12-SDMS-02

Rev.06

SPECIFICATION FOR LUGS AND CONNECTORS FOR LOW-VOLTAGE & MEDIUM-VOLTAGE DISTRIBUTION SYSTEM

Name	Employee 1 Name	Employee 2 Name	Employee 3 Name	Employee 4 Name	Employee 5 Name
Signature					

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Revision History

#	Date	Revision No.	Revised By	Major Revision Description
1	01/2021	06		Add 4-Holes Terminal Lug for 800mm² Aluminum Conductors
2				
3				
4				
5				
6				
7				
8				
9				
10				

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1 SCOPE

This SEC Distribution Materials Specification (SDMS) specifies the minimum technical requirements for design, engineering, manufacture, testing, inspection and performance of cable/conductors lugs and sleeve connectors for connection and jointing of cables/conductors up to 36 kV in the distribution system of Saudi Electricity Company (SEC) in Saudi Arabia.

2 CROSS REFERENCES TO OTHER SEC STANDARDS

This specification shall always be read in conjunction with SEC General Specification No. 01-SDMS-01 (latest revision) titled "General Requirements for all Equipment/Materials," which shall be considered as an integral part of this specification. It shall also be read in conjunction with SEC purchase order and/or contract schedules, and scope of work/technical specifications for projects, as applicable.

The latest revisions of the following specifications shall be applicable with reference to cables.

Standard #	Title
10-SDMS-01	Specification for 13.8kV and 33kV Overhead Line Conductors (ACSR/AW Type)
10-SDMS-02	Specifications for Bare Copper Conductors
11-SDMS-01	Specifications for Low-Voltage Power and Control Cables
11-SDMS-02	Specifications for Low-Voltage Overhead Line Conductors (Quadruplex Type)
11-SDMS-03	Specification for XLPE Insulated Power Cables for Rated Voltages from 15kV up to 36kV (Um)

Table 1: List of reference SEC standards

3 APPLICABLE CODES AND STANDARDS

The latest revision of the following codes and standards shall be applicable for the equipment/materials covered in this specification. In case of any deviation, the vendor/manufacturer may propose equipment/materials conforming to alternate codes or standards. However, the provisions of SEC standards shall supersede the provisions of these alternate standards in case of any difference.

Standard #	Title
IEC 60228	Conductors for Insulated Cables
IEC 61238-1	Compression and Mechanical Connectors for Power Cables for Rated Voltages up to 30kV (Um = 36kV) Part:1 – Test Methods and Requirements
EN 13600	Copper and Copper Alloys – Seamless Copper Tubes for Electrical Purposes
DIN 46235	able Lugs for Compression Connections Cover Plate Type for Copper Conductors
DIN 46267-1	Non Tension-Proof Compression Joints for Copper Conductors
DIN 46267-2	Non Tension-Proof Compression Joints for Aluminum Conductors
DIN 46329	Cable Lugs for Compression Ring Type for Aluminum Conductors
ANSI C119.4	Electric Connectors – Connectors for Use Between Aluminum-to-Aluminum and Aluminum-to-Copper Conductors Designed for Normal Operation at or Below 93°C and Copper-to-Copper for Normal Operation at or Below 100°C
NEMA CC1	Electric Power Connection for Substations
ASTM B545	Standard Specification for Electrodeposited Coatings of Tin

Table 2: List of applicable standards

4 MATERIAL, DESIGN AND CONSTRUCTION REQUIREMENTS

4.1. GENERAL

4.1.1 All cable/conductor lugs and connectors intended for electricity distribution or industrial networks shall be Class-A in which they can be subjected to short-circuit of relatively high intensity and duration.

4.1.2 Cable/conductor lugs and connectors shall meet or exceed the performance of conductor in all respect.

4.1.3 All cable/conductor lugs shall be compression type, and without inspection hole based on lug drawing. Connectors shall be with middle stopper camber.

4.1.4 Cable/conductor lugs and connectors shall be suitable for cable sizes listed in Table-3 and Table-4.

4.1.5 Manufacturer's drawings shall show the outline of the lugs and connectors together with all pertinent dimensions. Manufacturing tolerances shall not exceed the tolerance specified in this specification or related DIN standard.

4.2. MATERIAL

4.2.1 Cable/conductor lugs and connectors shall be made from copper or aluminum or combination of both metals as specified in the technical data schedule.

4.2.2 All copper lugs and connectors shall be made of E-copper as per EN 13600 with tin plated surface of thickness not less than 5µm.

4.2.3 All aluminum lugs and connectors shall be made of E-aluminum with 99.5% purity, tin plated surface of thickness not less than 20µm, and shall be provided with proper conductive oxide inhibiting compound then capped with plastic plugs.

4.2.4 All aluminum lugs shall manufactured from a round bar and not from a tube.

4.2.5 Bi-metallic use lugs unless otherwise specified shall consist of monometallic aluminum body, or aluminum barrel and copper palm jointed together through friction stir welding. Overall tin-plating thickness is 20µm and the barrel shall be provided with proper conductive oxide inhibiting compound then capped with plastic plugs.

4.3. CONSTRUCTION

4.3.1 The construction details and dimensions are given in the attached drawings which form part of this specification.

4.3.2 A summary of cables and conductors for which the lugs and connectors shall be used is given in Table-3 and Table-4.

Cable / Conductor Size (mm^2)	Material	Design / Shape
35, 70, 120, 185, 630	Copper	1-CORE /Round
50, 120, 800, 67.44, 170.5	Aluminum	1-CORE /Round
70, 185, 300	Aluminum	4-CORE /Sector

Table 3: Low-Voltage Cables and Overhead & Earthing Conductor Sizes

Cable Size (mm^2)	Material	Design / Shape
1 x 500/35	Copper	1-Core, Unarmored / Round
3 x 300/35	Copper	3-Core, Armored / Round
3 x 240/3	Copper	3-Core, Armored / Round
3 x 185/35	Copper	3-Core, Armored / Round
3 x 185/35	Copper	3-Core, Unarmored / Round
1 x 50/16	Copper	1-Core, Unarmored / Round
3 x 500/35	Aluminum	3-Core, Armored / Round
3 x 400/35	Aluminum	3-Core, Unarmored / Round
3 x 300/35	Aluminum	3-Core, Armored / Round
3 x 70/16	Aluminum	3-Core, Armored / Round

Table 4:Sizes of Medium-Voltage Cables

5 TESTING AND INSPECTION

All lugs and connectors shall be tested in full conformance with the latest edition of IEC 61238-1.

5.1. ROUTINE TESTS

These tests shall be carried out in accordance with the requirements of applicable standards to which the lugs and connectors are offered, and shall be carried out at the factory.

5.2. TYPE TESTS

5.2.1 The vendor shall provide certified copies of type test reports in full conformance with IEC 61238-1 with the bid for the materials offered carried out at SEC approved laboratory.

5.2.2 When the design of a lugs or connector meets the requirement of this standard, then it is expected that during its service:

a. The resistance of the connection will remain stable.

b. The temperature of the connector will be of the same order or less than that of the conductor.

c. The mechanical strength will be fit for the purpose.

d. Application of short-circuit currents must not affect items (a) and (b) mentioned above.

5.2.3 For situations where a connector may be raised to a high temperature by virtue of connection to highly rated plant, or where the connector is subjected to excessive mechanical vibration or shock or to corrosive conditions. In these instances, the tests in this standard may need to be supplemented by special tests agreed between supplier and purchaser.

