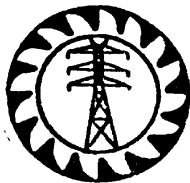


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**CEB
STANDARD**

**COMPRESSION CONNECTORS & TERMINATIONS FOR
OVERHEAD LINE CONDUCTORS**



**CEYLON ELECTRICITY BOARD
SRI LANKA**

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SPECIFICATION FOR COMPRESSION CONNECTORS AND TERMINATIONS FOR OVERHEAD LINE CONDUCTORS

1.0 SCOPE

This specification covers the design, manufacture and testing of compression Connectors and Terminations for overhead line bare conductors and insulated cables.

2.0 SYSTEM PARAMETERS

a.	Nominal Voltage	33 kV	11 kV	400/230 V
b.	System highest Voltage	36 kV	12 kV	400 V
c.	System frequency	50 Hz	50 Hz	50 Hz
d.	System fault levels	13.1 kA	13.1 kA	25 kA
e.	Method of Earthing	Non Effective Earthing	Effective Earthing	Effective Earthing

3.0 SERVICE CONDITIONS

a.	Annual average ambient temperature	30°C
b.	Maximum ambient temperature	40°C
c.	Maximum relative humidity	90%
d.	Environmental conditions	Humid tropical climate with polluted atmosphere.
e.	Operational altitude	From M.S.L. to 1900 meters above M.S.L.

4.0 APPLICABLE STANDARDS

The Compression Connectors and Terminations conform to the latest editions of the standards specified below and amendments thereof.

a)	BS	3288	(1973)	-	Insulators and Cable fittings for O/H power lines.
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- b) BS 4579 (1976) - Performance of compression joints in electric cables and wire connectors
- c) BS 1977 (1976) - High conductivity copper tubes for electrical purposes
- d) BS 1474 (1987) - Wrought Al and Al alloys, bars, extruded round tubes and sections
- e) BS 729 (1971) - Hot dip galvanized coatings on Iron & Steel articles.
- f) BSEN 20273 (1992) - Fasteners. Clearance holes for bolts and screws.

The Compression Connectors and Terminations specified shall be compatible with overhead Conductor and Insulated Cables manufactured to the following standards.

- g) BS 215 (1970) - All Aluminium Conductors and Aluminium Conductors Steel Reinforced.
- h) BS 3242 (1970) - Aluminium Alloy Stranded Conductors for overhead power transmission.
- i) BS 6346 (1989) - PVC Insulated Cables for electricity supply.
- j) IEC 502 (1994) - Extruded solid dielectric insulated power cables.

5.0 MATERIAL REQUIREMENT & WORKMANSHIP

5.1 Material

The Aluminium /Aluminium Alloy /Copper Compression Connectors and terminations shall be of high strength and high conductivity aluminium / aluminium alloy / copper.

In the case of Bi-metallic Connectors, all Copper Components or Parts shall be high conductivity copper or high copper content alloy.

The Components shall be properly proportioned to minimize stress concentration, corrosion and deterioration by galvanic action.

5.2 Oxide Inhibiting Grease/Compound

The internal faces of aluminium fittings shall be coated with Oxide Inhibiting Grease/Compound to improve electrical contact and ensure maximum electrical performance of fittings.

In the case of two part fittings i.e. those with separate aluminium and steel tube where this is impracticable adequate means shall be taken to protect the fitting from corrosion. The quantity of grease shall be sufficient when used on smallest conductor for which it is designed and tube ends should be protectively capped to prevent spoilage and spillage of the grease.

The Grease/Compound shall contain suspended particles to penetrate the oxide film present on aluminium surfaces and shall ensure maximum electrical performance of compression fittings.

Full details of the type of Grease/Compound used, and documents in proof of tests carried out for compatibility shall be furnished.

5.3 Workmanship

High quality Workmanship shall be maintained in the process of manufacture of Compression Connectors and Terminations.

They shall be free from sharp edges, burs and swarf. The contact surface of the Compression Connectors shall be uniform to provide effective contact with the conductors.

6.0 TECHNICAL REQUIREMENTS

6.1 General

The Compression Connectors and Terminations for conductors up to 100mm² shall be capable of being compressed with a standard hand operated mechanical crimping tool.

The Compression Connectors and Terminations for conductors above 100mm² Shall be capable of being compressed with a standard hand operated hydraulic "G" type head compression tool.

