH	mm	INCH	mm	INCH	mm
2 (.086)	0.090	0.098	.086	2.18	.190	4.83	.437	11.10
4 (.112)	.114	.122	.090	2.29	.193	4.90	.448	11.38
5 (.125)	.129	.137	.098	2.49	.203	5.16	.463	11.76
6 (.138)	.142	.152	.112	2.84	.216	5.49	.500	12.70
8 (.164)	.168	.178	.114	2.90	.220	5.59	.510	12.95
10 (.190)	.193	.203	.122	3.10	.236	5.99	.525	13.34
12 (.216)	.220	.236	.125	3.18	.250	6.35	.625	15.88
1/4 (.250)	.260	.275	.129	3.28	.260	6.60	.651	16.54
5/16 (.312)	.323	.338	.137	3.48	.275	6.99	.666	16.92
3/8 (.375)	.385	.400	.138	3.51	.312	7.92	.750	19.05
7/16 (.437)	.448	.463	.142	3.61	.323	8.20	.770	19.56
1/2 (.500)	.510	.525	.152	3.86	.338	8.59	.785	19.94
5/8 (.625)	.651	.666	.164	4.17	.375	9.53	.875	22.23
3/4 (.750)	.770	.785	.168	4.27	.385	9.78	.895	22.73
7/8 (.875)	.895	.910	.178	4.52	.400	10.16	.910	23.11

^{1/} Stud size in accordance with Handbook H28.

Metric equivalents (to the nearest .01 mm) are given for general information only and are based upon 1 inch - 25.4 mm.

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- 3.4.3 Wire insulation support: When specified on the applicable MS standard or specification sheet, wire insulation supports shall be required which encompasses the wire insulation and which when deformed by the crimping tool is not required to grip the wire insulation.
- 3.4.4 Insulation: Insulated (type II) lug terminals and conductor splices shall be insulated over the entire outer surface of the barrel and wire insulation support. The insulation, and metal sleeve if used, shall remain in its original position on the barrel of the terminal or conductor splice before and after crimping except as specified in 3.5.5. The insulation shall exhibit no evidence of fracturing or spalling as a result of the reshaping operation.
- 3.4.5 Finish: Unless otherwise specified (see 3.1), lug terminals and conductor splices shall have conducting parts tin plated over their entire surface in accordance with MIL-T-10727. Bare copper exposed at slug-out points on lug terminals, in strip form, shall not in itself be cause for rejection. The slug-out points shall not exceed 1/8 inch in width. Mercury shall not be used in the manufacture of these terminals.

3.5 Performance requirements:

The lug terminals and conductor splices shall conform to the following requirements, when crimped to each of the specified wire sizes with the applicable tool or crimping dies specified in 3.4. The specified performance of the terminals and splices is premised on there being no nicked or broken strands of the conductor.

- 3.5.1 Voltage drop: When tested as specified in 4.7.2, the millivolt drop of the lug terminal or conductor splice shall not exceed the millivolt drop of an equivalent length of wire by more than the value specified in table II.
- 3.5.2 Current cycling: When tested as specified in 4.7.3, the voltage drop (see 3.5.1) shall be as specified in the applicable columns of table II under "after test".
- 3.5.3 Dielectric withstanding voltage (type II): When tested as specified in 4.7.4, insulated lug terminals and conductor splices shall show no evidence of damage, arcing, or breakdown.
- 3.5.4 Salt spray (corrosion): When tested as specified in 4.7.5, lug terminals and conductor splices shall show no evidence of exposure of the base metal or blistering of the plated surfaces. After salt spray, the voltage drop and tensile strength shall be as specified in table II or table III as applicable. For voltage drop, the "after test" requirements shall apply.
- 3.5.5 Axial load:
- 3.5.5.1 Axial load (type I, multiple piece construction, crimped and uncrimped specimens): On multiple piece construction, the metal sleeve on uncrimped lug terminals shall withstand a minimum axial force of 8 pounds and shall not move more than 1/32 inch on the barrel of the lug terminal. The metal sleeve on a crimped lug terminal shall withstand a minimum axial force of 8 pounds (see 4.7.6.1 and 4.7.6.2).

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- 3.5.5.2 Axial load (type II, crimped and uncrimped specimens): The insulation, and metal sleeve if used, on uncrimped lug terminals or conductor splices shall withstand a minimum axial force of 8 pounds and shall not move more than 1/32 inch on the barrel of the lug terminal or conductor splice. The insulation, and metal sleeve if used, on a crimped lug terminal or conductor splice shall withstand a minimum axial force of 8 pounds and shall meet the dielectric withstanding voltage requirement specified in 3.5.3 (see 4.7.6.3 and 4.7.6.4).
- 3.5.6 Vibration: When tested as specified in 4.7.7.1 or 4.7.7.2, there shall be no evidence of cracking, breaking, or loosening of parts. After vibration, the voltage drop shall not exceed the "after test" values specified in table II, and tensile strength shall be not less than the values specified in table II or table III, as applicable.
- 3.5.7 Tensile strength: When tested as specified in 4.7.8, lug terminals and conductor splices shall not break or separate from the wire or cable to which it is terminated before the minimum tensile strength specified in table II or table III, as applicable, is reached.

TABLE II. Performance requirements.

Wire size (nominal)	Test current (amperes)	Maximum voltage drop (mV) - Millivolt drop of equivalent length of wire plus				Tensile strength pounds (min.)
		Initial		After test		
		Lug	Splice	Lug	Splice	
26	3	3	6	5	10	7
24	4.5	2	4	4	8	10
22	9	1	2	3	6	15
20	11	1	2	3	6	19
18	16	1	2	3	6	38
16	22	1	2	3	6	50
14	32	1	2	3	6	70
14 <u>1/</u>	32	---	6 <u>1/</u>	---	8 <u>1/</u>	70
12	41	1	2	3	6	110
10	55	1	2	3	6	150
8	73	1	2	3	6	225
6	101	1	2	3	6	300
4	135	1	2	3	6	400
2	181	1	2	3	6	550
1	211	1	2	3	6	650
0	245	2	4	4	8	700
00	283	2	4	4	8	750
000	328	2	4	4	8	825
0000	380	2	4	4	8	875

1/ For MS27429-2, wire size 14, disconnect splice only. All other dash numbers of MS27429 must comply with the requirements of table II.