5.3. SAMPLE INSPECTION

Samples together with actual CAD drawings, routine test reports, and material certificate of compliance with applicable standards shall be submitted for inspection/evaluation prior to issuance of approval for mass production. The following attributes shall be checked:

a. Dimensional verification

b. Engraved markings or indelible ink markings (Cable/Conductors Size, SEC Item Code, Manufacturer Logo or Initials, Manufacturer Catalogue/Product Number, Die Number, Crimp Positions). Manufacturer name shall be engraved to where it will not be affected or erased by crimping.

c. Mono-metallic aluminum lugs and connectors must have a mark saying “Bi-Metallic Use”.

d. Uniformity of the product/samples

e. Finishing – practically smooth surface without any form of nicks, deformations, and sharp edges.

6 PACKING AND SHIPPING

Packing and shipping shall generally be as per SEC General Requirements for Equipment/Materials, 01-SDMS-01 latest revision.

6.1. HARD BOX PACKAGING

Each hard box shall be printed with the following information:

a. Purchase Order Number / Tender Number

b. Lugs/Connectors Catalogue Number

c. Manufacturer's Name

d. Year of Manufacture

e. SEC Item Code

6.2. WOODEN BOX PACKAGING

Each wooden box shall be fixed with an aluminum plate bearing the following information:

a. Purchase Order Number / Tender Number

b. Lugs/Connectors Catalogue Number

c. Manufacturer's Name

d. Year of Manufacture

e. SEC Item Code

f. Gross Weight in Kilograms (Kg)

g. Position of Slinging Points and Other Relevant Handling Instructions

7 GUARANTEE

The supplier shall guarantee the products against all defects arising out of faulty design or manufacturing defects or defective material for a period of five (5) years from the date of delivery.

The supplier shall guarantee the uniformity of the products delivered with the approved samples.

8 SUBMITTALS

8.1. SUBMITTALS REQUIRED WITH TENDER/INQUIRY

8.1.1 Summary in table form with the following information: list of items offered, manufacturer, origin, catalogue number, and quantity

8.1.2 Clause-by-clause compliance with the latest revision of SEC specification 12-SDMS-02.

8.1.3 Manufacturer's Catalogue

8.1.4 Certificate stating that the raw material has been sampled, tested and inspected in accordance with relevant standard specifications.

8.1.5 Product type test reports and certificates carried out from SEC approved laboratories

8.1.6 Filled-up technical data schedule on each of the items offered

8.1.7 Manufacturer CAD drawings for each of the items offered

8.1.8 USB Flash Drive containing e-copy of all the documents mentioned above

8.2. SUBMITTALS REQUIRED FOLLOWING AWARD OF CONTRACT

8.2.1 Samples in compliance with Clause 5.3 of this specification

8.2.2 Quality assurance tests

8.2.3 Manufacturing and routine test schedules

8.2.4 Special tests, if applicable

9 Technical data schedule

SEC Inquiry No: Item No:

No	Description	SEC Specified Values	Vendor proposed values**
1	**Lugs**		
1.1	Material	Al / Cu / Bi-Metallic[a]	
1.2	Material Compliance	**	
1.3	Cable / Conductor Size (mm²)	*	
1.4	Bolt Size	M10 / M12 / M16	
1.5	Number of Holes	1 / 2 / 4	
1.6	Tin-Plating Thickness (µm)	5 / 20[a]	
2	**Connectors**		
2.1	Material	Al / Cu / Bi-Metallic[a]	
2.2	Material Compliance	**	
2.3a	Cu - Cu Conductor Sizes (mm² - mm²)	*	
2.3b	Al - Al Conductor Sizes (mm² - mm²)	*	
2.3c	Cu - Al Conductor Sizes (mm² - mm²)	*	
2.4a	Tin-Plating Thickness (µm) for Cu - Cu	5	
2.4b	Tin-Plating Thickness (µm) for Al - Al	20	
2.4c	Tin-Plating Thickness (µm) for Cu - Al	20[a]	
	Manufacturer	**	
	Manufacturer Catalogue Number	**	
	Country of Origin	**	
	Submittals Required with Tender/Inquiry Included or Not?	**	

Note: a – Overall Tin-Plating Thickness of Bi-Metallic Lugs and Connectors is 20µm

Table 5: Technical Data Schedule

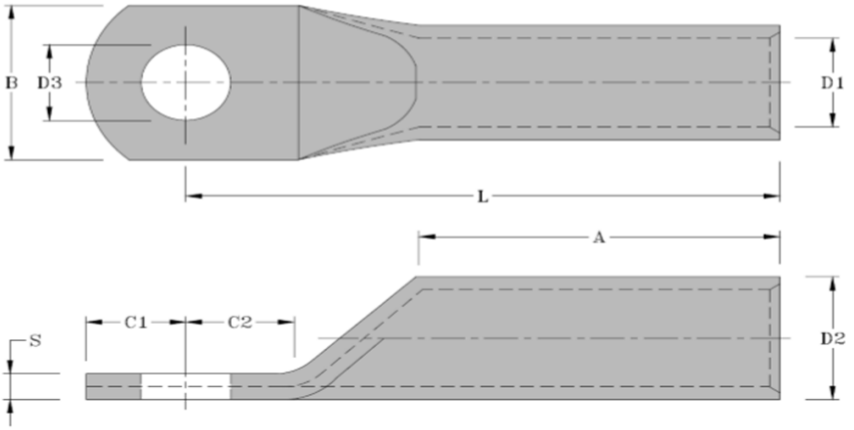
Cable / Conductor Lugs and Connectors

SEC Inquiry No: Item No:

- Additional Technical Information or Features Specified by SEC
- Additional Supplementary Data or Features Proposed by Bidder/Vendor/Supplier.
- Other Particulars to be filled-up by the Bidder/Vendor/Supplier.
- List of Deviations and Clauses to which exception is taken by the Bidder/Vendor/Supplier. (Use separate sheet, if necessary).

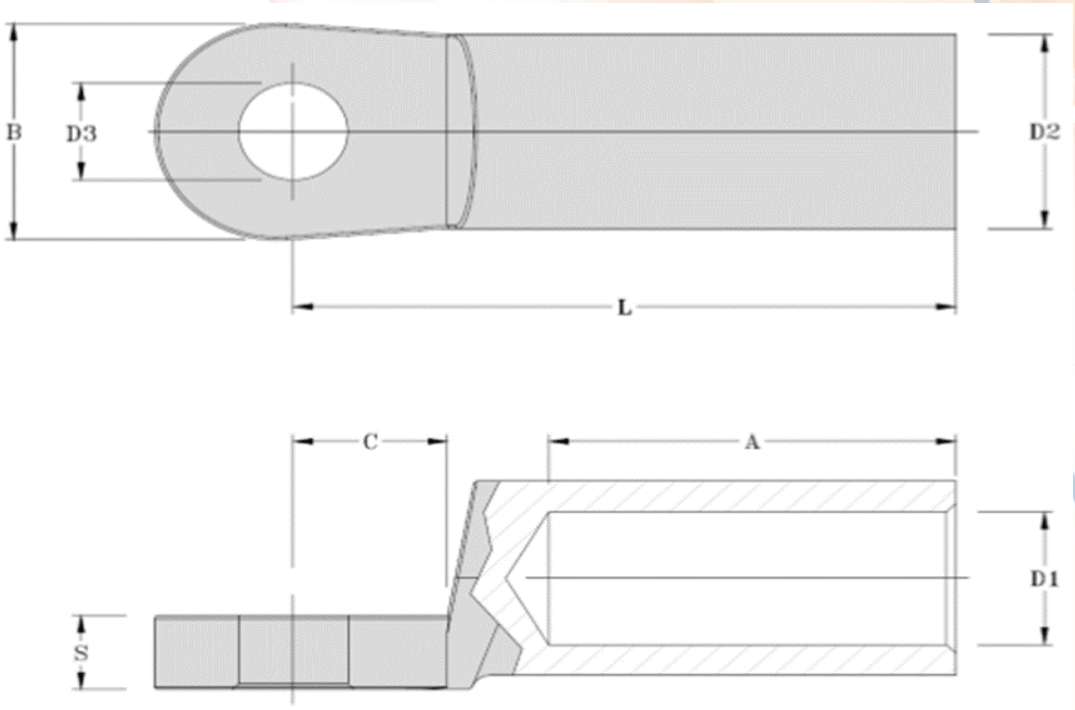
Description	**Manufacturer of Material/Equipment**	**Vendor/Supplier**
Name of Company		
Location and Office Address		
Name and Signature of Authorized Representative with Date		
Official Seal / Stamp		

