

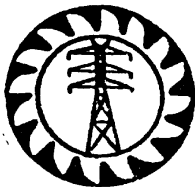
**003: 2008**

**CEB  
SPECIFICATION**

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**SPECIFICATION FOR  
ALL ALUMINIUM ALLOY  
STRANDED CONDUCTOR**



**CEYLON ELECTRICITY BOARD  
SRI LANKA**

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**Specification**

**for**

# **Specification For All Aluminium Alloy Stranded Conductor**

**CEB Specification - 003: 2008**

**CEYLON ELECTRICITY BOARD**

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# SPECIFICATION FOR ALL ALUMINIUM ALLOY STRANDED CONDUCTOR

## 1.0 SCOPE

This specification covers the manufacture, testing, supply and delivery of All Aluminium Alloy Stranded Conductors (AAAC) for the use in overhead power transmission and distribution systems.

## 2.0 SYSTEM PARAMETERS

(a)	Nominal voltage	11kV	33 kV
(b)	System highest voltage	12kV	36 kV
(c)	System frequency	50 Hz	50Hz
(d)	Neutral earthing	Effective	Non effective
(e)	System fault current	20 kA	20 kA

## 3.0 SERVICE CONDITIONS

(a)	Annual average ambient temperature	30 <sup>0</sup> C
(b)	Maximum ambient temperature	40 <sup>0</sup> C
(c)	Maximum relative humidity	90%
(d)	Environmental condition	Humid tropical climate with polluted atmosphere.
(e)	Operational altitude	From M.S.L. to 1900 meters above MSL

## 4.0 APPLICABLE STANDARDS

The items shall be in accordance with the latest editions of the standards specified below and the latest amendments thereof. However the CEB Specification shall supersede these standards in the event there is a discrepancy.

(a)	BS EN 50183: 2000	Conductors for overhead lines – Aluminium – magnesium – silicon alloy wires.
(b)	BS EN 1715 -2:1998	Aluminium and aluminium alloy – Drawing stock.
(c)	BS EN 573-3: 2007	Aluminium and aluminium alloy- Chemical composition and form of wrought products.
(d)	IEC 61089:1991	Round wire concentric lay overhead electrical stranded conductors.
(e)	BS EN 50326: 2002	Conductors for overhead lines. Characteristics of greases.
(f)	BS PD IEC 61394:1997	Overhead lines. Characteristics of greases for Aluminium, aluminium alloy and steel bare conductors.

## 5.0 MATERIAL REQUIREMENT AND WIRE PROPERTIES

### 5.1 General

The conductor shall be made of All Aluminium Alloy Wire, Type AL2 (Nominal; conductivity 52.5% of IACS) having the properties specified in BS EN 50183: 2000.

## 5.2 Materials

### 5.2.1 Aluminium Alloy

The Aluminium - Magnesium - Silicon Alloy shall be processed from the drawing stock having alloy designation EN AW-6201 (EA1 Mg0, 7Si) as per BS EN 1715 -2. The chemical composition of the designated alloy shall conform to BS EN 573 -3:) are as follows.

Element	Composition, %
Cu (Max)	0.10
Fe (Max)	0.50
Si	0.5 - 0.9
Mn ( Max)	0.03
Mg	0.6 - 0.9
Zn (Max)	0.10
Cr (Max)	0.03
B ( Max)	0.06
Other elements, each (max)	0.03
Other elements, total (max)	0.10
Al	Remainder

### 5.2.2 Grease

Grease used for additional corrosion protection shall have a dropping point of not less than 100°C.

## 5.3 Wire Properties

### 5.3.1 General

The alloy wire shall conform to BS EN 50183: 2000 in general. It shall be of uniform quality, circular cross section, clean, smooth and free from harmful defects, splinter irregularities and brittle places.

Joints in wires shall comply with Clause 9, Joints of BS EN 50183 and they may be made in the base rod or wire before final drawing.

### 5.3.2 Resistivity

The maximum allowable value of resistivity permitted of individual wire is 32.84 nΩ.m at 20°C.

### 5.3.3 The Tensile Strength and Elongation

The tensile strength and elongation shall not be less than the appropriate values given in table below.

