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CEB
SPECIFICATION

P.V.C. INSULATED UNARMOURED COPPER CABLES

CEYLON ELECTRICITY BOARD
SRI LANKA

Specification

for

P.V.C. INSULATED UNARMOURED COPPER CABLES

CEB Specification 083 : 2007

CEYLON ELECTRICITY BOARD

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SPECIFICATION FOR P.V.C. INSULATED UNARMOURED COPPER CABLES

1. SCOPE

This specification covers the general requirements of design, manufacture, testing, supply and delivery of following copper cables.

(a) PVC Insulated and sheathed single core 600/1000V unarmoured copper Cables.
(b) PVC insulated 450/750V, unarmoured copper cable for earth conductor.

2. SYSTEM PARAMETERS

(a)	Nominal System Voltage	400/230V 3ph & Neutral
(b)	System highest Voltage	440/250V 3ph & Neutral
(c)	System frequency	50 Hz.
(d)	Number of phases	03
(e)	Method of earthing	Solidly earthed neutral at substations
(f)	System fault level	16 kA

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

4. 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.

(a)	BS 6346 (1997)	Electric cables. PVC insulated armoured cables for voltage of 600/1000V and 1900/3300 V
(b)	BS 6004 (2000)	Electric cables for PVC Insulated, non-armoured cables for voltages up to and including 450/750V, for electric power, lighting and internal wiring
(c)	BS 7655-3:1(1997)	Specification for insulating & sheathing materials for cables. PVC insulating compounds. Harmonized Types.
(d)	BS 7655-4:1(1997)	Specification for insulating & sheathing materials for cables. PVC sheathing compounds. Harmonized Types.
(e)	BS 6360 (1991)	Conductors in insulated cables and cords.
(f)	BS EN/IEC 60811 -1.1 (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.
(g)	BS EN/IEC 60811 -1.2 (1995)	Insulating and sheathing materials of electric cables. Common test methods. General application. Thermal ageing methods.
(h)	BS 5099: 1992	Specification for spark testing of electric cables.

5. TECHNICAL REQUIREMENTS

5.1 Conductor

a)	Conductor material					Annealed Copper		
b)	Tensile Strength					155 - 195 N/mm²		
c)	Minimum Elongation of wire after break(for wire diameter. 1.36mm & above)					22.5%		
d)	Number of cores					Single		
e)	Wrapping Test					No crack		
f)	Nominal Cross Section area of the conductor (mm²)	50	70	95	120	185	240	300
g)	Number of Standards	19/1.78	19/2.14	19/2.52	37/2.03	37/2.52	61/2.25	61/2.52
h)	Max Conductor D.C. Resistance (ohm/km)	0.387	0.268	0.193	0.153	0.0991	0.0754	0.0601

5.2 Insulation

a)	Insulation Type					PVC Type TI 1 as per BS 7655 3.1 1997		
b)	Minimum tensile strength as manufactured					12..5 N/mm²		
c)	Minimum tensile strength after ageing					12..5 N/mm²		
d)	Minimum elongation at break as manufactured					125 %		
e)	Minimum elongation at break after ageing					125 %		
f)	Maximum variation of tensile strength					20 %		
g)	Maximum variation of elongation at break					20 %		
h)	Nominal Cross Section area of the conductor (mm²)	50	70	95	120	185	240	300
i)	Minimum insulation thickness (mm)	1.4	1.4	1.6	1.6	2.0	2.2	2.4

5.3 Sheath

a)	Sheath type					PVC Type TM 1as per BS 7655 4.1 1997		
b)	Minimum Tensile Strength as of manufactured					12..5 N/mm²		
c)	Minimum Tensile Strength after ageing					12..5 N/mm²		
d)	Minimum elongation at break as manufactured					125 %		
e)	Minimum elongation at break after ageing					125 %		
f)	Maximum variation of tensile strength					20 %		
g)	Maximum variation of elongation at break					20 %		
h)	Nominal Cross Section area of the conductor (mm²)	50	70	95	120	185	240	300
i)	Minimum thickness of the sheath (mm)	1.5	1.6	1.6	1.7	1.8	1.9	1.9

5.4 Completed Cable

a)	Minimum insulation resistance per km at 20 °C	5 MΩ

6. BASIC FEATURES

6.1 General

The cables stipulated in the schedule of prices shall be as follows.