10 DRAWING



CONDUCTOR SIZE, mm^2	BOLT SIZE	DIMENSIONS, mm								
		A	B	C1	C2	D1	D2	D3	L	S
16	M10	20	17	15	12	5.5	8.5	10.5	36	2.5
35	M10	20	19	15	12	8.2	12.5	10.5	42	2.5
35	M12	20	21	16	13	8.2	12.5	13	42	2.5
50	M12	28	24	16	13	10	14.5	13	52	4.0
70	M12	28	24	16	13	11.5	16.5	13	55	4.5
120	M12	35	32	16	13	15.5	21	13	70	5.5
185	M12	40	37	16	13	19	25.5	13	82	6.0
185	M16	40	37	19	16	19	25.5	17	82	6.0
240	M12	40	42	16	13	21.5	29	13	92	6.5
240	M16	40	42	19	16	21.5	29	17	92	6.5
300	M12	50	48	16	13	24.5	32	13	100	7.0
300	M16	50	48	19	16	24.5	32	17	100	7.0
500	M12	70	60	25	20	31	42	13	125	10
500	M16	70	60	25	20	31	42	17	125	10

Figure 1: Technical Lugs for Copper Conductors



CONDUCTOR SIZE, mm^2	BOLT SIZE	DIMENSIONS, mm							
		A	B	C	D1	D2	D3	L	S
70	M12	52	25	15.5	11.2	18.5	13	72	5.5
120	M12	56	30	20	14.7	23	13	80	7.5
185	M12	60	30	20	18.3	28.5	13	91	8
300	M12	70	38	24	23.3	34	13	103	13
300	M16	70	38	24	23.3	34	17	103	13
400	M12	73	38	24	26	38.5	13	116	14
400	M16	73	38	24	26	38.5	17	116	14
500	M12	79	44	24	29	44	13	122	15
500	M16	79	44	24	29	44	17	122	15
Quail (67.44)	M12	-	34	-	13.5	-	13	60	-
Merlin (170.5)	M16	-	41	-	20	-	13	105	-

Note: Lugs are manufactured from a round bar and not from a tube

Figure 2: Terminal Lugs for Aluminum Conductors

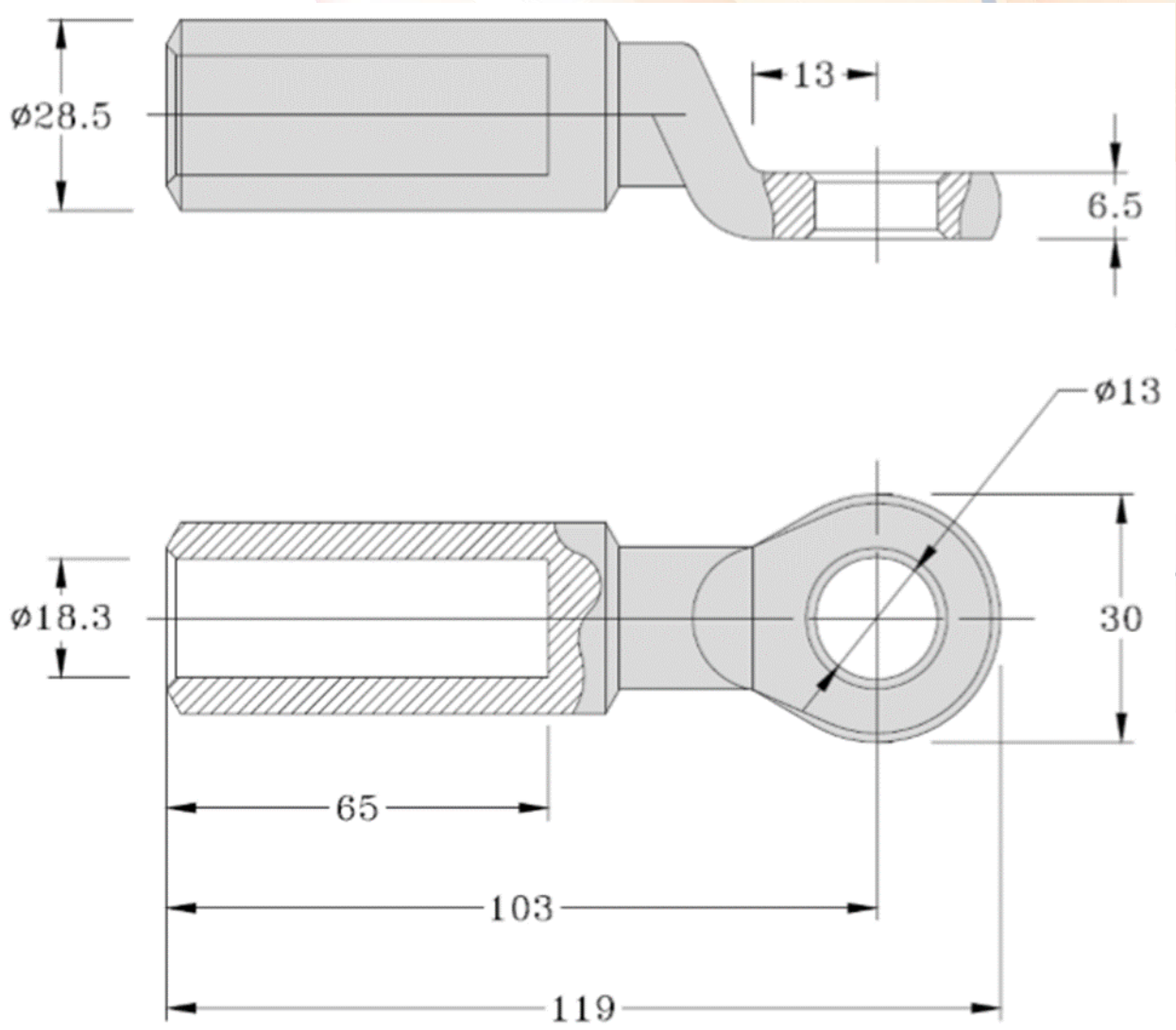


Figure 3: Mono-Metallic Aluminum Lug for Bi-Metallic Use for 185mm² Aluminum Conductors

