

**005-1: 2012**

**CEB  
SPECIFICATION**

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**P.V.C. INSULATED ALUMINIUM  
SERVICE MAIN WIRE-FINISHED  
PRODUCT**



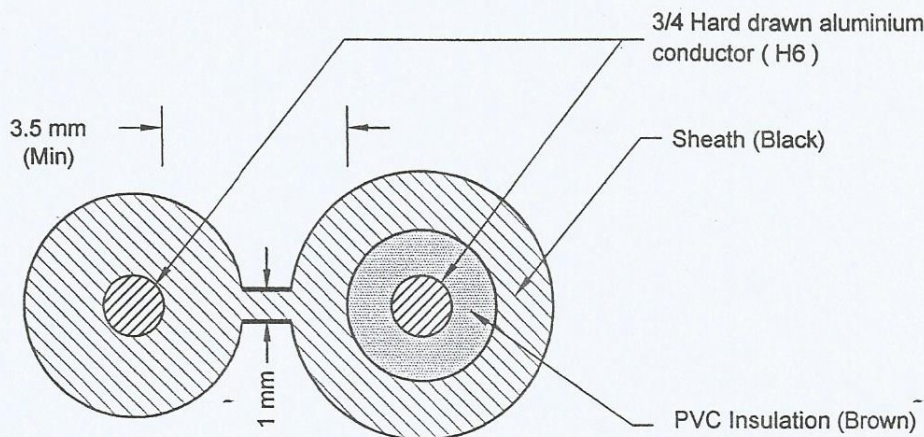
**CEYLON ELECTRICITY BOARD  
SRI LANKA**

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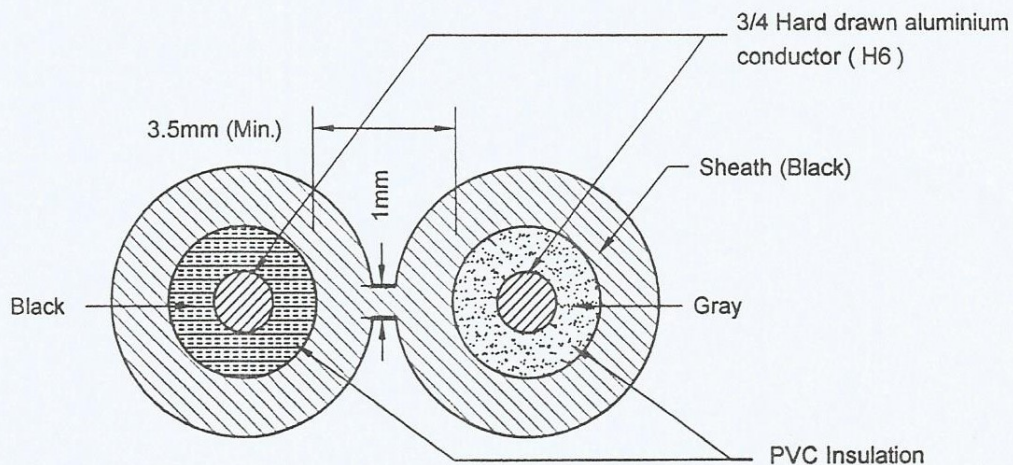
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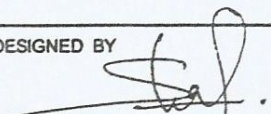



**( a ) SERVICE MAIN WIRE  
( PHASE CORE INSULATED, NEUTRAL CORE BARE & BOTH SHEATHED )**



**( b ) FLAT TWIN SERVICE MAIN WIRE  
( BOTH CORES INSULATED AND SHEATHED )**



 <p>CEYLON ELECTRICITY BOARD</p> <p>RE PROJECTS &amp; PROC. (REGION 1) BRANCH</p>	DISTRIBUTION STANDARDS & SPECIFICATION		SCALE : NOT TO SCALE
	PVC INSULATED ALUMINIUM SERVICE MAIN WIRE		DRAWN : LALANI
	DESIGNED BY	APPROVED BY	DATE : Oct, 2012
	 EE (REP&P)	 CHAIRMAN, SPECIFICATION COMMITTEE	DRG. NO : DS&S/2012/005
			CAD NO :

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## P.V.C. INSULATED ALUMINIUM SERVICE MAIN WIRE- FINISHED PRODUCT

### 1.0 SCOPE

This specification covers design, manufacture and testing of the following PVC Insulated Aluminium Service Main Wires;

- a) Twin Service Main Wire with phase core insulated neutral core bare and both sheathed together.
- b) Twin Service Main Wire with both cores insulated and sheathed.