(a) PVC insulated and PVC sheathed un-armoured cables for voltage 600/1000V as per BS 6346 :1997 in regard to thickness and formation of the Insulation and Sheath.
(b) PVC insulated unarmoured cable as per BS 6004 :2000 in regard to thickness and formation of the Insulation.

6.2 Manufacture

(a) Conductor

The core of the cable shall be stranded plain annealed copper conductor of class 2 as per BS 6360 The electrical and mechanical properties of the conductor shall be as stipulated in Clause 5.0 - Technical Requirements. .

(b) Insulation

The Insulation shall be of extruded PVC compound Type TI 1 confirming to BS 7655 -3.1 /1997. The insulation shall be closely applied to the conductor. It shall be possible to remove insulation without damage to the insulation itself and the conductor. The mean value of the thickness of the insulation shall not be less than the value stipulated in the Clause 5.0 - Technical requirements.

(c) Sheath

The oversheath shall be an extruded layer of PVC material confirming to the requirements for Type TM 1 material specified in BS 7655-4.1 /1997. This homogeneous oversheath layer applies over the insulation and it shall be treated to prevent deterioration due to ultra violet radiation of sunlight. The sheath shall be capable of being removed without damage to the core insulation. The mean value of sheath thickness shall be as stipulated in Clause 5.0 - Technical requirements.

6.3 Single Core Cables - Insulated and Sheathed

The single core copper cable conforming to BS 6346 is required for use as phase and neutral cables. The core insulation shall be **Brown, Black, Grey or Blue colour** (as stipulated in the schedule of prices) and the over sheath shall be **Black** colour. Cross sectional area of the core conductor shall be as indicated in the schedule of Prices.

6.4 Single Core Insulated Cable for Earth Conductor

The single core copper cable ($50mm^2$ or sizes specified in the price schedule) conforming to BS 6004 is required for use as the earth conductor. The PVC insulation of the core shall be **green and yellow colour** .

7. QUALITY ASSURANCE

The Manufacturer shall possess ISO 9001: 2000 Quality Assurance Certification valid throughout the delivery period of this tender, for the manufacture of PVC Cables for the plant where the PVC Cables is being manufactured. 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. ADDITIONAL REQUIREMENTS

8.1 Marking

The outer sheath/insulation of the cables shall be embossed with letters " CEB " followed by the identifications marked legibly as per relevant BS standard at every 500mm or less along the length of the Cable as follows;

a) Manufacturer's Identification
b) Voltage designation 600/1000 V or 450/750V.
c) British Standard Number.
d) Cable Type & nominal cross section area of the Conductor

8.2 Packing

The cable shall be delivered in 100 Metre Coils (unless specified otherwise in the price schedule) 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

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9. INFORMATION TO BE FURNISHED WITH THE OFFER

9.1 All information furnished shall be in English,

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 manufacture of PVC cables and shall furnish sufficient documentary evidence along with the offer bid to prove his manufacturing experience.

9.2 Type Test Certificates

(a) 600/1000V cables - Type Tests as per BS 6346 and BS 6360

The certified copies of the Type Tests Certificates for the following applicable tests as per relevant BS Standard shall be furnished with the offer.

a) Insulation Material
b) Oversheath physical properties
c) Compatibility Test for completed cables
d) Flame propagation test on complete cable
e) Elongation test.

(b) 450/750V cable - Type Tests as per BS 6004 and BS 6360

The certified copies of the Type Tests Certificates for the following applicable tests as per relevant BS Standard shall be furnished with the offer.

a) Insulation Material
b) Compatibility Test for completed cables
c) Flame propagation test on complete cable
d) Voltage test on core
e) Elongation test.

