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**CEB
SPECIFICATION**

**ALL ALUMINIUM CONDUCTORS
(AAC)**



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SPECIFICATION FOR ALL ALUMINIUM CONDUCTORS (AAC)

1.0 SCOPE

This specification covers the general requirements of the manufacture and testing of All Aluminium Conductors (AAC) from Aluminium Re-draw Rods, to be used in overhead power distribution systems.

2.0 SYSTEM PARAMETERS

(a)	Nominal voltage	400/230 V – 3 phase and neutral
(b)	System highest voltage	440/250 V – 3 phase and neutral
(c)	System frequency	50 Hz
(d)	Method of earthing	Solid earthed neutral at sub stations
(e)	System faults level	25kA rms

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 highly polluted atmosphere
(e)	Operational altitude	From M.S.L. to 1900 m above M.S.L.

4.0 APPLICABLE STANDARDS

The conductors fabricated shall be in accordance with the latest edition of the standards specified below and the amendments thereof.

(a)	BS 215 - Part 1 (1970)	All Aluminium Conductors
(b)	BS 2627 (1970)	Wrought Aluminium for Electrical purposes, Wire
(c)	ASTM B 233 - 97	Standard specification for Aluminium 1350 Drawing Stock for electrical purposes

The requirements stated in this CEB specification supersede the requirements in the above standards.

5.0 BASIC FEATURES

5.1 Design of Wire

The Aluminium wires used in the manufacture of AAC shall conform to BS 2627.

The wire shall be of uniform quality, circular cross section, clean, smooth and free from harmful defects, splinter irregularities and brittle places.

5.2 Joints in the wires of conductors

5.2.1 Conductors containing seven wires

There shall be no joints in any wire of a stranded conductor containing seven wires, except those made in the base rod or wire before final drawing.

5.2.2 Conductors containing more than seven wires

In stranded conductors containing more than seven wires, joints in individual wires are permitted in addition to those made in the base rod or wire before final drawing, provided the following requirements are met;

- (a) The joints shall not be less than 15m apart in the complete stranded conductor.
- (b) The joints shall be made by resistance or cold-pressure butt-welding.
- (c) The joints made by resistance butt-welding shall, subsequent to welding, be annealed over a distance of at least 200mm on each side of the joint.

5.3 Construction (Stranding)

The fabrication and physical data of the complete conductor shall be in accordance with the Annex A and BS 215 (Part I).

The outermost layer of the Conductor shall be stranded with a right-hand lay and it shall be smooth and free from imperfections.

5.4 Material - Aluminium Re-draw Rods

Aluminium Re-draw Rods used for the manufacture of All Aluminium Conductor (AAC) shall conform to BS 2627 and ASTM B 233-97.

The quality of Aluminium Re-draw Rods used for the manufacture of AAC Conductor shall be as stipulated below

- I. The purity of the aluminium re-draw rods shall not be less than 99.5% and the percentage composition of other elements shall not be more than the values stipulated below.

Element	Composition % Max.
(a) Silicon	0.10
(b) Iron	0.40
(c) Copper	0.05
(d) Manganese	0.01
(e) Chromium	0.01
(f) Zinc	0.05
(g) Boron	0.05
(h) Gallium	0.03
(i) Vanadium plus Titanium total	0.02
(j) Other Elements each	0.03
(k) Other Elements total	0.10

- II. The maximum electrical resistivity of the Aluminium Re-draw Rods shall be $0.028080 \Omega \cdot \text{mm}^2/\text{m}$
- III. The tensile strength of Aluminium Re-draw rods shall be 108 MPa to 138 MPa

Quality assurance certificates conforming to ISO 9001:2008 shall be followed in the manufacture of Aluminium Re-draw Rods. The bidders shall furnish documentary evidence that the Aluminium Re-draw Rod manufacturers have obtained ISO 9001:2008 certifications.

Offers of bidders who fail to furnish the proof of ISO 9001:2008 certifications for the manufacturer of Aluminium Re-draw Rods will be rejected.

5.5 Workmanship

The conductors shall be cleaned and free of imperfections, such as pipes, laps, cracks, kinks, bends, twists, seems, excessive grease and other injurious defects.

Higher quality of work shall be maintained in drawing the wire and fabrication of the conductors.

Due precautions shall be taken by the manufacturer to prevent the Aluminium Re-draw Rods or Aluminium conductors making contact with Copper conductors, Copper parts or Copper residues during the process of re-drawing, stranding and storage.

All machines and equipment used for this purpose of re-drawing/stranding shall be properly cleaned and free from any Copper residues.