Nominal Wire Diameter (mm)	Minimum Tensile Strength of individual wires (N/mm <sup>2</sup> )	Minimum Elongation after fracture on 250 mm (%)
1.5mm to 3.5mm	325	3.0
3.5mm to 5.0mm	315	3.0

## **6.0 MANUFACTURE AND WORKMANSHIP**

### **6.1 Manufacture**

The fabrication and physical data of the completed conductor shall be in accordance with the relevant BS Standards. All wires of the conductor shall be concentrically stranded. The outermost layer of the conductor shall be stranded with a right-hand lay and it shall be smooth and free from imperfections.

The Alloy Aluminium Strands of the Conductor shall be given a protective coating of grease during manufacture but no grease shall be applied to the finished conductor. Sufficient grease shall be applied to the inner Aluminium Alloy Strands to fill the inter-strand spaces (viz: Inner Layer Protection).

Due precaution shall be taken by the manufacturer to prevent the Aluminium Alloy Wire or All Aluminium Alloy Conductor making contact with copper conductors, copper parts, or copper residues during the process of redrawing as well as storage.

All machines and equipments used for this purpose of redrawing shall be properly cleaned, free from any copper residues.

### **6.2 Workmanship**

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

### **6.3 Joints in the wires of Conductor**

#### **6.3.1 General**

Joints may be made in the drawing stock and in wire after heat treatment but before final drawing. No joints shall be made during final drawing or in the finished wire. All joints made during the stranding operation shall be in accordance with Clause 6.3.2 and 6.3.3. They shall be free from visible defects.

#### **6.3.2 Conductors containing seven wires.**

For conductors containing seven wires, joints in the wires shall be made only by cold-pressure butt-welding. The minimum distance between any two joints in the conductor shall be 15m.

#### **6.3.3 Conductors containing more than seven wires.**

For conductors containing more than seven wires, joints in the wires shall be made by cold-pressure butt-welding or electric butt-welding. Joints made by electric butt-welding shall be annealed after welding over a distance of at least 250 mm on each side of the joint. The minimum distance between any two joints in the conductor shall be 15m.

## **7.0 QUALITY ASSURANCE**

The Manufacturer shall possess ISO 9001:2000 Quality Assurance Certification for the manufacture of All Aluminium Alloy Stranded Conductor for the plant where the manufacture of All Aluminium Alloy Stranded Conductor is done. The bidder shall furnish a copy of the ISO Certificate certified as true copy of the original by the manufacturer, along with the offer.

## **8.0 MANUFACTURING EXPERIENCE**

Manufacturer should have a minimum of 05 years experience of the manufacture of All Aluminium Alloy Stranded Conductor and the manufacturer should have supplied the same to

minimum of five Electricity Utilities internationally during last 05 years. The manufacturer shall submit proof documents such as supply records, the name of the purchasers, quantity sold, and the year of sale.

## **9.0 ADDITIONAL REQUIREMENTS**

### **9.1 Supply**

The conductor shall be supplied in continuous length per drum as given in the Annex A.

### **9.2 Packing**

The finished conductor shall be wound on the drum and the exposed end of the conductor in each drum shall be crimp-sealed. The drum and battens shall be made of well seasoned wood that is treated to prevent deterioration by termites or fungus attack. The chemical used for treating the wood shall not be harmful to the conductor. Drums shall be lined with an impervious material to prevent direct contact of the conductor with the drum.

External flange diameter shall be such that the distance between the outer edge of the flange and the packed conductor shall be not less than 75 mm. Drums shall be suitable for rolling on the flanges without causing damage to the conductor and the direction of rolling shall be clearly shown.

All drums shall have spindle hole of adequate diameter and shall be reinforced with steel plates and by bolts and shall be designed for mounting on a horizontal axle for laying out the conductor. The hub and the flanges of the drum shall be securely fastened together with reinforcing by bolts & nuts.

### **9.3 Labeling**

Each Drum shall be labelled with clear stencil, which shall withstand extreme weather conditions. The following are the data shall be included in each drum..