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3.5.7.1 Additional tensile strength requirements: Table III tensile strength requirements shall apply to the following MS standards:

MS17143	MS21007	MS21012
MS21003	MS21008	MS21013
MS21004	MS21009	MS21014
MS21005	MS21010	MS21015
MS21006	MS21011	

TABLE III. Tensile strength requirements.

Wire size	Navy cable size	Tensile strength pounds (min.)
22-18	1 (1)	15
	1 (7)	16
	1 (10)	15
	1-1/2 (1)	24
	1-1/2 (7)	23
	1-1/2 (16)	24
	1-1/2 (41)	24
	2 (7)	40
16-14	2-1/2 (1)	38
	2-1/2 (19)	41
	2-1/2 (26)	43
	3 (7)	50
	4 (1)	50
	4 (19)	50
	4 (7)	50
	4 (41)	50
12-10	6 (7)	60
	6 (19)	60
	9 (7)	100
	9 (37)	100

3.5.8 Immersion (type II): After testing as specified in 4.7.9.1 or 4.7.9.2, lug terminals and conductor splices shall withstand the dielectric withstanding voltage test (see 4.7.4).

3.5.9 Heat aging (type II): After testing as specified in 4.7.10.1 or 4.7.10.2, lug terminals and conductor splices shall meet the dielectric withstanding voltage requirements specified in 3.5.3. Discoloration of the insulation material during this test shall not be cause for rejection.

3.5.9.1 Heat aging (Type 1): After testing as specified in 4.7.10.3, lug terminals shall meet the requirements of 3.8.

3.5.10 Flammability (type II): When tested as specified in 4.7.11, lug terminal and splice insulation shall be self-extinguishing within 30 seconds after removal from flame.

3.5.11 Low-temperature crimp (type II): When tested as specified in 4.7.12, insulated lug terminals and splices shall show no evidence of rupture or cracking and shall withstand the dielectric withstanding voltage test (see 4.7.4).

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3.5.12 Engaging and disengaging forces and endurance: In addition to those tests specified for conductor splices, MS27429 disconnect splices shall meet the engaging and disengaging values of table IV (see 4.7.13) and the endurance requirements of 4.7.14.

TABLE IV. Engaging and disengaging forces.

MS27429	Wire size	Engaging force (pounds)		Disengaging force (pounds)	
		Max.	Min.	Max.	Min.
-1	22-18	15	2	15	6
-2	16-14	15	2	15	6
-3	12-10	20	2	20	8

3.6 Manufacturer's control drawing:

The terminal manufacturer shall prepare a control drawing for the crimping dies used to crimp his class 2 terminals and conductor splices for the applicable tests. The control drawing shall specify the critical dimensions and motion of the dies and shall also specify the acceptance and in-service gaging requirements. The terminal manufacturer shall certify to the equipment manufacturer that the equipment manufacturer's dies are in accordance with the control drawing and shall furnish to the equipment manufacturer the acceptance and in-service gaging requirements (see 4.5.2.1).

3.7 Identification of product:

Class 1 and class 2 terminals and conductor splices for wire sizes 22 and larger shall have the wire size, or range as shown on the applicable MS standard or specification sheet legibly molded or stamped on it in addition to the manufacturer's trademark; additionally, type II terminals and conductor splices shall be color coded in accordance with the applicable MS standard or specification sheet for identification purposes.

3.8 Workmanship:

Lug terminals and conductor splices shall be free from burrs, sharp edges, blistering, pitting or peeling of plating, cracks, and other defects which may affect serviceability.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for inspection:

Unless otherwise specified in the contract, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

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4.1.1 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 shall be in accordance with MIL-C-45662.

4.2 Classification of inspections:

The inspections specified herein are classified as follows:

- a. Materials inspection (4.3).
- b. Qualification inspection (4.5).
- c. Quality conformance inspection (4.6).

4.3 Materials inspection:

Materials inspection shall consist of certification supported by verifying data that the materials listed in table V used in fabricating the lug terminals and conductor splices, are in accordance with the applicable specification or requirements prior to such fabrication.

TABLE V. Materials inspection.

Material	Requirement paragraph	Applicable specification or requirement
Metals	3.3.1	QQ-C-502, QQ-C-576, or ASTM B75-68
Fungus resistant	3.3.3	MIL-STD-454

4.4 Inspection conditions:

Unless otherwise specified herein, all inspections shall be performed in accordance with the test conditions specified in the "GENERAL REQUIREMENTS" of MIL-STD-202.

4.4.1 Assembly to conductors: All lug terminals and conductor splices shall be crimped on the wire by the testing activity, using the specified crimping tool and dies (see 3.1 and 4.5.2.1). The type of wire specified on the applicable MS standard or specification sheet shall be used when performing the specified tests. Where a lug terminal or conductor splice is designed to cover a range of wire sizes, the specified number of sample units for testing shall be selected for both the minimum and maximum wire size within the wire range.

4.4.2 Attachment: During temperature and voltage tests, lug terminals shall be securely bolted back-to-back with a minimum clearance in free air of 18 inches in all directions. Steel bolts, nuts, and washers of the appropriate stud size shall be used. When assembled, the bolt shall not extend more than 1/8 inch beyond the nut (see figure 1).