6.0 ADDITIONAL REQUIREMENTS

6.1 Packing

- I. The All Aluminium Conductor shall be supplied in non-returnable wooden /steel drums. The AAC shall be supplied in continuous length per drum as given in the Annex A.
- II. Drums shall be stoutly constructed of good quality timber or steel and clearly marked with the length and type of conductor in a manner not easily removable. Drums shall be securely battened around the perimeter and shall be lined with approved impervious material to prevent contact between the contents and both the drum itself and any chemicals with which the drum has been treated. Drums shall be suitable for rolling on the flanges without causing damage to the conductor and the direction of rolling shall be clearly shown.
- III. All timber drums and battens shall be protected from deterioration by termite or fungus attack by an approved impregnation treatment at the works before despatch. Such substance shall not be harmful to the conductor.
- IV. All drums shall have suitable spindle holes and the holes shall be stoutly reinforced with steel plates.
- V. The exposed end of the conductor in each drum shall be crimp-sealed and clamped to the drum.

6.2 Labelling (Marking)

Each drum shall be labelled with clear stencil on both sides of the drum with the following.

- (a) CEYLON ELECTRICITY BOARD, TENDER NO :
- (b) Manufacturer's name.
- (c) Direction of rolling.
- (d) Lifting Instructions and limitations.

The letters shall not be less than 75 mm of height and the ink used shall be water-proof. An aluminium name plate shall be fixed to each drum clearly showing the following.

- (a) Serial No. (The serial numbers shall be from 001 onwards).
- (b) Conductor type, material and stranding
- (c) Length of the conductor
- (d) Net Weight
- (e) Gross Weight
- (f) Manufacturer's batch number.
- (g) Winding date
- (h) Approximate Measurements of the drum

7.0 INFORMATION TO BE SUPPLIED WITH THE OFFER

The following information shall be furnished for each size of Aluminium Conductor.

- (a) The following particulars for the aluminium wire used for the fabrication of AAC conductor.
 - I. Breaking load
 - II. Modulus of elasticity
 - III. Coefficient of linear thermal expansion.
- (b) Electrical characteristics including d.c. resistance value at 20°C, co-efficient of variation of resistance.
- (c) Drum details
- (d) ISO 9001:2008 certification as per clauses 5.4 above.
- (e) Certificates of type tests, for the following, carried out in accordance with the specified standard, by a recognised independent testing authority acceptable to the purchaser.
 - 1. Aluminium RE-draw Rods
 - a. Tensile test.
 - b. Determination of chemical composition and purity.
 - c. Temper test.
 - d. Electrical resistivity test.
 - 2. Aluminium wires
 - a. Dimension Tests.
 - b. Tensile test.
 - c. Wrapping test.
 - d. Resistivity test.

8.0 SAMPLE STUDY

The sample length of five (5) metres of All Aluminium Conductor offered shall be furnished with the offer by the bidder to facilitate analysis and evaluation of bid

If the size of the conductor specified in this bid is not available with the manufacturer at the time of submitting samples, the manufacturer may submit a sample closest to the size of the conductor specified.

The grade of the Aluminium of the sample shall be same as specified. The manufacturer shall indicate clearly on the sample, the code name and the physical characteristics of the conductor sample.

9.0 INSPECTION & TESTING

9.1 Inspection

The selected bidder shall make arrangements for inspection by an Engineer appointed by the purchaser during manufacture and before despatch and also to carry out in his presence necessary sample and routine tests of the materials offered.

9.2 Routine Tests

The following tests conforming to BS 2627 and BS 215 (Part 1) shall be witnessed by the authorised representative of the CEB.

- (a) Tensile Test
- (b) Wrapping Test
- (c) Resistivity Test

10.0 ANNEX

Annex A - Guaranteed Schedule of Particulars - All Aluminium Conductors.

Annex B - Schedule of Particulars - To be filled by the Bidders.

Annex C - Price Variation. - The Bidders shall forward their offers on the basis of the Price Variation stipulated in Annex C.

ANNEX A

**SCHEDULE OF PARTICULARS
All Aluminium Conductors**

Conductor Code	Nominal Area of Complete Conductor mm²	No. & Diameter of Wires mm	Overall Diameter of Conductor mm	Approx. mass of Conductor kg/km	Calculated D.C. Resistance at 20°C ohm/km	Calculated Breaking kN	Weight of Conductor per Drum kg
Lady Bird	-	7/2.79	8.4	117.9	0.672	7.3	290 - 310
Fly	60	7/3.40	10.2	175.3	0.452	10.5	290 - 310
Wasp	100	7/4.39	13.2	292.3	0.271	16.9	290 - 310
Hornet	150	19/3.25	16.3	434.1	0.183	25.3	490 - 510
Cockroach	250	19/4.22	21.1	732.2	0.108	40.9	740 - 760