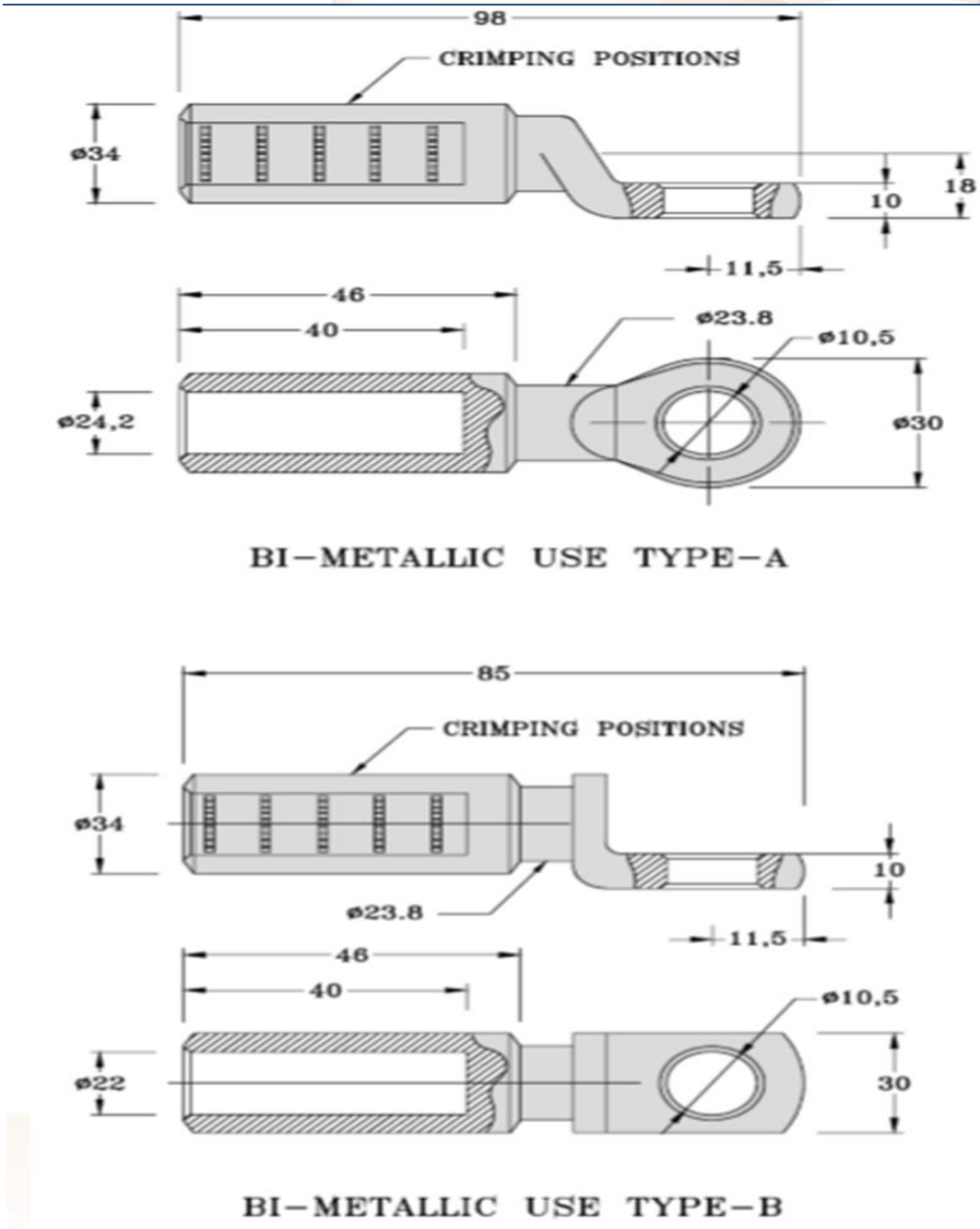


Figure 4: Mono-Metallic Aluminum Lug for Bi-Metallic Use for 300mm² Aluminum Conductors