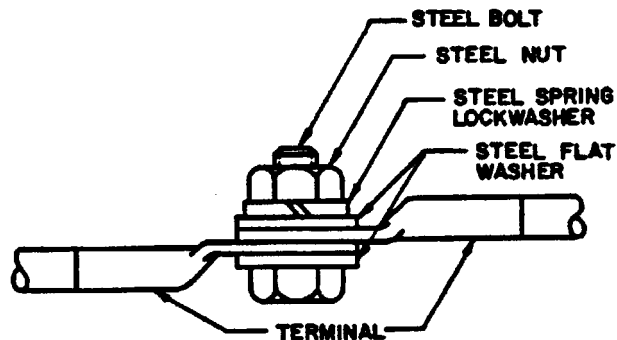


FIGURE 1. Terminal assembly.

4.4.3 Temperature stabilization: Voltage drop measurements shall be made after the temperature of the wire has stabilized. Temperature stabilization shall be determined by three consecutive readings within $\pm 1^\circ\text{C}$ at intervals of 3 minutes each.

4.5 Qualification inspection:

Qualification inspection shall be performed on sample units produced with equipment and procedures normally used in production at a laboratory acceptable to the Government (see 6.4) for class 1 terminals and conductor splices (see 4.5.1) and in-plant by the contractor for class 2 units (see 4.5.2).

4.5.1 Class 1: Samples for each part number shall be separately packaged and forwarded to the activity responsible for qualification as designated in the letter of authorization (see 6.4). Each sample shall be identified by marking each package with the following information:

Sample for qualification

Specification MIL-T-7928G

MS or specification sheet part number _____ (class 1 items)

TERMINALS, LUG; OR SPLICE, CONDUCTOR: (as appropriate)

CRIMP STYLE, COPPER

Type _____ Class _____

Name of contractor

Contractor's part number

Submitted (date) under authorization (reference letter authorizing the inspection)

4.5.2 Class 2: Qualification inspection shall be performed by the contractor and the test report shall be furnished to the activity responsible for qualification (see 6.4). Upon approval by the activity responsible for qualification, the control drawing number for the crimping dies (see 3.6) shall be listed in the applicable qualified products list.

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- 4.5.2.1 Test reports: The contractor shall furnish the activity responsible for qualification with a certified test report, in duplicate, showing quantitative results for class 2 terminals and splices as required by this specification and further certified in the forwarding letter by an officer of the contractor. The report shall designate the equivalent part number of the class 1 terminal or conductor splice which will replace the class 2 terminal or conductor splice submitted. The report shall also include the manufacturer's control drawings specified in 3.6 and the part numbers of the tool and die used to perform the qualification tests.
- 4.5.3 Sample size: The number of lug terminals or conductor splices specified in table VI for each barrel size of each military standard (see 3.1) for which qualification is sought shall be submitted for qualification inspection. In addition, five lug terminals for each stud size for which qualification is sought shall be submitted for visual and dimensional examination. Fifteen additional class 1 lug terminals or conductor splices shall be submitted to the activity responsible for qualification for any additional testing deemed necessary. The sample size shall be the same for class 1 and class 2 terminals and conductor splices.
- 4.5.4 Inspection routine: Sample units shall be subjected to the qualification inspection specified in table VI, in the order shown. All sample units shall be subjected to the inspection of group I. The sample units shall then be divided into groups II through XI, as shown in table VI, and subjected to the inspection for their particular group.
- 4.5.5 Failures: One or more failures shall be cause for refusal to grant qualification approval.
- 4.5.6 Qualification by similarity: (Group I testing required) Qualification by similarity to qualified lug terminals and splices is permissible for those lug terminals and splices, Class 1 or Class 2, of the same type and wire size when the materials, design and manufacturing processes are identical except for tongue shapes or non-essential dimensions that differ due to the multiple stud sizes, various stud configurations or minor design considerations. When materials, design and manufacturing processes differ, sufficient testing to prove the adequacy of the affected characteristic may be required to obtain qualification by similarity. Full details of the similarities and differences, with proposed tests, if the submitter deems necessary, shall be submitted to the qualifying activity for approval prior to commencing testing.

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TABLE VI. Qualification inspection.

Inspection	Requirement paragraph	Method paragraph	Sample units	
			type	
			I	II
<u>Group I</u>				
Visual and dimensional examination - - - - -	3.1, 3.3, 3.4, 3.7, and 3.8	4.7.1	26 16 <u>3/</u>	40 55 <u>1/</u> 52 <u>2/</u>
<u>Group II</u>				
Voltage drop - - - - -	3.5.1	4.7.2	4	4
Current cycling - - - - -	3.5.2	4.7.3		
Voltage drop - - - - -	3.5.1	4.7.2		
<u>Group III</u>				
Voltage drop - - - - -	3.5.1	4.7.2	4	4
Vibration - - - - -	3.5.6	4.7.7		
Voltage drop - - - - -	3.5.1	4.7.2		
Tensile strength - - - - -	3.5.7	4.7.8		
<u>Group IV</u>				
Immersion (105°C) - - - - -	3.5.8	4.7.9.1	---	8
Immersion (150°C) - - - - -	3.5.8	4.7.9.2		20 <u>2/</u>
Dielectric withstanding voltage (type II) - -	3.5.3	4.7.4		
<u>Group V</u>				
Flammability - - - - -	3.5.10	4.7.11	---	2
<u>Group VI</u>				
Voltage drop - - - - -	3.5.1	4.7.2	4	4
Salt spray (corrosion) - - - - -	3.5.4	4.7.5		
Voltage drop - - - - -	3.5.1	4.7.2		
Tensile strength - - - - -	3.5.7	4.7.8		
<u>Group VII</u>				
Heat aging (105°C) - - - - -	3.5.9	4.7.10.1	---	4
Heat aging (150°C) - - - - -	3.5.9	4.7.10.2	---	4 <u>2/</u>
Dielectric withstanding voltage (type II) - -	3.5.3	4.7.4		
Heat aging (175°C) - - - - -	3.5.9.1	4.7.10.3	4 <u>5/</u>	
<u>Group VIII</u>				
Low-temperature crimp (type II) - - - - -	3.5.11	4.7.12	---	4
Dielectric withstanding voltage (type II) - -	3.5.3	4.7.4		
<u>Group IX</u>				
Axial load (type I) - - - - -	3.5.5.1	4.7.6.1 and 4.7.6.2	10 <u>4/</u>	
Axial load (type II) - - - - -	3.5.5.2	4.7.6.3 and 4.7.6.4		10
Dielectric withstanding voltage (type II) - -	3.5.3	4.7.4		
<u>Group X 1/</u>				
Engaging and disengaging forces - - - - -	3.5.12	4.7.13	---	10

See footnotes at end of table.