The inside of each aluminium tube and the internal faces of other aluminium fittings shall be coated with oxide inhibiting grease to improve electrical contact as stipulated in Clause 5.2.

The design of Bimetallic Fittings shall be such as to eliminate any effect arising from galvanic corrosion, which impairs the performance of the fittings.

Tubular type Connectors and Terminations shall have an internal chamfer to facilitate easy entry of the conductor.

The Connectors and Terminations shall be suitable to accommodate conductors of equal and unequal sizes as indicated in the Schedule of Prices.

The area of the Compression Connectors and Terminations shall be such that;

- a) the current carrying capacity of the same shall not be less than that of the conductor

- b) the temperature rise of the connectors and terminations shall not be more than that of the main conductor.

The dies to be used for Compression Connectors and Terminations shall be compatible with the Burndy type.

6.2 The Non Tension Compression Connectors for AAC, AAAC and ACSR

The Compression type Non Tension Jointing Sleeves / Terminals shall comply with the relevant Standards specified and shall be suitable for use with conductors operating at a temperature of 65EC.

The Non Tension Compression Connectors shall be made of Aluminium/Aluminium Alloy and shall be of the types stipulated below.

6.2.1 Non Tension Jumper Connector (Jointing Sleeve)

The Non Tension Jumper Connector (Jointing Sleeve) shall be of the tubular type and suitable for jointing two ends of the jumper conductors.

It shall be designed to withstand jumper loop tensile and vibration stresses.

It shall correctly accommodate the conductors indicated in the schedule of prices and shall be provided with a center stop "indent" for correct positioning of conductor before compression.

The conductor type, size and "Across Flat Dimension" of the Die to be used is given in Table - 1 Annex A. The number of crimps shall not be less than four.

6.2.2 Non Tension Jumper Terminal (Palm Type)

The Non Tension Jumper Terminal (Palm type) shall be suitable for making jumper connection (using bolts) between the Full Tension Dead-end Assemblies stipulated in Clause 6.3.2 below or for making bolted connection between two ends of the jumper conductors, to facilitate disconnection whenever required.

The palm shall have two holes. The hole near the barrel shall be round and the other shall be slotted. The spacing between hole centers shall be 44mm. The hole diameter shall be 14mm and the minimum slotted hole length shall be 20mm.

It shall be designed to withstand jumper loop tensile and vibration stresses.

The conductor type, size and "Across Flat Dimension" of the Die to be used are given in Table - 1 Annex A. The number of crimps shall not be less than two.

Galvanized steel bolts and nuts shall also be provided with the jumper terminals as given below;

- a) A single bolt and nut shall be provided for non tension jumper terminals for making bolted connection between two ends of the jumper conductors.
- b) Two bolts and nuts shall be supplied for making jumper connection between the Full Tension Dead-end Assemblies stipulated in Clause 6.3.2

6.2.3 Line Tap " H Type" for Main Line Connection

It shall be "H" shaped Aluminium Compression Connector suitable for making main line non tension jumper connection and tee off connections.

It shall be of one piece type, suitable to accommodate conductors of equal and unequal sizes as indicated in the Schedule of Prices.

The die to be used shall be "O" Type or "D" Type or "N" type depending on the conductor size. The conductor type, size, type of tool (Mechanical/Hydraulic), Die type and number of crimps are given in Table - 2 Annex B.

6.2.4 Line Tap "H Type" for Service Connection A/AI

It shall be H shaped Aluminium Compression Connector suitable for connecting the aluminium stranded service conductor to the main line AAC Conductor and shall be able to accommodate conductors of sizes indicated below.

The area of the line tap shall be such that the current carrying capacity of the same shall not be less than that of the service conductor and the temperature rise of the connector shall not be more than that of the service conductor.

The die to be used shall be either an "O" Type or "D3" Type depending on the conductor size. The conductor type, size, type of tool (Mechanical/Hydraulic), die type and number of crimps are given in Table - 2 Annex B.

	Main	Tap
Type a)	7/2.79mm to 7/3.40mm	7/1.35mm to 7/1.70mm
Type b)	7/4.39mm	7/1.35mm to 7/1.70mm

6.3 Full Tension Compression Connectors for AAC, AAAC and ACSR

The Full Tension Compression Connectors shall comply with the relevant Standards specified and shall be suitable for use with AAC, AAAC and ACSR operating at a temperature of 65°C.