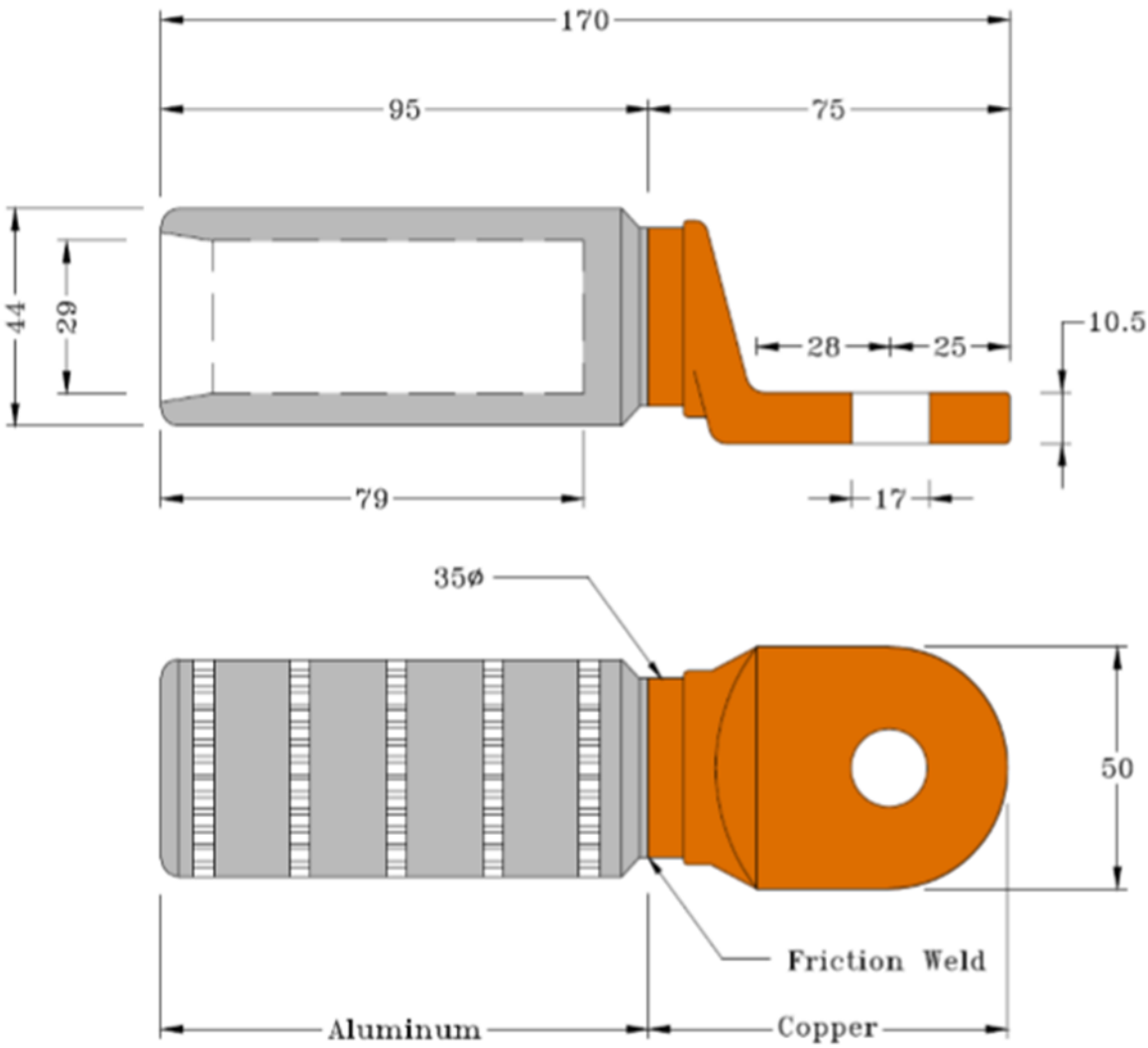


Figure 5: Bi-Metallic Terminal Lugs for 500mm² Aluminum Conductors

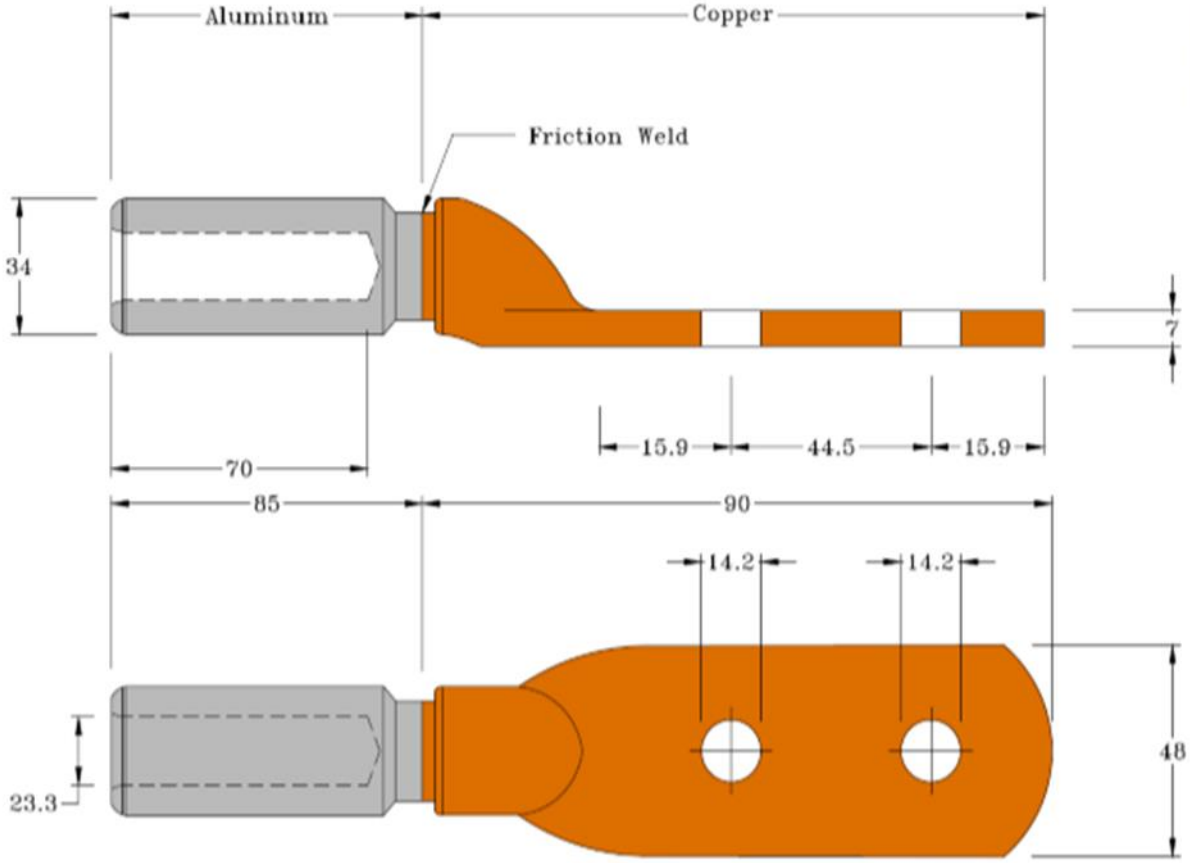
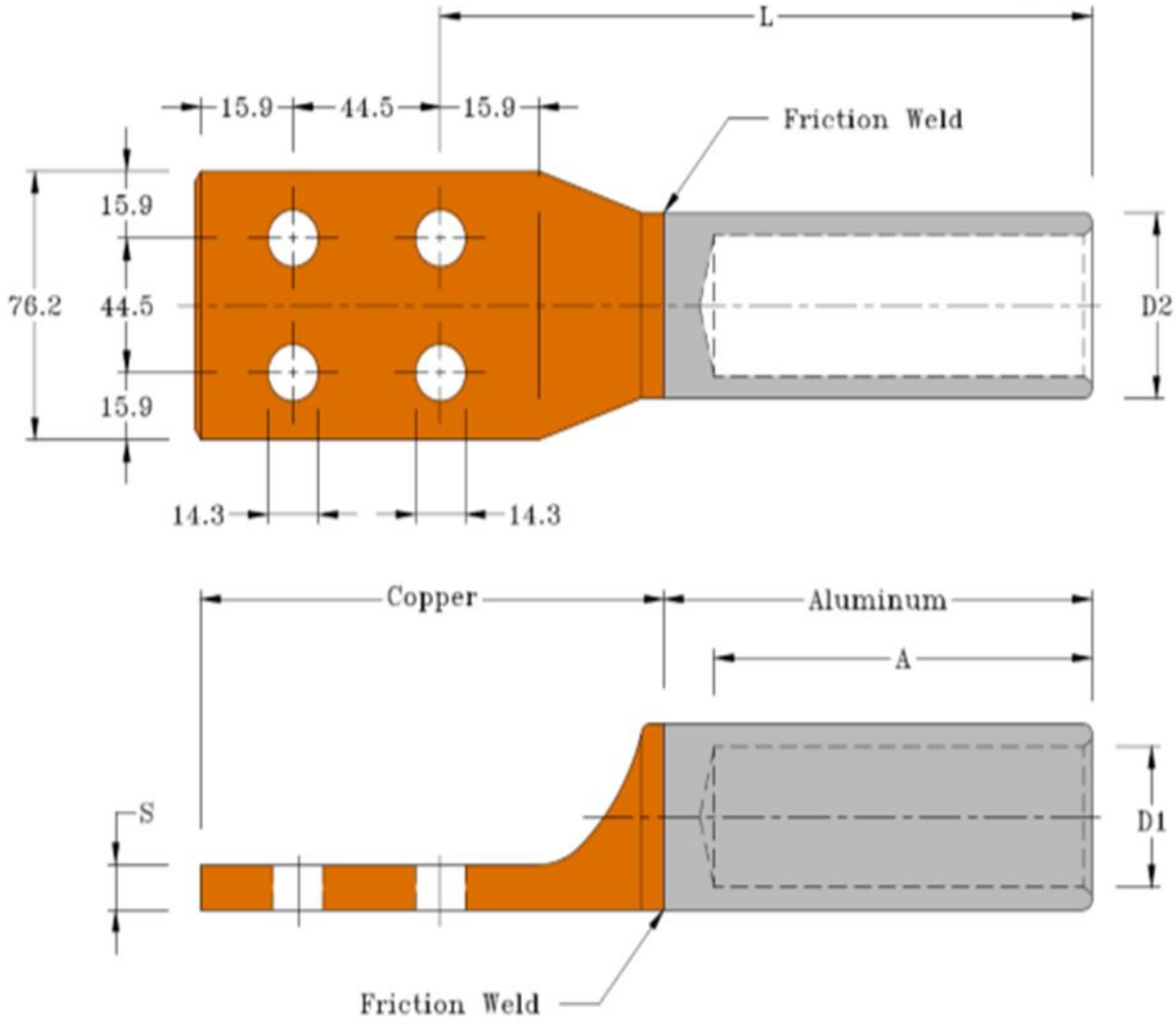


Figure 6: 2-Holes NEMA-Pad Bi-Metallic Terminal Lug for 300mm² Aluminum Conductors



CONDUCTOR SIZE, mm²	BOLT SIZE	DIMENSIONS, mm				
		A	D1	D2	L	S
400	M12	73	26	38.5	125	10
500	M12	79	29	44	125	10

Figure 7: 4-Holes NEMA-Pad Bi-Metallic Terminal Lug for 500mm² and 400mm² Aluminum Conductors