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TABLE VI. Qualification inspection - Continued.

Inspection	Requirement paragraph	Method paragraph	Sample units	
			Type	
			I	II
Group XI 1/				
Voltage drop - - - - -	3.5.1	4.7.2	---	5
Endurance- - - - -	3.5.12	4.7.14	---	
Voltage drop - - - - -	3.5.1	4.7.2		

1/ Applicable to MS27429 splices only.

2/ Applicable to 150°C items only (see 3.1).

3/ Applicable to one-piece construction only.

4/ Applicable to multiple-piece construction only.

5/ Applicable to 175°C items only (see 3.1).

4.5.7 Retention of Qualification: To retain qualification, the contractor shall forward reports to the qualifying activity every 12 months on the groups A and B tests, and every 36 months on the group C tests. The qualifying activity shall establish the initial reporting date. The reports shall consist of:

- a. (Group A tests every 12 months) A summary of the results of the test performed for inspection of product for delivery, group A, indicating as a minimum the number of lots that have passed and the number that failed. The results of tests of all reworked lots shall be identified and accounted for.
- b. (Group B tests every 12 months) A summary of the results of the tests performed for periodic inspection, Group B, including the number and mode of failures. The summary shall include results of all group A quality conformance inspection performed and completed during the 12 month period. If the summary of the test results indicates non-conformance with specification requirements and corrective action acceptable to the qualifying activity has not been taken, action may be taken to remove the failing product from the qualified list.
- c. (Group C tests every 36 months) A summary of the results of the tests performed for periodic inspection, group C, including the number and mode of failures. If the summary of test results indicates non-conformance with specification requirements and corrective action acceptable to the qualifying activity has not been taken, action may be taken to remove the failing product from the qualified products list.

Failure to submit the report within 30 days after the end of each 12 month period may result in loss of qualification for the product. In addition to the periodic submission of inspection data, the contractor shall immediately notify the qualifying activity at any time during the 12 month period that the inspection data indicated failure of the qualified product to meet the requirements of this specification.

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4.5.7 (Continued):

In the event that no production occurred during the reporting period, a report shall be submitted certifying that the company still has the capabilities and facilities necessary to produce the item. If during two consecutive reporting periods there has been no production, the manufacturer may be required, at the discretion of the qualifying activity, to submit a representative item of those covered by a single specification sheet or military standard to testing in accordance with the qualification inspection requirements.

4.6 Quality conformance inspection:

4.6.1 Inspection of product for delivery: Inspection of product for delivery shall consist of group A inspection.

4.6.2 Inspection lot: An inspection lot, as far as practicable, shall consist of all lug terminals and conductor splices of a single type, class, size, and composition manufactured under essentially the same conditions and offered for inspection at one time.

4.6.3 Group A inspection: Group A inspection shall consist of the examination and tests specified in table VII and shall be made on the same set of sample units, in the order shown. After the visual examination is completed, the lot shall be divided and tensile strength tests performed on both the minimum and the maximum diameter wires within the accommodated wire range.

4.6.3.1 Sampling plan: Statistical sampling and inspection shall be in accordance with MIL-STD-105 for special inspection levels. The acceptable quality level (AQL) shall be as specified in table VII. Major and minor defects shall be as defined in MIL-STD-105 and table X.

4.6.3.2 Rejected lots: If an inspection lot is rejected, the contractor may rework it to correct the defects, or screen out the defective units, and resubmit for reinspection. Resubmitted lots shall be inspected using tightened inspection. Such lots shall be separate from new lots, and shall be clearly identified as reinspected lots.

TABLE VII. Group A inspection.

Inspection	Requirement paragraph	Method paragraph	AQL (percent defective)		Sampling plan
			Major	Minor	
Visual and mechanical examination	3.1, 3.3, 3.4, 3.7, and 3.8	4.7.1	1.0	4.0	S-4
Tensile strength	3.5.7	4.7.8	0.65	---	S-1

4.6.4 Periodic inspection: Periodic inspection shall consist of groups B and C. Except when the results of these inspections show noncompliance with the applicable requirements (see 6.5), delivery of products which have passed group A shall not be delayed pending the results of these periodic inspections.

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- 4.6.4.1 Group B inspection: Group B inspection shall consist of the tests specified in table VIII, in the order shown, and the sample shall be selected from inspection lots that have passed group A inspection.

TABLE VIII. Group B inspection.

Inspection	Requirement paragraph	Method paragraph
Group 1 <u>(15 units) (type II only)</u> Dielectric withstanding voltage Engaging and disengaging forces <u>1/</u>	 3.5.3 3.5.12	 4.7.4 4.7.13
Group 2 <u>(15 units) (any type)</u> Voltage drop	 3.5.1	 4.7.2

1/ Applicable to MS27429 splices only.

- 4.6.4.1.1 Sampling plan: Fifteen type I and 30 type II lug terminals or conductor splices, as applicable, shall be selected from those covered by a single MS standard or specification sheet and having the same barrel size, 12 months after the date of notification of qualification, and after each subsequent 12 month period. A manufacturer's normal quality control tests and production tests may be used to fulfill all or part of group B inspection; however, all of the group B inspection shall be completed as specified.
- 4.6.4.1.2 Failures: If one or more units fail to pass group B inspection, the sample shall be considered to have failed.
- 4.6.4.1.3 Disposition of samples: Samples which have been subjected to group B inspection shall not be delivered on the contract or order.
- 4.6.4.2 Group C inspection: Group C inspection shall consist of the examinations and tests specified in table IX, in the order shown. Group C inspection shall be made on sample units selected from inspection lots which have passed the groups A and B inspection.
- 4.6.4.2.1 Sampling plan: As specified in 4.5.3, the number of sampling units of each wire size and type shall be selected from production lots 36 months after the date of notification of qualification, and after each subsequent 36-month period. In those cases where a terminal or conductor splice covers a range of wire sizes, the number of sample units shall be selected for a maximum and an equal number for the minimum wire size within the range.
- 4.6.4.2.2 Failures: If one or more units fail to pass group C inspection, the sample shall be considered to have failed.