### 2.0 SYSTEM PARAMETERS

a)	Nominal System Voltage	400V ph to ph /230V ph to Neutral
b)	System Highest Voltage	440 V ph to ph /250V ph to Neutral
c)	System Frequency	50 Hz
d)	Method of Earthing	Solidly earthed neutral at substations
e)	System Fault Level	25 kA

### 3.0 SERVICE CONDITIONS

a)	Annual average ambient temperature	30 °C
b)	Maximum ambient temperature	40 °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 M.S.L.

### 4.0 APPLICABLE STANDARDS

The items and components supplied shall be in accordance with the latest edition of the standard specified below and amendments thereof. However CEB specification shall supersede these standards in the event there is a discrepancy.

BS 2627: 1970	Specification for Wrought Aluminium for Electrical Purposes Wire
IEC 61089: 1991	Round wire concentric lay overhead electrical stranded conductors
BS 6004: 2000	Electric Cables PVC insulated non armoured cables for Voltages up to and including 450/750V, for electric power, lighting and Internal wiring
BS 7655-3.1: 1997	Specification for insulating & sheathing materials for cables. <b>PVC insulating compounds. Harmonized types</b>
BS 7655-4.2:2000	Specification for insulating & sheathing materials for cables. <b>PVC sheathing compounds. General Application</b>
BS EN/IEC 60811.1: 1995	Insulating and sheathing materials of electric cables. Common test methods. General application. Measurement of thickness and overall dimensions. Test for determining the mechanical properties.
ASTM B233-97 (2003)	Standard Specification for Aluminium 1350 Drawers stock for Electrical Purpose.

## 5.0 BASIC FEATURES

### 5.1 General

The Service Main Wires shall be of 300/500 V grade and shall comply with BS6004: 2000 in regard to thickness of the Insulation and the Sheath. The formation of insulations and overall sheathing shall be as per drawing No. DS&S/2012/005.

The core for the Service Main Wires stipulated under Clauses 5.2(a) and 5.2(b) shall be  $\frac{3}{4}$  hard drawn aluminium (H6) wires as per BS 2627: 1970.

The Insulation shall be of harmonized PVC type TI 1 complying with BS7655-3.1: 1997.

The Sheath shall be PVC type 6 complying with BS7655-4.2: 2000. It shall fit closely to avoid ingress of moisture while in service but shall not adhere to the Insulation or to the bare conductor so that it shall be possible to remove the Sheath easily without damage to the Insulation.

### 5.2 Manufacture

#### (a) Twin Service Main Wire phase core Insulated, neutral core bare and both Sheathed.

The Service Main Wire shall be of twin type, phase core shall be insulated with **Brown** coloured PVC Insulation, the neutral core shall be bare, both lay parallel and cores are sheathed with **Black** PVC sheath material.

The sheath shall separate the insulated conductors by a minimum thickness of 3.5 mm to provide additional Phase to Neutral Insulation. In addition to this a groove of width not less than 1mm shall be provided on the sheath between the phase and the neutral so that the both could be separated easily without bearing the Neutral as per drawing No DS&S/2012/005.

Cross sectional area of the cores shall be (10mm<sup>2</sup>/16 mm<sup>2</sup>) as indicated in the schedule of the prices.

#### (b) Twin Service Main Wire both cores Insulated and Sheathed.

The Service Main Wire shall be twin type, and the colours of the insulation shall be **Black, and Gray** and both lay in parallel and sheathed with **Black** colour PVC sheath material.

Cross sectional area of the cores shall be (10mm<sup>2</sup>/16 mm<sup>2</sup>) as indicated in the schedule of the prices.