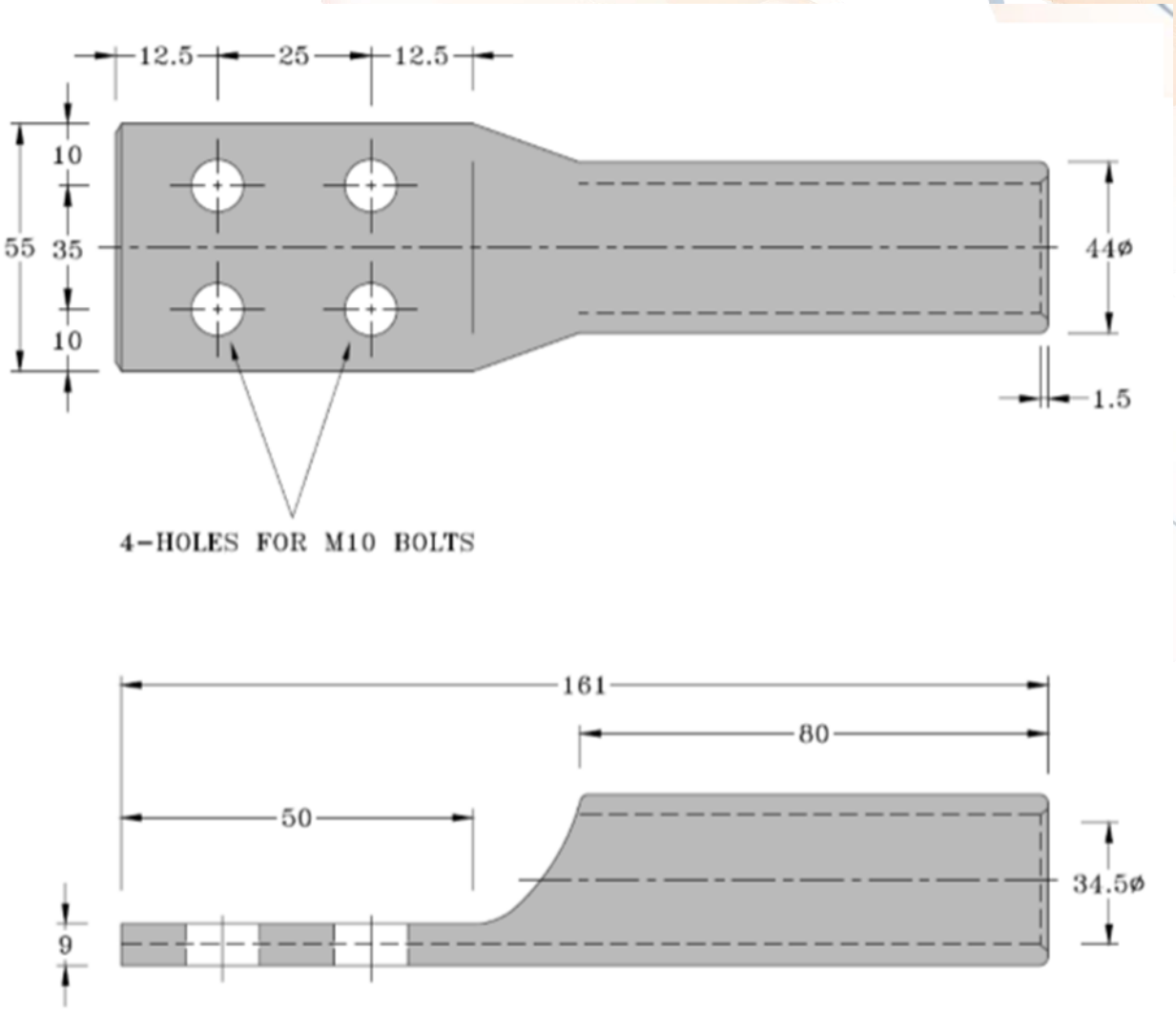


Figure 8: 4-Holes Terminal Lug for 630mm² Copper Conductors

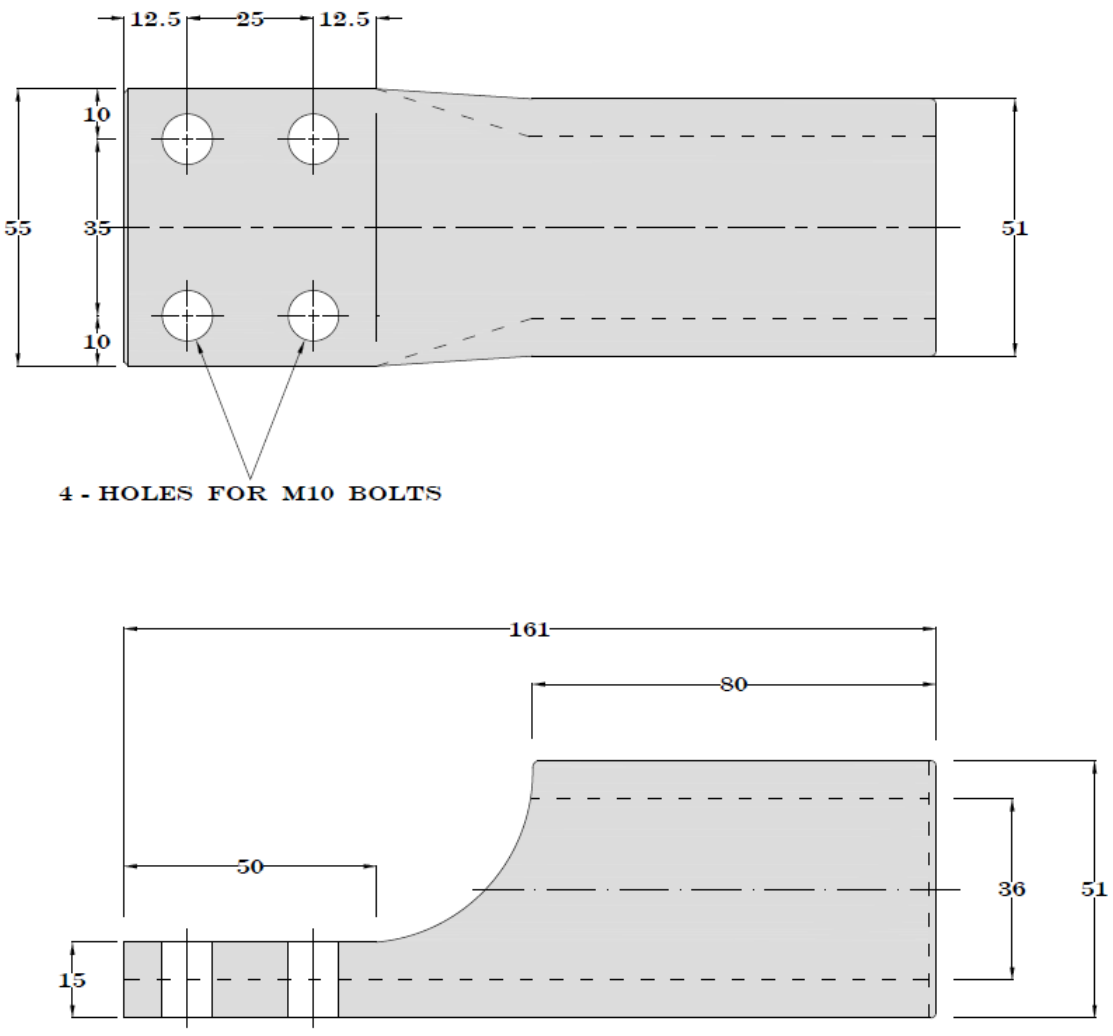
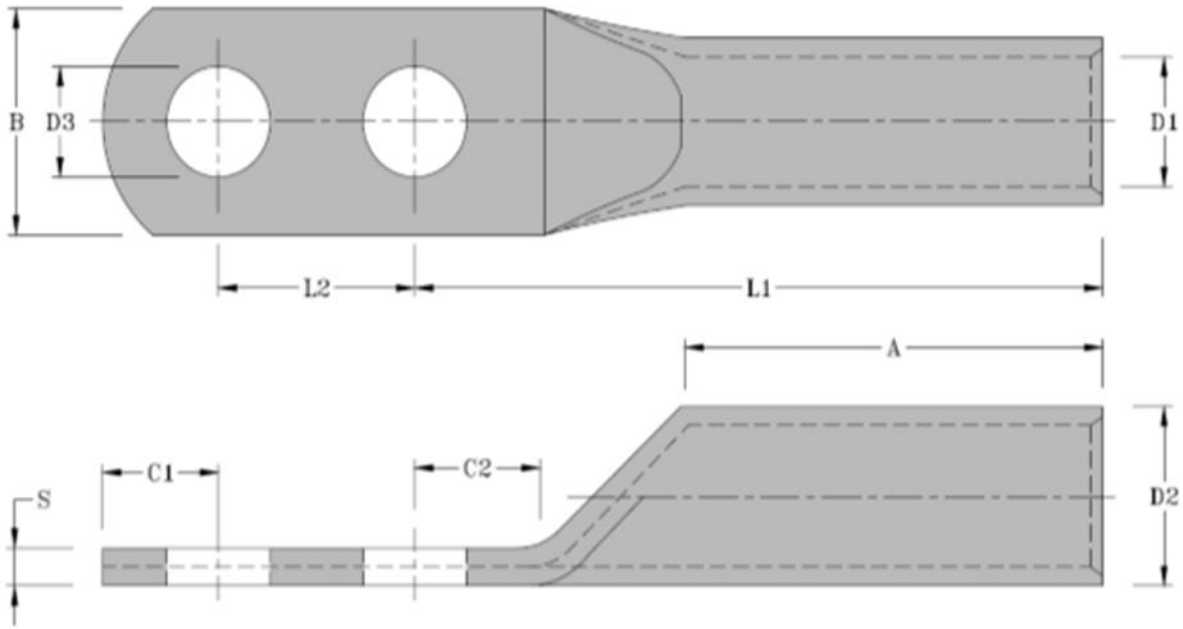
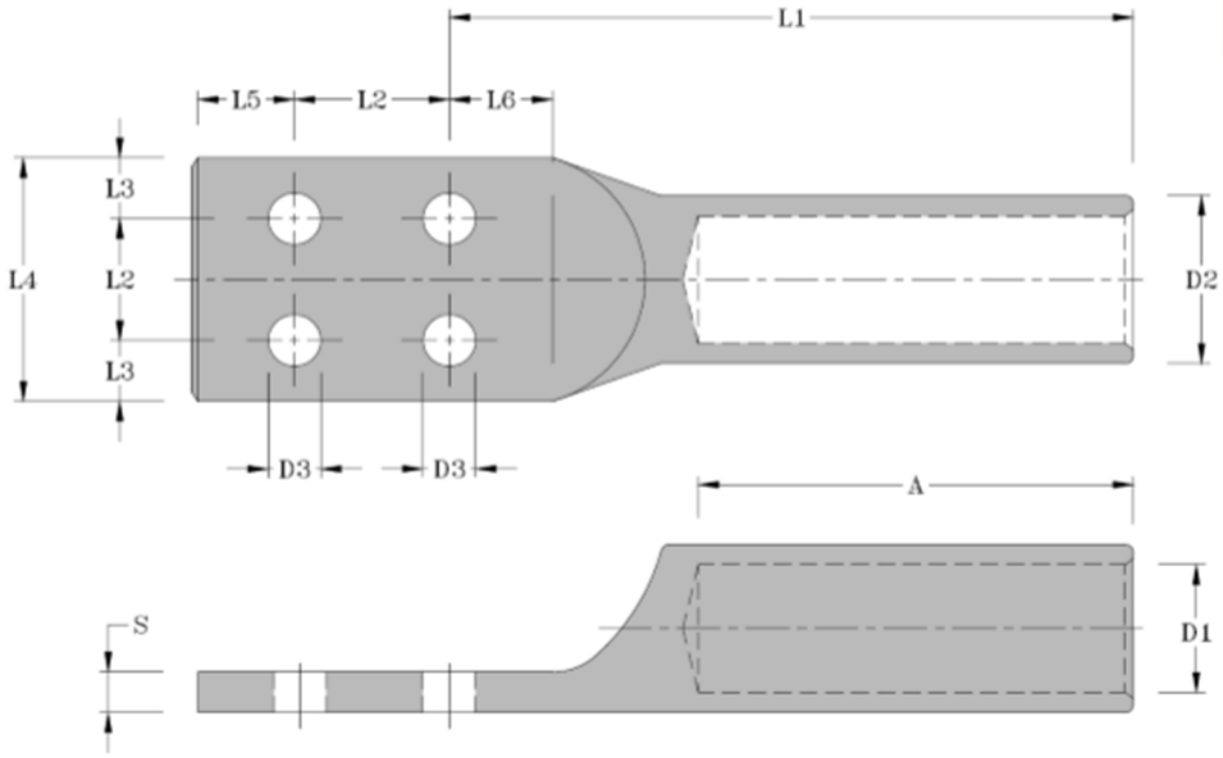


Figure 9: 4-Holes Terminal Lug for 800mm² Aluminum Conductors



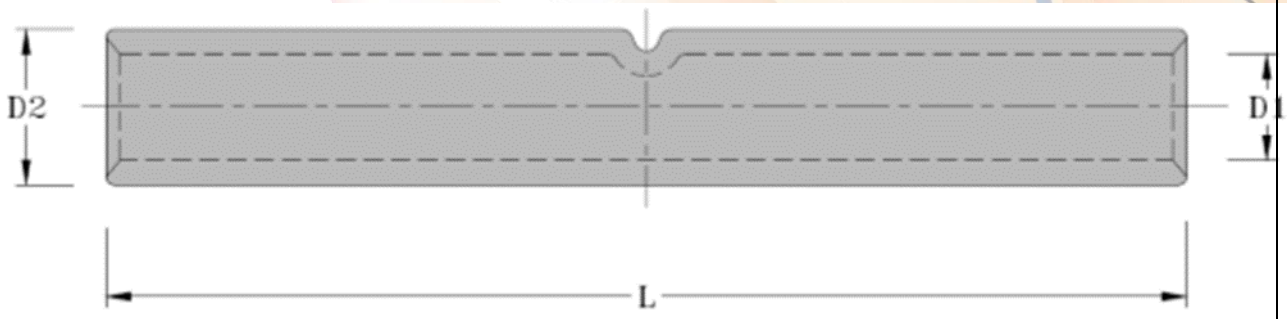
CONDUCTOR SIZE, mm^2	MAT'L	BOLT SIZE	DIMENSIONS, mm									
			A	B	C1	C2	D1	D2	D3	L1	L2	S