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TABLE IX. Group C inspection.

Inspection	Requirement paragraph	Method paragraph	Sample units	
			Type	
			I	II
<u>Group I</u>				
Current cycling- - - - -	3.5.2	4.7.3	4	4
Voltage drop - - - - -	3.5.1	4.7.2		
<u>Group II</u>				
Vibration- - - - -	3.5.6	4.7.7	4	4
Voltage drop - - - - -	3.5.1	4.7.2		
Tensile strength - - - - -	3.5.7	4.7.8		
<u>Group III</u>				
Immersion (105°C)- - - - -	3.5.8	4.7.9.1		8
Immersion (150°C) 2/ - - - - -	3.5.8	4.7.9.2		20
Dielectric withstanding voltage (type II)- - - - -	3.5.3	4.7.4		
<u>Group IV</u>				
Flammability - - - - -	3.5.10	4.7.11		2
<u>Group V</u>				
Salt spray (corrosion) - - - - -	3.5.4	4.7.5	4	4
Voltage drop - - - - -	3.5.1	4.7.2		
Tensile strength - - - - -	3.5.7	4.7.8		
<u>Group VI</u>				
Heat aging (105°C) - - - - -	3.5.9	4.7.10.1		4
Heat aging (150°C) 2/ - - - - -	3.5.9	4.7.10.2		4
Dielectric withstanding voltage (type II)- - - - -	3.5.3	4.7.4		
Heat aging (175°C) - - - - -	3.5.9.1	4.7.10.3	4	

See footnotes at end of table.

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TABLE IX. Group C inspection - Continued.

Inspection	Requirement paragraph	Method paragraph	Sample units	
			Type	
			I	II
<u>Group VII</u>				
Low-temperature crimp (type II)- - -	3.5.11	4.7.12		4
Dielectric withstanding voltage (type II)- - - - -	3.5.3	4.7.4		
<u>Group VIII</u>				
Axial load (type I)- - - - -	3.5.5.1	4.7.6.1 and 4.7.6.2	10 3/	
Axial load (type II) - - - - -	3.5.5.2	4.7.6.3 and 4.7.6.4		10
Dielectric withstanding voltage (type II)- - - - -	3.5.3	4.7.4		
<u>Group IX</u>				
Engaging and disengaging forces 1/ -	3.5.12	4.7.13		10
<u>Group X</u>				
Endurance 1/ - - - - -	3.5.12	4.7.14		5
Voltage drop - - - - -	3.5.1	4.7.2		

1/ Applicable to MS27429 splices only.

2/ Applicable to 150°C items only (see 3.1).

3/ Applicable to multiple piece construction only.

4/ Applicable to 175°C items only (see 3.1).

4.6.4.2.3 Disposition of sample units: Sample units which have been subjected to group C inspection, shall not be delivered on the contract or order.

4.6.5 Inspection of preparation for delivery: Except when commercial packaging is specified, the sampling and inspection of the preservation-packaging and interior package marking shall be in accordance with the group A and B quality conformance inspection requirements of MIL-P-116. The sampling and inspection of the packing and marking for shipment and storage shall be in accordance with the quality assurance provisions of the applicable container specification and the marking requirements of MIL-STD-129. The inspection of commercial packaging shall be as specified in the contract or purchase order (see 6.3).

4.7 Methods of examination and test:

4.7.1 Visual and mechanical examination: Lug terminals and conductor splices shall be examined to verify that the materials, design, construction, physical dimensions, marking and workmanship are in accordance with this specification and applicable military standard or specification sheet. Dimensions shall conform to those specified on the manufacturer's drawing for class 2, and to the applicable MS standard or specification sheet for class 1. Classification of defects for visual and mechanical examination shall be as specified in table X.

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TABLE X. Classification of defects.

Examination of product	Major	Minor
Dimensions:		
Overall length (max.)	X	---
Width of tongue (max.)	X	---
Stud hole (min.)	X	---
Centerline of stud hole to end of tongue (max.)	X	---
Washer clearance	X	---
All other dimensions	---	X
Materials	X	---
Workmanship and marking	---	X

4.7.2 Voltage drop (see 3.5.1): Lug terminals and conductor splices shall be tested as follows:

- a. Test points: Lug terminal measurements shall be made by puncturing the insulation of the current-carrying conductor 1/16 inch back from the wire-receiving end of the terminal for one test point and using the intersection of the tongue and barrel for the other test point. The distance between the two test points shall be noted.

Conductor splice measurements shall be made by puncturing the insulation of the current-carrying conductor on each end of the splice 1/16 inch back from the wire-receiving end of the splice. The distance between the two test points shall be noted.

Measurement of the current-carrying conductor shall be made by puncturing the conductor insulation the same distance between test points as that noted for the terminal and splice measurements. The conductor measurement shall be made midway on the wire between termination joints. The millivolt drop of the equivalent length of wire may be determined by averaging four readings taken on 10-inch lengths of wire selected at random throughout the supply of wire to be used for subsequent tests.

- b. Measurements: The millivolt drop through the crimp termination and the current-carrying conductor shall be measured while the specified test current (see table II) is being applied and after the temperature of the wire has stabilized (see 4.4.3).

4.7.3 Current cycling (see 3.5.2): Test samples attached to 3-foot lengths of appropriate wire shall be subjected to 50 current cycles. Each cycle shall consist of 30 minutes at 125 percent of the test current specified in table II, followed by 15 minutes at no load. Voltage drops shall be measured at test currents specified in table II after the test assembly has returned to room temperature.