The Compression joints when made with Full Tension Connectors shall not permit slipping or cause damage to or failure at a load less than 95% of the ultimate strength of the conductor.

The conductor type, size, breaking load and "Across Flat Dimension" of the Die to be used are given below in Table - 1 Annex A.

The number of crimps shall not be less than six.

The Full Tension Compression Connectors shall be of the types stipulated below;

6.3.1 Mid Span Joints

Mid Span Jointing Sleeve shall be of the tubular type, used to joint two conductors of same size and shall be of two types as indicated below;

a) For AAC Conductors, AAAC Conductors and ACSR Conductors having a single strand of steel wire.

Full Tension Sleeve shall be of approved alloy and a single part fitting in the case of AAC and AAAC Conductors.

All the single part fittings shall be provided with a center stop "indent" for correct positioning of Conductor before Compression.

It shall be of Single/Two part fittings (Steel and Aluminium) in the case of ACSR Conductors.

b) For ACSR having Multi Stranded Steel Wires

Tension Sleeve shall be a two part fitting of approved Aluminium and Steel for ACSR having Multi Stranded Steel Wires.

Number of crimps for steel sleeve shall not be less than six.

6.3.2 Full Tension Dead-end Assembly

The Full Tension Dead End Assembly shall be used for terminating the Conductor. It shall have an eye or clevis end to connect to the Tension Insulator Hardware conforming to IEC 120 through a socket eye and shall have a two bolt type palm to connect the Jumper Terminals as stipulated in Clause 6.2.2 above.

The palm shall have two holes and the spacing between the hole centers shall be 44mm. The hole diameter shall be 14mm.

a) For AAC Conductors, AAAC Conductors and ACSR Conductors having Single Stranded Steel Wires

The Full Tension Dead-end Joint shall be of single/two piece type.

b) For ACSR Conductors having Multi Stranded Steel Wires

The Full Tension Dead-end Assembly shall be of two piece type (Aluminium sleeve and steel sleeve)

Number of crimps for steel sleeve shall not be less than six.

6.4 Conductor Repair Sleeve for AAC, AAAC and ACSR

The Conductor Repair Sleeve shall be suitable for the application over the damaged surface of the AAC, AAAC and ACSR to be repaired.

The Conductor Repair Sleeve shall comply with the relevant standards specified and shall be suitable for use with conductor operating at a temperature of 65°C.

The Conductor Repair Sleeve offered shall be either one piece or two pieces, to suit the conductor to be repaired.

The Conductor type, size and "Across Flat Dimension" of the Die to be used is given in Table - 1 ANNEX - A.

The number of crimps shall be six or more.

6.5 Socket Connectors for insulated Stranded Copper Cables.

The Compression Socket Connectors for PVC /XLPE insulated stranded copper cable shall comply with the relevant Standard specified and suitable for terminating the cable operating at a temperature of 65°C.

The Compression Socket Connectors shall be made of high strength high conductivity annealed copper and hot dip tinned to BS 219.

It shall correctly accommodate the round, compacted / non-compacted copper cables as indicated in the schedule of prices.

A hole shall be provided in the barrel of the socket to permit quick visual inspection for proper insertion of cable before crimping and the palm shall be provided with single hole for clamping.

The conductor type, size, palm hole size "Across Flat Dimension" of the Die to be used is given in Table - 3 Annex C.

The number of crimps shall be two or more.

6.6 Compression Bi-metallic Fitting

The Compression type Bi-metallic Fittings shall comply with the relevant Standards specified and shall be suitable for use with Conductor /Cable operating at a temperature of 65°C.

The Bi-metallic Clamp shall be manufactured with Bi-metalled Alloy or where manufactured with Cu. & Al., the contact surfaces shall be effectively friction welded to prevent electrolytic corrosion.

Technical literature (in English) shall be furnished with regard to the manufacture and utilization of Bi-metallic Fittings.

6.6.1 Bi-metallic Service Clamps

The Bi-metallic Compression Service Clamps shall be used to connect Aluminium Stranded Service Conductor to Copper Main Line Conductor and shall be able to accommodate unequal combination.