- a) CEYLON ELECTRICITY BOARD Contract No. ....
- b) Net Weight
- c) Gross Weight
- d) Total length of the Conductor
- e) Conductor material/and stranding
- f) Manufacture's name
- g) Manufacture's Batch Number
- h) Manufacture's Drum Number
- i) Stranding date
- j) Approximate Measurements
- k) Direction of rolling
- l) Lifting instructions and limitations

## **10.0 INFORMATION TO BE SUPPLIED WITH THE OFFER.**

The following information shall be furnished with the offer.

- (a) Chemical composition of All Aluminium Alloy conductor specified in the price schedule.
- (b) Constructional features and the dimensional drawing of the conductor.
- (c) Complete mechanical properties including breaking load, modulus of elasticity, coefficient of linear thermal expansion.
- (d) Electrical characteristics including D.C. resistance value at 20°C, co-efficient of variation of resistance.
- (e) Technical details of the grease used.
- (f) Type Test Reports

The following test reports, performance curves etc. based on the Type tests conforming to the relevant Standard shall be supplied along with the offer. The test certificate referred to shall be issued from an **independent testing authority acceptable to the purchaser.**

- (i) Joints in aluminium wires
  - (ii) Stress-strain curves
  - (iii) Breaking strength of conductor
- (g) Plant facilities, Annual Reports of two consecutive years within last five years or the audited Financial Statements of two consecutive years within last 05 years that indicates capital invested, turnover, profit etc. shall also be submitted.

**Failure to furnish the particulars requested in the Clause 10.0 and sample as stipulated in clause 11.0 will result in the offer being rejected.**

## **11.0 SAMPLE**

A sample piece of 3.5 Meter length of All Aluminium Alloy Conductor specified in the price schedule shall be supplied with the offer. The Bidder's identity shall be punched or marked with indelible ink on the sample conductors.

## **12.0 INSPECTION AND TESTING**

### **12.1 Inspection**

The manufacturer shall be responsible for the performance of all inspection and test requirements specified in this specification, at his own cost. The manufacturer shall provide all reasonable facilities to the purchaser's representative in the performance of tests and to satisfy himself that the material conforms to this specification.

Expenditure incurred by the Purchaser in repeating tests as indicated below shall be borne by the Supplier.

### **12.2 Routine Test**

The following tests shall be carried out by the manufacturer during inspection of the finished goods.

#### **(a) On wire before Stranding**

- I. Tensile & Elongation Tests
- II. Wrapping Tests
- III. Resistivity Test

#### **(b) On the Conductor**

- I. Cross Sectional Area
- II. Overall diameter
- III. Linear density - mass per unit lengths
- IV. Surface conditions
- V. Lay Ratio and direction of lay

#### **(c) Selection of Test Samples**

Samples for the tests specified in Clause 12.2 shall be taken at random from the outer end of 10% of the drums of conductor included in any one consignment/shipment.



### **12.3 Acceptance or Rejection**

Failure of a test specimen to comply with any one of the requirements of this Standard shall constitute grounds for rejection of the lot represented by the specimen.

If any lot is so rejected the manufacturer shall have the right to test, only once, all Individual drums of conductors in the lot and submit those which meet the requirement for acceptance for repeat testing by the Purchaser. The Purchaser shall then repeat the tests selecting a sample of 10% from the batch of drums selected by the Manufacturer.

### **12.4 Place of Testing**

All tests may be carried out at the manufacturer's plant if suitable facilities are available. Where such test facilities are not available at the manufacturer's plant, tests may be carried out at a laboratory approved by the Purchaser.

## **13.0 ANNEX**

- A - Particulars of All Aluminium Alloy Conductors
- B - Schedule of Guaranteed Technical Particulars for Alloy Conductor- to be filled by the Bidder
- C - Price Variation - Bidders shall submit their offer based on the Price Variation Formula. Failure to do so will result in the offer being rejected.