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- 4.7.4 Dielectric withstanding voltage (type II) (see 3.5.3): Insulated lug terminals and conductor splices shall be tested in accordance with method 301 of MIL-STD-202. The following details shall apply:
- Preparation of specimen - The tongue of the type II crimped lug terminal shall be sealed with a suitable insulating compound to a depth sufficient to close the open end of the lug barrel without covering the depression resulting from the applied crimping pressure. One of the wires in a type II crimped splice shall be cut as close to the insulating sleeve as possible, and the wire entrance end shall be insulated as described above. The samples shall be immersed in a 5 percent salt water solution to a depth sufficient to cover the crimped areas of the barrel and insulating grip.
 - Magnitude of voltage - 1,500 volts.
 - Nature of potential - AC.
- 4.7.5 Salt spray (corrosion) (see 3.5.4): The salt spray (corrosion) test shall be in accordance with method 101, test condition B of MIL-STD-202. Terminal lugs shall be crimped to short lengths of proper size wire and mounted in the salt spray (corrosion) chamber in a horizontal position. Conductor splices shall be crimped to short lengths of wire and free ends of the wire shall be terminated with approved lug terminals. Adjoining samples shall be separated by at least 1/4 inch. During this test, the samples shall not come in contact with metallic or wooden objects, and the salt spray (fog) shall be a salt solution concentration of 5 percent and shall have free access to the samples. The samples shall be removed from the salt spray, washed with distilled water, air dried for a minimum of 1 hour and examined for compliance with 3.5.4. Prior to subsequent testing, the corrosion on the terminal's tongue shall be removed. The terminal lugs and conductor splices shall then be subjected to the voltage drop (see 4.7.2) and tensile strength (see 4.7.8) tests.
- 4.7.6 Axial load:
- 4.7.6.1 Axial load (type I, multiple piece construction, uncrimped specimens) (see 3.5.5.1): Five uncrimped specimens shall have a 0.022 inch diameter hole drilled through the metal sleeve and a piano wire of 0.020 inch diameter shall be inserted through the drilled hole. The specimens shall then be fastened in a tensile testing machine and the axial force specified in 3.5.5.1 shall be exerted on the piano wire (see figure 2). An alternate test method may be used provided the requirements of 3.5.5.1 are met.
- 4.7.6.2 Axial load (type I, multiple piece construction, crimped specimens) (see 3.5.5.1): Five new specimens shall be crimped to the specified smallest size wire accommodated by the terminal lug. The specimens shall be tested by applying the specified axial force (see 3.5.5.1) at a maximum speed of one inch per minute between the crimped conductor and a suitable test jig positioned under the metal sleeve. The free end of the crimped conductor and the test jig shall be fastened in the jaws of the tensile machine (see figure 3).

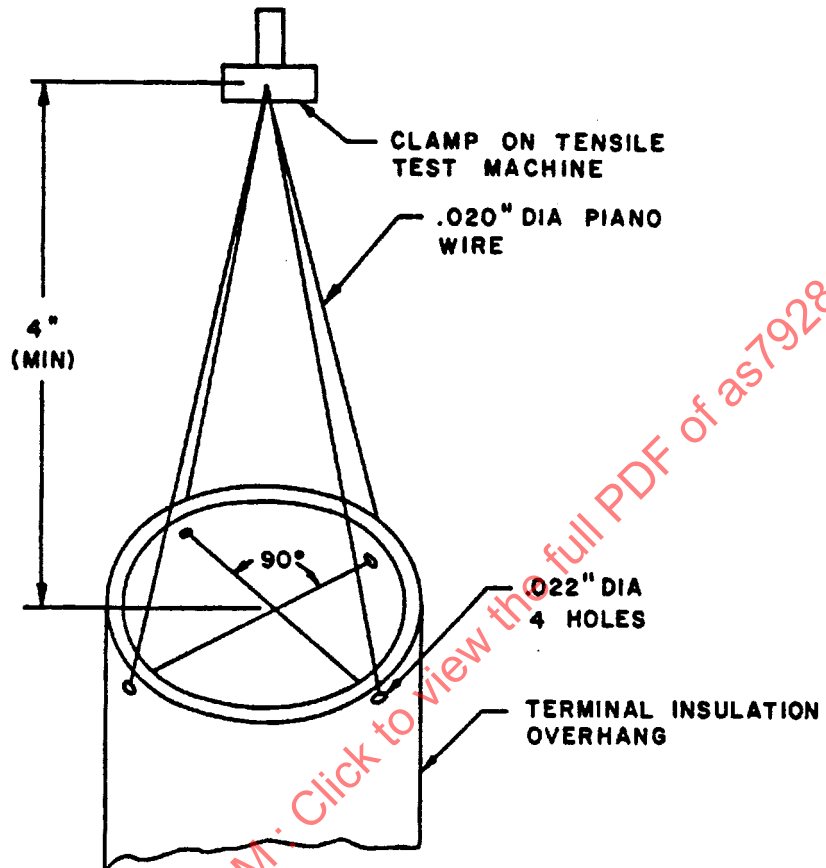


FIGURE 2. Set up for axial load test (uncrimped specimens).