The Bi-metallic Service Clamps shall comply with the relevant Standard specified and shall be suitable for use with conductors operating at a temperature of 65°C.

The Bi-metallic Service Clamps shall accommodate conductors of sizes as given below and in Schedule of Prices. The number of crimps shall be two or more.

The current carrying capacity of the Bi-metallic Service Clamps shall not be less than that of the service conductor and the temperature rise of the Clamp shall not be more than that of the main conductor.

Dies to be used shall either be an "O" Type or "D3" Type. The number of crimps shall be two or more.

Main	Tap
25mm ² to 50mm ² copper	7/1.35mm to 7/1.70mm aluminium.

6.6.2 Bi-metallic Socket Connectors for insulated Aluminium Cables.

The Compression type Bi-metallic socket connectors for PVC / XLPE insulated aluminium cables shall have an aluminium barrel and copper palm.

The barrel shall correctly accommodate the stranded/solid, circular/sector shaped; compacted /non compacted aluminium cable as indicated in the schedule of prices and the palm shall be of single bolt type.

The area of the barrel and the palm shall be such that the current carrying capacity of the bi-metallic socket connector shall not be less than that of the cable and the temperature rise shall not be more than that of the cable. The minimum number of crimps shall be two.

The conductor type, size, palm hole size "Across Flat Dimension" of the Die to be used is given in Table - 3 Annex C.

7.0 QUALITY CONTROL

Quality Assurance System conforming to ISO 9001 shall be followed in the process of manufacture of Compression Connector & terminations for Overhead Line Conductors and Insulated Cables. Bidders shall furnish documentary evidence in proof of this.

8.0 ADDITIONAL REQUIREMENTS

8.1 Identification

Compression Connectors and Fittings shall be identified with the manufacturer's identification marks and fitting references.

This marking shall also be applied to any component of the fitting where the component is separate from the fitting when dispatched by the manufacturer.

8.2 Markings

For easy identification the compression connectors and terminations shall have markings indicating the size of conductor applicable, sequence and location of the hexagonal compression indents and dies to be used.

All Compression Fittings shall be marked with the following information.

- i) The limit of compression and individual compression positions.
- ii) The end at which the compression shall be commenced.
- iii) The Conductor Type (AAAC, ACSR or AAAC), size and range of the Conductor to be compressed on both sides.
- iv) The Across Flat Dimension of the Die to be used.

These information shall be engraved or embossed on the external surface of fitting.

8.3 Packing

All Compression Clamps and Fittings shall be individually or collectively packed as appropriate and similar items shall be packed together.

The method adopted shall provide mechanical and corrosion protection to contact surfaces in transit and storage.

All packages shall be marked with the batch number or code of fitting(s) therein.

Compression connectors and terminations which are not subject to factory assembly shall be secured and packed together as complete fittings, before dispatched.

9.0 INFORMATION TO BE SUPPLIED WITH THE OFFER

The following shall be supplied with the offer.

- a) The catalogues (in English) describing the items and indicating the Model/Reference number, Code Name / Across Flat dimension of the relevant die to be used for Compression, Conductor Sizes and other relevant details.
- b) Constructional features and material used for components and relevant technical literature.
- c) Certification for Quality Assurance conforming to ISO 9001.
- d) Schedule of Particulars (Annexure - A)
- e) Dimensional Drawings of all items.

f) **Type Test Reports**

The following type test reports from a **Recognized Independent Testing Authority acceptable to Purchaser** pertaining to a manufacture of same Model/Type of Compression Connectors and Terminations shall be furnished.

1. Resistance Measurement
2. Heating-cycle Test
3. Mechanical Strength Test

- g) Certification for Quality Assurance conforming to ISO 9001.

Failure to furnish the above details will result in the offer being rejected.

10.0 SAMPLE STUDY

Three samples of each item offered shall accompany the bid to facilitate analysis and evaluation.

11.0 INSPECTION & TESTING

11.1 Inspection

The selected Bidder shall make necessary arrangements for inspection by an Engineer appointed by the Purchaser and also to carry out in his presence necessary routine/sample tests on the materials offered.

11.2 Testing (Sample/Acceptance Tests)

The following Sample /Acceptance tests (as per BS 3288 Part 1) shall be witnessed by the Purchaser.