## 6.0 TECHNICAL REQUIREMENTS

### (A) General

a)	Type of service main wire	As per clause 5.0
b)	Nominal cross sectional area	10 mm <sup>2</sup> or 16 mm <sup>2</sup>
c)	No. of wires & nominal diameter for (10 mm <sup>2</sup> ) wire for (16 mm <sup>2</sup> ) wire	7/1.35mm 7/1.71mm
d)	Number of cores	Two cores
e)	Colour of Sheath	Black

**(B) Conductor**

a)	Conductor material	¾ Hard drawn Aluminium (H6 as per BS 2627)
b)	Conductor Diameter for (10 mm <sup>2</sup> ) for (16 mm <sup>2</sup> )	4.05mm 5.12mm
c)	Conductor D.C. Resistance for (10 mm <sup>2</sup> ) for (16 mm <sup>2</sup> )	2.8264 ohm/km 1.7665 ohm/km
d)	Tensile Strength of Conductor material	125 N/mm <sup>2</sup> ~165 N/mm <sup>2</sup>
e)	Result of wrapping Test of wire (only for 10mm <sup>2</sup> )	No crack

**(C) Insulation**

a)	Insulation Type	Type TI 1 as per BS 7655-3.1: 1997
b)	Thickness	1 mm
c)	Smallest thickness	0.8mm
d)	Tensile Strength	12.5 N/ mm <sup>2</sup>
e)	Tensile Strength after ageing	12.5 N/ mm <sup>2</sup> with max. Variation ±20%
f)	Elongation at break	125 %
g)	Elongation at break after ageing	125 % with max. Variation ±20%
h)	Resistance to cracking	Temp:150±2 °C Requirement: No crack

**(D) Sheath**

a)	Sheath type	Type 6 as per BS 7655-4.2 : 2000
b)	Thickness for (10 mm <sup>2</sup> ) wire for (16 mm <sup>2</sup> ) wire	1.2mm 1.3mm
c)	Smallest Thickness for (10 mm <sup>2</sup> ) wire for (16 mm <sup>2</sup> ) wire	1mm 1mm
d)	Tensile Strength	12.5 N/ mm <sup>2</sup>
f)	Elongation at break	125 %
h)	Resistance to cracking	Temp:150±2 °C Requirement: No crack

**(E) Tests**

a)	Spark test-A.C. (r.m.s.)-10 kV	No breakdown
b)	Voltage test- A.C. (.r.m.s.)-2.0 kV	No breakdown
c)	Flame propagation of single cable	As per BS EN 50265-2-1.

**7.0 QUALITY ASSURANCE**

The Manufacturer shall possess ISO 9001: 2008 Quality Assurance Certification valid throughout the delivery period of this tender, for the plant where the Service Main Wire is being manufactured. The Bidder shall furnish a certified copy of the ISO Certificate along with the offer.

Quality Assurance System conforming to ISO 9001:2008 shall be followed in the manufacture of the Aluminium Re-draw Rods. The Bidders shall furnish documentary evidence that the Aluminium Re-draw Rods manufacturers have obtained ISO 9001:2008 Certification.

Offers of bidders who fail to furnish the proof of ISO 9001:2008 certificates will be rejected.

## 8.0 RAW MATERIAL

### Aluminium Re-draw Rods

Raw material shall not be supplied by the purchaser.

Aluminium Re-draw Rods used in the manufacturing of Aluminium wire for the fabrication of Twin Service Main Wires shall conform to ANSI / ASTM 233-97.

The Quality of Aluminium Re-draw rods used for the manufacture of Twin Service Main Wires shall be as stipulated below.

- (a) The purity of the Aluminium re-draw rods shall not be less than 99.5%. The percentage composition of other elements shall not be more than the values stipulated in the below.

	Element	Allowed % Max.
i.	Silicon	0.10
ii.	Iron	0.40
iii.	Copper	0.05
iv.	Manganese	0.01
v.	Chromium	0.01
vi.	Zinc	0.05
vii.	Boron	0.05
viii.	Gallium	0.03
ix.	Vanadium plus titanium, total	0.02
x.	Other elements, each	0.03
xi.	Other elements, total	0.10

**Total % of impurities shall not be more than 0.5**

- (b) Temper of the Aluminium Re-draw Rods shall be H14 classification.
- (c) The tensile strength of Rods shall be between 103MPa to 138MPa (10.3 N/mm<sup>2</sup> to 13.8N/mm<sup>2</sup>).
- (d) The Maximum Electrical resistivity of the Aluminium Re-draw Rods shall be 0.028080Ω.mm<sup>2</sup>/m

## 9.0 ADDITIONAL REQUIREMENTS

### 9.1 Marking

The outer sheath, of the Service Main Wire shall be embossed with letters "CEB" followed by the manufacturer's identification, rated voltage & conductor size according to clause 5.3 of BS 6004 at every 550mm or less along the length.