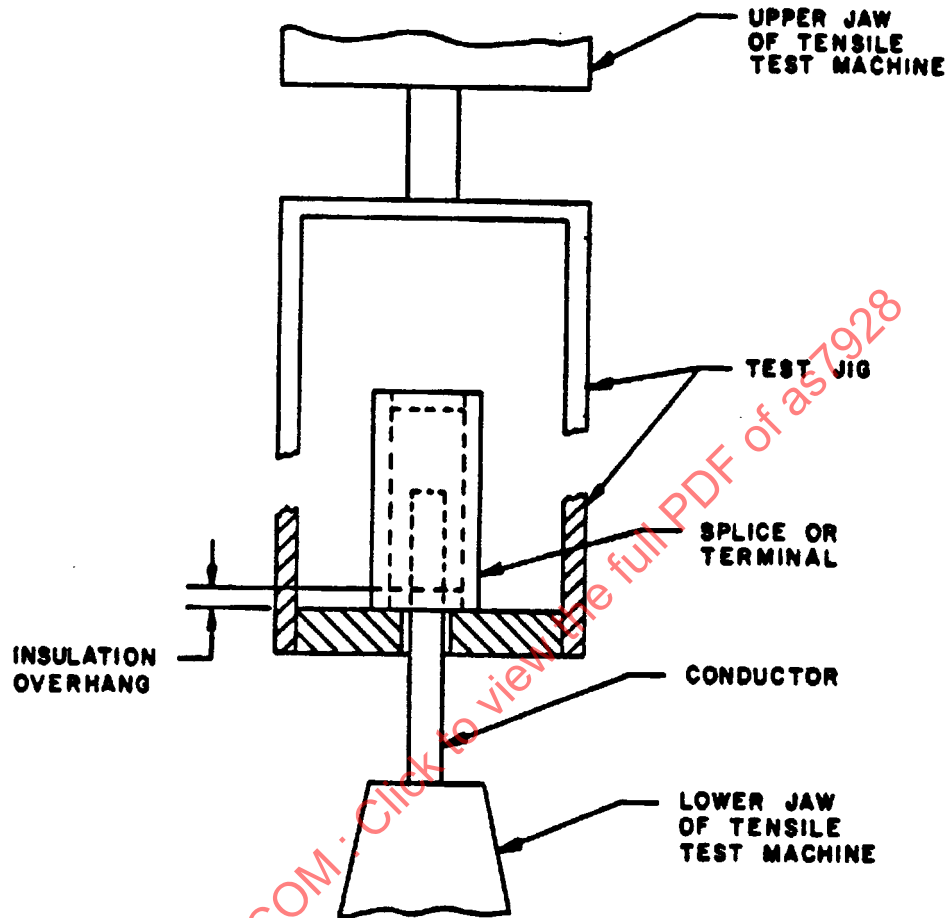


FIGURE 3. Set up for axial load test (crimped specimens).

- 4.7.6.3 Axial load (type II, uncrimped specimens) (see 3.5.5.2): Five uncrimped specimens, each of type II terminal lugs, and conductor splices shall have four 0.022 inch diameter holes drilled through the insulation overhang, and metal sleeve if used, and four piano wires of 0.020 inch diameter shall be inserted through the drilled holes. The specimens shall then be fastened in a tensile testing machine and the axial force specified in 3.5.5.2 shall be exerted on the piano wires (see figure 2). An alternate test method may be used provided the requirements of 3.5.5.2 are met.
- 4.7.6.4 Axial load (type II, crimped specimens) (see 3.5.5.2): Five new specimens each of the terminal lugs and conductor splices shall be crimped to the specified smallest size wire accommodated by the terminal lug or splice. The specimens shall then be subjected to humidity (steady state) in accordance with test condition B, method 103, of MIL-STD-202. After completion of the humidity conditioning, prior to axial load, (one conductor of the splice shall be cut as close to the insulation sleeve as possible) the terminal lug and conductor splice specimens shall be tested by applying the specified axial force (see 3.5.5.2) at a maximum speed of one inch per minute between the crimped conductor and a suitable test jig positioned under the insulation overhang. The free end of the crimped conductor and the test jig shall be fastened in the jaws of the tensile machine (see figure 3). Each crimped terminal lug or conductor splice shall then be tested for dielectric withstanding voltage as specified.
- 4.7.7 Vibration:
- 4.7.7.1 Vibration (with insulation support and sizes 12 and larger without insulation support (see 3.5.6): Lug terminals and conductor splices shall be attached to a length of wire. The terminals shall be rigidly mounted to and not more than 1 inch above the vibrating platform by their normal mounting means (see figure 4). The test terminals shall be so mounted that the junction of the other end of the test sample shall be secured to a stable support 12 inches external to the vibrating table with all slack or tension removed from the wire. Conductor splices shall be assembled and so mounted that the center of the splice is 6 inches from the vibrating platform and 6 inches from the support (see figure 5). Lug terminals shall be attached to the opposite ends of the wires attached to the conductor splice to insure equal distribution of stress among the strands. The specimens shall be vibrated in accordance with method 201 of MIL-STD-202 for 18 hours on each of two axes mutually perpendicular to each other and to the axis of the wire. Following the test, the lug terminal and conductor splice shall be subjected to the voltage drop (see 4.7.2) and tensile strength (see 4.7.8) tests.