185	Copper	M12	40	37	16	16	19	25.5	14.2	82	44.5	6
240	Copper	M12	40	42	16	16	21.5	29	14.2	92	44.5	6.5
300	Copper	M12	50	48	16	16	24.5	32	14.2	100	44.5	7

Figure 10: 2-Holes NEMA-Pad Terminal Lugs for National Grid SA Substations



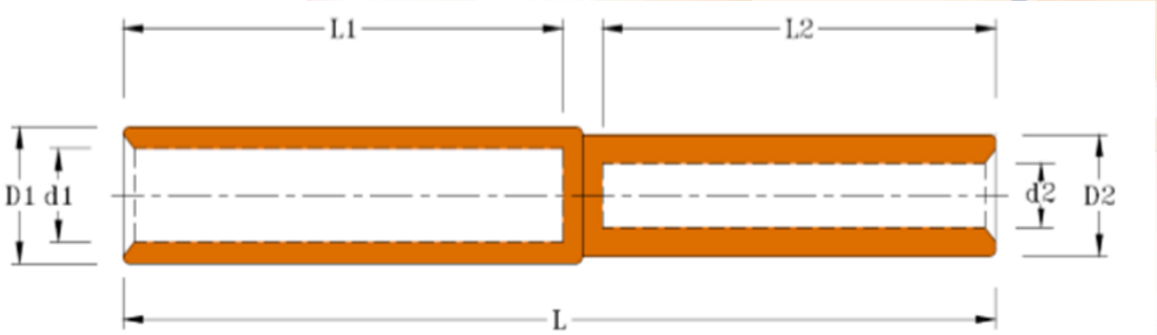
CONDUCTOR SIZE, mm^2	MAT'L	BOLT SIZE	DIMENSIONS, mm										
			A	D1	D2	D3	L1	L2	L3	L4	L5	L6	S
500	Copper	M12	70	31	42	14.3	125	44.5	16	70	16	16	10