## **9.2 Packing**

The Service main Wire shall be delivered in 100 Metre or 250 Metre Coils (as stipulated in the schedule of prices) and wrapped in polythene. Each coil shall bear a tag under the polythene wrappings showing the following particulars.

- (a) Manufacturer's Name or Trade Mark,
- (b) Type of cable
- (c) Core size
- (d) Length of cable
- (e) Colour of Insulation /sheath.
- (f) Net weight/Gross weight.

## **10.0 INFORMATION TO BE FURNISHED WITH THE OFFER**

### **10.1 The following shall be furnished with the offer in English Language**

- (a) Catalogues describing cables offered.
- (b) Completed schedule of guaranteed technical particulars (Annex A).
- (c) The manufacturer shall have at least 10 years of experience in the manufacturer of PVC cables and he shall furnish sufficient documentary evidence in the bid to prove his manufacturing experience.
- (d) ISO 9001:2008 quality assurance certificates as per clause 7.0

### **10.2 Type Test Certificates**

The certified copies of the Type Tests Certificates for the following tests as per BS 6004 IEC 61089 and ASTM B233-97 shall be furnished with the offer;

- (a) Insulation resistance ( as per BS 6004:2000, clause 7.6 )
- (b) Compatibility test (as per BS 6004:2000, clause 8.4)
- (c) Voltage test on cores (as per BS 6004:2000 Clause 7.4)
- (d) Flame propagation of a single cable (as per BS 6004:2000, clause 8.5)
- (e) Joints in Aluminium wires (as per IEC 61089, clause 6.5.4)
- (f) Stress–strain curves (as per IEC 61089, clause 6.5.1 and clause 6.5.2)
- (g) (Breaking strength of conductor (as per IEC 61089, clause 6.5.3)

### **Aluminium Re-draw Rods**

- (a) Tensile test. ( as per ASTM B233-97, clause 7)
- (b) Determination of chemical composition and purity. ( as per ASTM B233-97, clause 5)
- (c) Electrical resistivity test. (As per ASTM B233-97, clause 9)

The type test certificates pertaining to recent manufacture of Aluminium Service Main Wire specified herein shall be from an independent testing authority acceptable to the purchaser.

## **11.0 SAMPLE**

The sample pieces of Aluminium Service Main Wire of length two.0 metre (2m) each for the conductor sizes indicated in the price bidder schedule which are manufactured according to this specification shall be accompanying the offer. Bidder's identity shall be indelibly marked on the samples.



## **12.0 INSPECTION & TESTING**

### **12.1 Acceptance/Sample Test**

The Manufacturer shall make necessary arrangements for inspection by an Engineer appointed by the CEB during Manufacture and before dispatch and also to carry out in his presence the sample tests and routine tests (as per Clause 12.2 below) stated in BS 6004, EN 60811-1-1:1995 and IEC 61089. Following tests shall be witnessed by the Engineer on selected samples and the copies of the test certificates shall be supplied with the cable.

- (a) Cross section area of the conductor (as per IEC 61089 clause 6.6.1 )
- (b) Conductor diameter (as per IEC 61089 clause 6.6.2 )
- (c) Linear density-Mass per unit length (as per IEC 61089 clause 6.6.3 )
- (d) Breaking strength of wires (as per IEC 61089 clause 6.6.4 )
- (e) Surface condition (as per IEC 61089 clause 6.6.5 )
- (f) Lay ratio and direction of lay (as per IEC 61089 clause 6.6.6 )
- (g) Measurement of insulation thickness and overall dimensions (as per EN 60811-1-1:1995, clause 8.1)
- (h) Conductor resistance (as per BS 6004, clause 7.2 )
- (i) Insulation resistance as per BS 6004:2000, clause 7.6 )
- (h) Voltage test on completed cable (as per BS 6004:2000 Clause 7.3)

### **12.2 Routine Test**

The following Routine test report of Service Main Wire shall be made available for the observation of the CEB inspector.