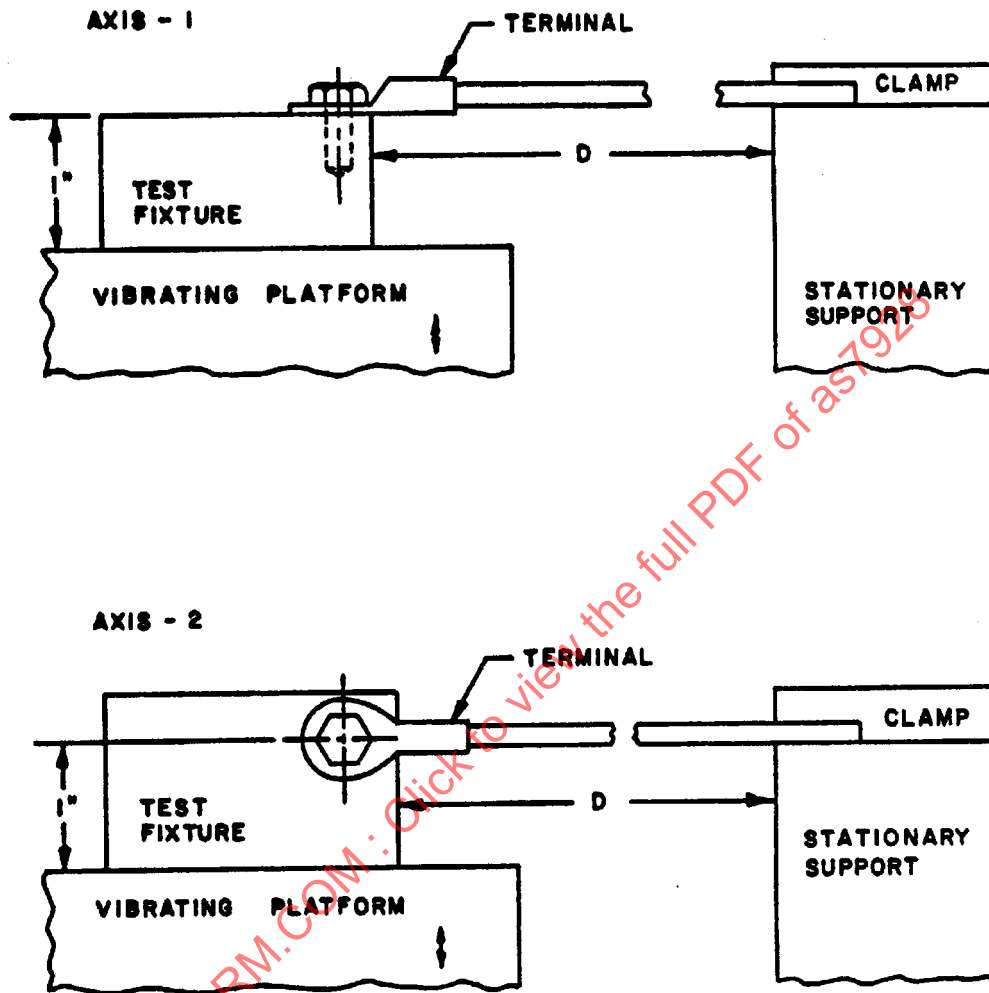


FIGURE 4. Vibration test for lug terminals.

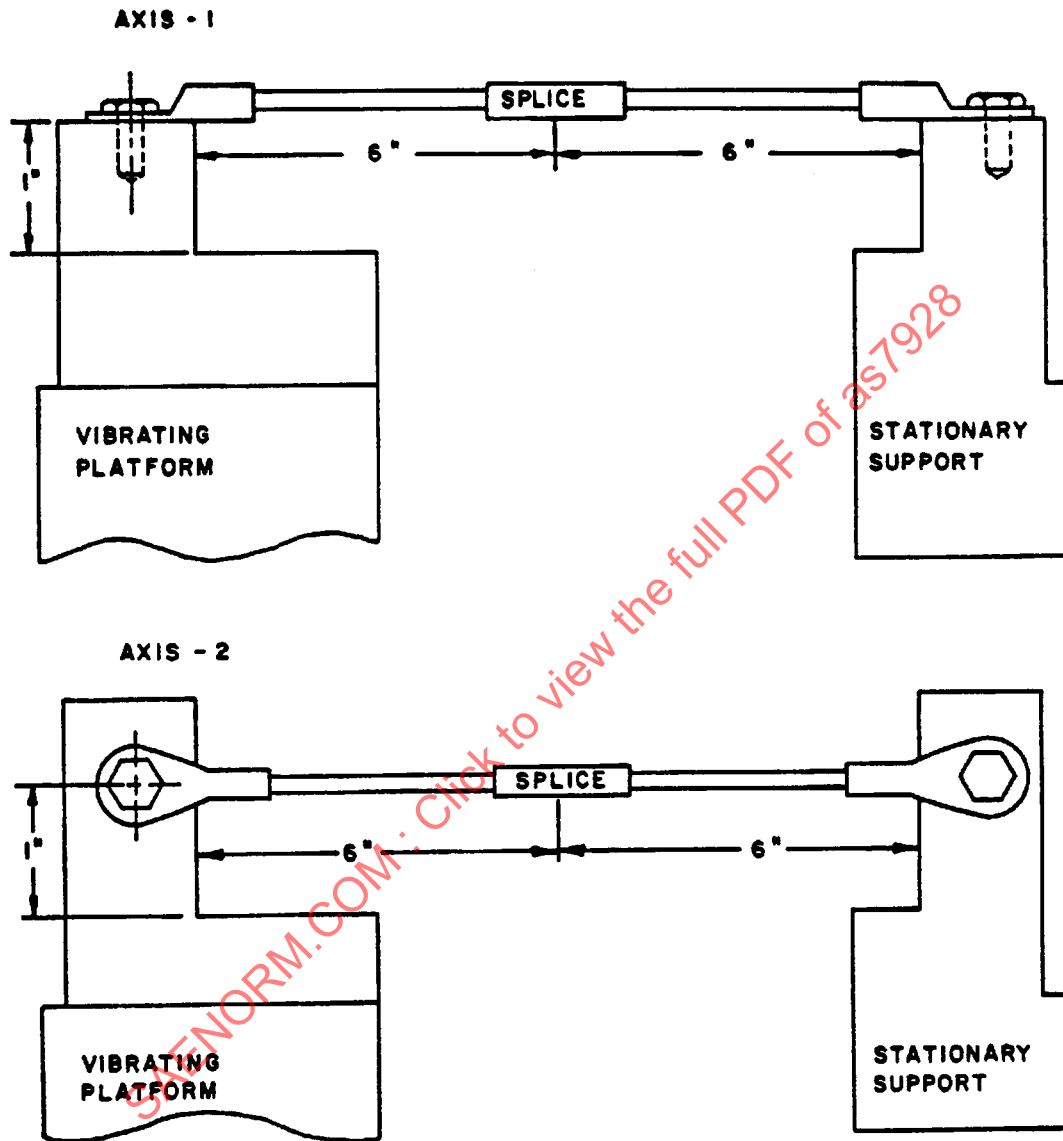


FIGURE 5. Vibration test for conductor splices.