Figure 11: 4-Holes NEMA-Pad Terminal Lug for National Grid SA Substations



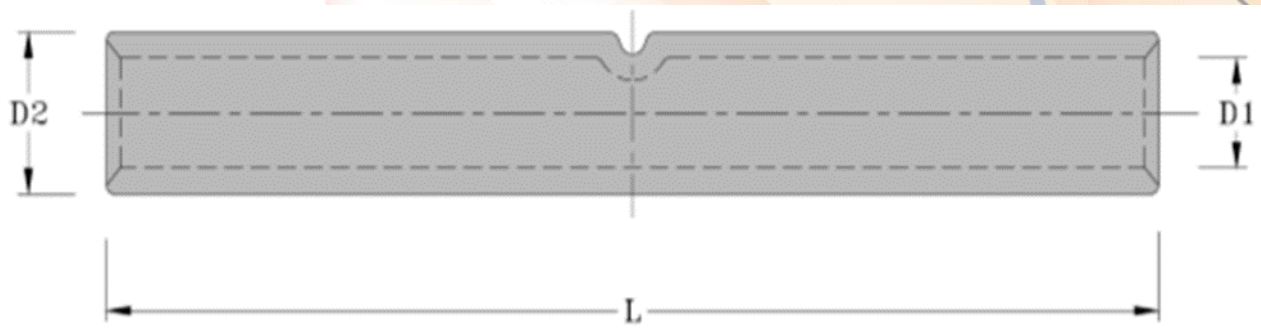
SECTION, mm²		**DIMENSIONS, mm**		
Copper	Copper	D1	D2	L
500	500	31	42	160
300	300	24.5	32	100
240	240	21.5	29	90
185	185	19	25.5	85
35	35	8.2	12.5	50

Figure 12: Sleeve Connectors for Copper-to-Copper Conductors



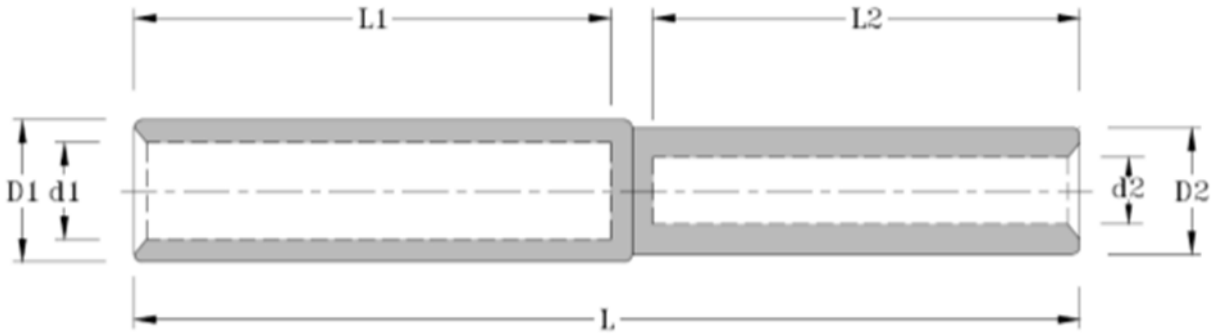
SECTION, mm^2		DIMENSIONS, mm						
Copper	**Copper**	D1	d1	L1	D2	d2	L2	L
300	185	32	24.5	60	25.5	19	45	115

Figure 13: Reduction Sleeve Connectors for Copper-to-Copper Conductors



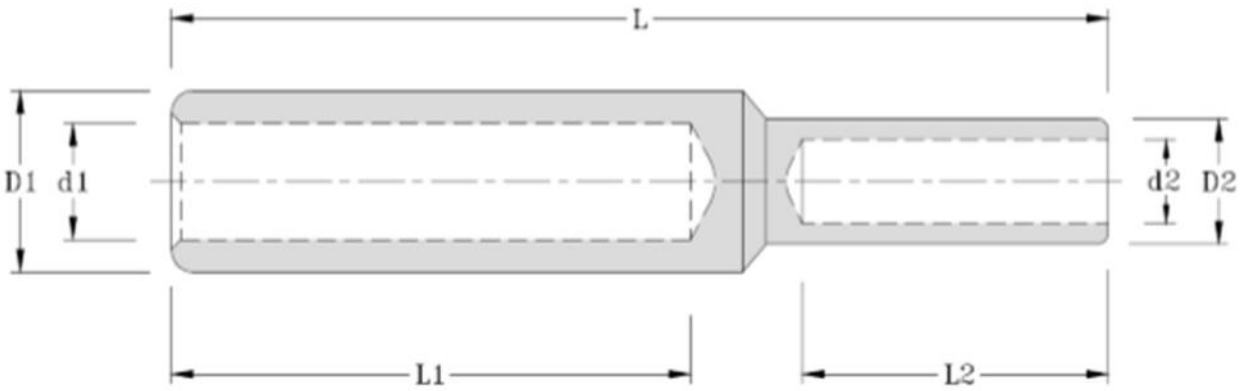
SECTION, mm^2		DIMENSIONS, mm		
Aluminum	**Aluminum**	D1	D2	L
500	500	29	44	210
400	400	26	38.5	210
300	300	23.3	34	145
185	185	18.3	28.5	125
70	70	11.2	18.5	105
35	35	8	14	85

Figure 14: Sleeve Connectors for Aluminum-to-Aluminum Conductors



SECTION, mm^2		DIMENSIONS, mm						
Aluminum	**Aluminum**	D1	d1	L1	D2	d2	L2	L
500	300	44	29	105	34	23.3	73	215
300	150	34	23.3	73	25	16.3	63	155
185	120	28.5	18.3	63	23	14.7	56	130
185	95	28.5	18.3	63	22	13.2	56	130
120	70	23	14.7	56	18.5	11.2	53	120
95	70	22	13.2	56	18.5	11.2	53	110

Figure 15: Reduction Sleeve Connectors for Aluminum-to-Aluminum Conductors



SECTION, mm^2 Aluminum	Copper	DIMENSIONS, mm						
		D1	d1	L1	D2	d2	L2	L
500	300	44	29	120	32	24.5	60	215
500	185	44	29	120	25.5	19	45	195
400	240	38.5	26	116	29	21.5	50	195
300	300	34	23.3	80	32	24.5	60	150
300	185	34	23.3	80	25.5	19	45	145
300	120	34	23.3	80	21	15.5	40	135
185	120	28.5	18.3	70	21	15.5	40	130
150	95	25	16.3	70	19	13.5	40	120
120	70	23	14.7	60	16.5	11.5	35	110
95	70	22	13.2	60	16.5	11.5	35	100
70	35	18.5	11.2	60	12.5	8.2	25	95
50	35	16	9.8	50	12.5	8.2	25	90
35	16	14	8	50	8.5	5.5	25	90

Figure 16: Aluminum Reduction Sleeve Connectors for Bi-Metallic Use for Aluminum-to-Copper Conductors