1. Verification of Dimensions
2. Mechanical Test
3. Electrical Tests
4. Heating Cycle Test

12.0 TECHNICAL LITERATURE AND DRAWINGS

- i) Booklets / leaflets indicating the following for all items supplied shall be furnished with the items;
 - a) Technical Literature including Code/Ref. numbers of all items
 - b) Details of current carrying capacity.
 - c) Conductor sizes applicable and other relevant details.
 - d) The standards to which the items are manufactured
 - e) Dimensional Drawings.
 - f) Operational instructions
- ii) Routine Test Certificates

13.0 ANNEX

- | | | |
|---|---|-------------------------|
| A | - | Table - 1 |
| B | - | Table - 2 |
| C | - | Table - 3 |
| D | - | Schedule of Particulars |

ANNEX A

Table - 1

CONDUCTOR DATA			ACROSS FLAT DIMENSION OF THE DIE TO BE USED. (mm)	
Code Name	No. of Strand/Wire Diameter (mm)	Breaking Load (kN)	Single part Fittings	Two Part Fittings
Lady Bird (AAC)	7/2.79	7.4	14.0	--
Fly (AAC)	7/3.40	10.5	17.3	--
Wasp (AAC)	7/4.39	16.8	21.0	--
Weasel (ACSR)	7/2.59	11.4	14.0	14.0 (Alu) 7.2 (Steel)
Racoon (ACSR)	7/4.09	27.4	21.0	21.0 (Alu) 12.0 (Steel)
Lynx (ACSR)	37/2.79	82.7	-	29.0 (Alu) 16.0 (Steel)
AAAC	7/2.67	12.7	12.0	--
AAAC	7/4.25	30.8	17.3	--
AAAC	19/3.66	60.33	26.0	--

ANNEX B

Table - 2

CONDUCTOR DATA		TOOL, DIE SET NO. AND NO. OF CRIMPS		
Main	Tap (mm)	Tool	Die Set No.	No. of Crimps
7/2.79 - 7/3.40	7/1.35 - 7/1.70	Mechanical/Hydraulic	"O" Die	Mec - 4 Hyd - 2
7/4.39	7/1.35 - 7/1.70	Mechanical/Hydraulic	"D3" Die	Mec - 4 Hyd - 2
7/2.59 - 7/3.40	7/2.59 - 7/3.40	Mechanical/Hydraulic	"O" Die	Mec - 4 Hyd - 2
7/4.09 - 7/4.39	7/2.59 - 7/3.40	Mechanical/Hydraulic	"D3" Die	Mec - 4 Hyd - 2
7/4.09 - 7/4.39	7/4.09 - 7/4.39	Mechanical/Hydraulic	"D3" Die	Mec - 4 Hyd - 2
37/2.79 - 19/3.66	7/4.09 - 7/4.39	Hydraulic	"N" Die	3
37/2.79 - 19/3.66	37/2.79 - 19/3.66	Hydraulic	"N" Die	3

ANNEX - C

Table - 3

Nominal Cross Sectional Area of the Cable (Aluminium/Copper) (mm ²)	Hole Size of the Palm (mm)	Across Flat Dimension of the Die to be used (mm)	
		Copper	Aluminium
16	10.0	6.6	9.0
25	12.0	7.6	9.0
35	12.0	9.0	10.0
50	14.0	10.0	12.0
70	14.0	12.0	14.0
95	14.0	14.0	17.0
150	14.0	17.0	21.5
185	14.0	19.0	21.5
240	14.0	21.5	28.0
300	14.0	23.0	28.0

ANNEX - D**SCHEDULE OF PARTICULARS**

(This schedule shall be duly filled by the Manufacturer))

- | | | |
|----|---|---|
| a) | Name of Item | - |
| b) | Name of Manufacturer | - |
| c) | Country of Manufacture | - |
| d) | Applicable Standards | - |
| e) | Current carrying capacity | - |
| f) | Temperature rise at rated current. | - |
| g) | Whether the following Reports furnished. | |
| | i) Type Test | - |
| | Quality Assurance Certification | - |
| | conforming to ISO 9001. | - |
| h) | Marking details (cable sizes, No. crimps etc.) | - |
| i) | Method of fusion (for bi-metallic fitting only) | - |
| j) | Whether documentary evidence to prove the ISO 9001 Certification furnished. | - |

I we certify that the above data are true and correct.

 Seal and Signature of the Bidder /Date

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