ANNEX B**GUARANTEED SCHEDULE OF PARTICULARS
(To be filled by the bidder)**

(i)	Manufacturer's name and country of origin		
(ii)	ALUMINIUM WIRE		
	(a) Diameter	mm	
	(b) Resistivity at 20°C	$\mu\Omega$ cm	
	(c) Coefficient of linear expansion	/°C	
	(d) Tensile strength (min.)	N/mm ²	
(iii)	ALL ALUMINIUM CONDUCTOR		
	(a) Aluminium wires	Nos	
	(b) Overall diameter	mm	
	(c) Lay ratio for Aluminium layers	Max	
		Min	
	(d) Breaking load (min.)	kN	
	(e) D.C. Resistance at 20°C	Ω /km	
	(f) Coefficient of Linear expansion	/°C	
	(g) Modulus of Elasticity	N/mm ²	
(iv)	ALUMINIUM RE_DRAW RODS (used for the manufacture Al. wire for AAC)		
	(a) Purity of Aluminium	%	
	(b) Composition of other elements		
	I. Silicon	% Max	
	II. Iron	% Max	
	III. Copper	% Max	
	IV. Manganese	% Max	
	V. Chromium	% Max	
	VI. Zinc	% Max	
	VII. Boron	% Max	
	VIII. Gallium	% Max	
	IX. Vanadium plus Titanium total	% Max	
	X. Other Elements each	% Max	
	XI. Other Elements total	% Max	
	XII. Total % of impurities shall not be more than	% Max	
	(c) Maximum electrical resistivity	Ω .mm ² /m	
	(d) Minimum tensile strength	MPa	
(v)	Whether quality assurance certification ISO 9001:2008 Furnished	Yes/No	
(vi)	TYPE TEST CERTIFICATES		
	(a) Whether the type test certificates for AAC furnished	Yes/No	
	(b) Whether the type test certificates of Aluminium re draw rods (for tensile strength, electrical resistivity and chemical	Yes/No	

	composition) from a recognized independent testing authority is furnished		
	(c) Whether the type test certificates are from a recognized independent testing authority	Yes/No	

.....
Seal and Signature of the bidder

.....
date

ANNEX C: PRICE VARIATION

The bidders shall forward their offers on the basis of the Price Variation stipulated below.

1. BASIS OF THE OFFER

- (a) Suppliers of All Aluminium Conductors are required to make their offers on the basis of a Base Price plus a Fixed Price Margin.
- (b) The Base Price shall be the Cash Seller's Midday Official Average Price of High Grade Aluminium 99.7% at London Metal Exchange (LME) in US Dollars on the day of the closing of bids or the previous working day if the day of closing of bid is a non working day at the LME.
- (c) The Fixed Price Margin (FP) shall be quoted in the currency of choice of the bidder in the case of foreign bidders and in Sri Lanka Rupees in the case of local bidders.

Accordingly FOB price for bidders offering finished conductor from outside the country for the evaluation and the ex-factory price of finished conductor offered by the local bidder for the evaluation shall be computed as;

$$(B_0 + FP) \times MT$$

Where

B_0 - Base Price which is the LME price per Metric Tonne in US Dollars on the fixed date [Clause (b)].

FP - Fixed Price Margin per Metric Tonne.

MT - Quantity of All Aluminium Conductors in Metric Tonnes

2. AWARD PRICE

The FOB Award price for bidders offering finished conductor from outside the country and the Ex-factory Award price of local bidders offering finished conductor shall be computed as;

$$(B_1 + FP) \times MT$$

Where

B_1 - Cash seller's midday official average price of Aluminium High Grade 99.7% in US Dollars per Metric tonne at the LME on the first working day immediately after the day of award.

FP - Fixed Price Margin per Metric Tonne.

MT - Quantity of All Aluminium Conductors in Metric Tonnes

Intimation of the award will be faxed/telexed to the successful bidder and or his agent in Sri Lanka.

3. CONVERSION OF CURRENCY

- (a) For the purpose of the evaluation the Price Bo in US Dollars and the Fixed Price Margin (FP) in the currency of choice of the bidder will be converted to Sri Lanka Rupees at the official Selling Exchange Rate of the Central Bank of Sri Lanka prevailing on the day of opening of bids.
- (b) The payment for the supply of finished conductor outside the country will be made to the supplier at the contract price in the currency quoted for the Fixed Price Margin (FP). The base price B1 in US Dollars will be converted to the currency of the FP at the exchange rates indicated in the bulletin of the LME applicable on the first working day immediately after the date of the award of the offer; where such exchange rate is not available for the currency of the FP in the bulletin the official Selling exchange rate at the Central Bank of Sri Lanka shall be applicable.
- (c) The payment for supply of finished conductor from within the country by local suppliers will be made in Sri Lanka Rupees. The Base Price B1 in US Dollars will be converted to Sri Lanka Rupees at the official Selling Exchange rate at the Central Bank of Sri Lanka prevailing on the first working day immediately after the date of the letter of award.