## ANNEX -A

## PARTICULARS OF ALL ALUMINIUM ALLOY CONDUCTORS

Description	UNIT	Conductor		
		CEDAR	WILLOW	ELM
Calculated area of complete conductor	mm <sup>2</sup>	35.5	89.8	<b>211</b>
No. & Diameter of wires	No/mm	7/2.54	7/4.04	<b>19/3.76</b>
Overall diameter of conductor	mm	7.62	12.12	<b>18.80</b>
Approximate of weight conductor	kg /km	97.0	246.0	<b>580.0</b>
Calculated DC resistance at 20°C	Ohm/km	0.928	0.366	<b>0.156</b>
Calculated breaking load	kN	9.94	25.10	<b>59.10</b>
Length of conductor per drum	km	3	1.2	<b>0.6</b>

## ANNEX – B

**SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS**

(To be filled by the Bidder for each type of conductor)

	Description	Units	Data to be filled
1	Name of Manufacturer		
2	Country of Origin		
3	Name of conductor		
4	Applicable Standard		
5	(a) Nominal cross section area of the conductor	mm <sup>2</sup>	
	(b) Actual area of AAAC	mm <sup>2</sup>	
	(c) Overall diameter of the conductor	mm	
	(d) Number of strands and diameter of a strand	No./ mm	
	(e) Guaranteed Ultimate Breaking Load of conductor	kN	
	(f) Finished Conductor weight per km	Kg	
6	Individual wire before stranding		
	(a) Tensile Breaking Stress	N/ mm <sup>2</sup>	
	(b) Elongation on 250mm length on breaking	%	
	(c) Equivalent Modulus of Elasticity (final)	N/mm <sup>2</sup>	
	(d) Equivalent Co-efficient of linear expansion	per °Cx 10 <sup>-6</sup>	
	(e) Maximum calculated resistance per km at 20 deg.°C		
7	Chemical composition of the Aluminium alloy		
	(a) Cu (Max)		
	(b) Fe (Max)		
	(c) Si		
	(d) Mn ( Max)		
	(e) Mg		
	(f) Zn (Max)		
	(g) Cr (Max)		
	(h) B ( Max)		
	(i) Other elements, each (max)		
	(j) Other elements, total (max)		
	(k) Al		
8	(a) Type of inter strand Grease		
	(b) Minimum drop point Temperature of inter-strand grease	°C	
9	(a) Standard length of conductor on drum		
	(b) Weight of complete drum plus conductor		
	(c) Diameter of drum		
10	Weather the manufacturer certified by ISO 9001:2000	Yes/No	
11	Weather Type test reports submitted	Yes/No	

Signature &amp; Seal 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 Alloy wires 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 Aluminium High Grade 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.
- (d) Accordingly FOB Price of AAAC Conductor of foreign Bidders and ex-factory price of AAAC Conductor of local Bidders for the purpose of evaluation shall be computed as;

$$(B_0 \times MT) US_0 + (FP \times MT) CC_0$$

$B_0$  Base Price which is the Cash seller's midday official average price of Aluminium High Grade 99.7%, in US Dollars per Metric tone at the LME on the fixed date [Clause (1 b)].

FP Fixed Price Margin per Metric Tonne of AAAC in the currency choice

MT Quantity of AAAC required in Metric Ton.

$CC_0$  Currency Conversion rate from the currency of choice of the Bidder to Sri Lanka Rs. prevailing on the date of Bid opening.

$US_0$  Currency Conversion rate from the US Dollars to Sri Lanka Rs. prevailing on the date of Bid opening.

**2. FOB PRICE FOR AWARD**

- (a) The FOB award price for Foreign Bidders and ex-factory award price for Local shall be computed as;

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

Where

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

FP Fixed Price Margin per Metric Tonne of AAAC in the currency of choice.

MT Quantity of AAAC offered in Metric Tonnes

- (b) Intimation of the award will be faxed/telexed to the successful Bidder and or his agent in Sri Lanka.

- (b) 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  $B_0$  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 will be made to the Supplier at the contract price in the currency quoted for the Fixed Price Margin (FP) for foreign bidders. The base price  $B_1$  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 selling rate at the Central Bank of Sri Lanka shall be applicable.

Description of the AAAC offered

1)	Type of the Conductor offered		
2)	Cross Sectional Area of the Aluminium Alloy Conductor	mm <sup>2</sup>	
3)	Fixed Price Margin for manufacture of one Ton of AAAC Conductors in the currency allowed in Clause 3(b) <b>FP</b>	/ Ton	
4)	Weight in metric tones of AAAC Conductors. - <b>MT1</b>	Metric tones	