- (a) Visual inspection of cable markings
- (b) Absence of faults in the insulation (as per BS 6004:2000 Clause 7.5)

## Annex-A

**SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS**

(To be filled by the bidder – Use separate sheet for each type of wire)

**(A) General**

a)	Name of Manufacturer	
b)	Type of service main wire	
c)	Nominal cross sectional area of the conductor (mm <sup>2</sup> )	
d)	Number of strands & nominal diameter (mm)	
e)	Number of cores	
f)	Colour of insulation	
g)	Colour of Sheath	

**(B) Conductor**

a)	Conductor material	
b)	Conductor overall Diameter	
c)	Conductor D.C. Resistance for (10 mm <sup>2</sup> ) for (16 mm <sup>2</sup> )	
d)	Tensile Strength of Conductor at 20 <sup>o</sup> C	
e)	Result of wrapping Test (Crack / No crack)	

**(C) Insulation**

a)	Insulation Thickness (mm)	
b)	Smallest measure of Thickness (mm)	
c)	Tensile Strength (N/mm <sup>2</sup> )	
d)	Tensile Strength after ageing (N/mm <sup>2</sup> )	
e)	Elongation at break (%)	
f)	Elongation at break after ageing (%)	
g)	Resistance to cracking Temp: Requirement: No crack/crack	

**(D) Sheath**

a)	Thickness	
b)	Smallest measure of Thickness	
c)	Tensile Strength (N/mm <sup>2</sup> )	
e)	Elongation at break (%)	
g)	Resistance to cracking Temp: Requirement: No crack/crack	

**(E) Test on completed Cable**

a)	Spark test-A.C. (r.m.s.)-10 kV (No breakdown/ breakdown)	
b)	Voltage test- A.C. (.r.m.s.)-2.0 kV (No breakdown/ breakdown)	
c)	Flame propagation of single cable (Pass/Fail)	

**ALUMINIUM RE-DRAW RODS (used for the manufacture Twin Service Main Wire)**

a)	The tensile strength	N/mm <sup>2</sup>	
b)	Temper Classification	H	
c)	Electrical Resistivity	$\Omega$ .mm <sup>2</sup> /m	
d)	Purity	%	
e)	Whether quality Assurance Certification As per ISO 9001:2008 Furnished	Yes/No	
f)	Chemical composition as indicated in the below		

	Element	% Max.	
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.	

I/We do hereby certify that the above particulars are true and correct.

-----  
**Seal and the Signature of the manufacturer**

-----  
**Date**

**Annex – B**

**NON COMPLIANCE SCHEDULE**

On this schedule the bidder shall provide a list of non-compliances with this specification, documenting the effects that such noncompliance is likely to have on the equipment’s life and operating characteristic. Each non-compliance shall be referred to the relevant specification clause.

Clause No.	Non compliance

-----  
**Seal and the Signature of the manufacturer**

-----  
**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 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 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.

Accordingly for the evaluation, FOB Price for Foreign Bidders / Ex-factory price for Local Tenderers shall be computed as,

$$[(Bo \times WAI \times US) + (FP \times CC)] \times TL$$

- Where Bo - Base Price which is the Cash seller's midday official average price of Aluminium High Grade 99.7% in USD per Metric Ton at the LME on the fixed date [as per Clause (1b)].
- FP - Fixed Price Margin per kilometer of wire, in Currency of Choice.
- WAI - quantity of High Grade Aluminium 99.7% in Metric Tons required to Manufacturer one kilometer of the wire. (MT/km)
- TL - Total Length of wire in km.
- CC - Conversion rate from the currency of choice to Sri Lanka Rs. Prevailing on the Date of Bid opening.
- US - Conversion rate from the US Dollars to Sri Lanka Rs. prevailing on the Date of Bid opening.

**2. AWARD PRICE**

- (a) The FOB Award Price for Foreign Bidders and the Ex-factory Award Price of Local Bidders shall be computed as;

$$[B1 \times WAI + FP] \times TL$$

- Where B1 - Base Price which is the Cash seller's midday official average price of Aluminium High Grade 99.7% in USD per Metric Ton at the LME on the first working day immediately after the day of award (please see clause 3 of Annex-c).
- FP - Fixed Price Margin per kilometer of wire, in Currency of Choice.
- WAI - Quantity of High Grade Aluminium 99.7% in Metric Tons required to Manufacturer one kilometer of the wire. (MT/km)
- TL - Total Length of wire in km.
- (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 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 Middle Exchange Rate of the Central Bank of Sri Lanka prevailing on the day of opening of Bids.
- b) The payment for the suppliers will be made 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 middle exchange rate at the Central Bank of Sri Lanka shall be applicable.

4) VARIATION FIGURES

The Bidders shall furnish Fixed Price Margin and the weight of Aluminium required to manufacture one kilometer of the wire in the column provided for in the Schedule of Prices. Failure to furnish these particulars will result in the offer being rejected.