The type test certificates pertaining to the above single core copper cables offered shall be from an independent testing authority acceptable to the purchaser,

10. SAMPLE

Sample pieces of 1.0m length of copper cable for each cable size indicated in the price schedule that manufactured according to this specification shall accompany with the offer. Bidder's identity shall be indelibly marked on the sample.

11. INSPECTION & TESTING

11.1 Acceptance/Sample Tests

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 11.2 below) stated in relevant BS standards. These tests shall be witnessed by the Engineer on selected samples and the copies of the test certificates shall be supplied with the delivery of cables.

(a) 600/1000V cables - Sample tests as per BS 6346

a) Conductor construction
b) Insulation thickness
c) Oversheath thickness

(b) 450/750V cable - Sample tests as per BS 6004

a) Conductor construction
b) Insulation thickness and application
c) Conductor resistance
d) Voltage test on completed cable
e) Insulation resistance

11.2 Routine Tests

The original of the following routine test reports of cable shall be made available for the observation of the CEB engineer inspecting the cable.

(a) 600/1000V cables - Routine tests as per BS 6346

a) Spark test on insulation
b) Spark test on over sheath
c) Conductor resistance
d) Voltage test on completed cable
e) Insulation resistance on completed cable
f) Cable markings

(b) 450/750V cable - Routine tests as per BS 6004

a) Cable markings
b) Absence of faults in the insulation

12. ANNEXURE

Annexure A - Schedule of Guaranteed Technical Particulars (To be duly filled by the Bidder)
Annexure B - Price Variation
Annexure C - Non Compliance Schedule

Annexure - A

SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS

(To be filled by the manufacturer for each type/size of cable)

1) General

a)	Name of Manufacturer	
b)	Type of cable	
c)	Nominal cross sectional area	
d)	Number & nominal diameter of wire	
e)	Number of cores	
f)	Colour of insulation	
g)	Colour of sheath	

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2) Particulars of the Conductor

a)	Conductor material		
b)	Conductor Diameter	mm	
c)	Conductor DC Resistance at 20 ^{0}C	ohm/km	
d)	Tensile Strength of Conductor wire	N/mm²	
e)	Minimum elongation of wire after break	%	
f)	Wrapping Test		

3) Particulars of the Insulation

a)	Insulation type		
b)	Thickness	mm	
c)	Smallest measure of Thickness	mm	
d)	Minimum tensile strength as manufactured	N/mm²	
e)	Minimum tensile strength after ageing	N/mm²	
f)	Minimum elongation at break as manufactured	%	
g)	Minimum elongation at break after ageing	%	
h)	Maximum variation of tensile strength	%	
I)	Maximum variation of elongation at break	%	

4) Particulars of the Sheath

a)	Sheath type		
b)	Thickness	mm	
c)	Smallest measure of Thickness	mm	
d)	Minimum tensile strength as manufactured	N/mm²	
e)	Minimum tensile strength after ageing	N/mm²	
f)	Minimum elongation at break as manufactured	%	
g)	Minimum elongation at break after ageing	%	
h)	Maximum variation of tensile strength	%	
i)	Maximum variation of elongation at break	%	
j)	Whether the sheath is UV stabilized type	Yes/No	

5) Particulars of the Completed Cable

a)	Insulation resistance per km	M Ohm	
b)	Withstand the fire conditions		

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

……

Seal and Signature of the Manufacturer/Bidder

Date:

Annexure-B

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 PVC Insulated single core Copper Cables 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 Copper Grade A, 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 Copper Cables of foreign Bidders and ex-factory price of Copper Cables of local Bidders for the purpose of evaluation shall be computed as;

$$\{[(B_0 \times MT)) \times US_0] + (FP \times CC)\} \times TL$$

Where ;

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

FP - Fixed Price Margin per kilometre of Copper Cables in the currency allowed under Clause 1(c) above.

MT - Quantity of Copper Grade A required in Metric Ton for the manufacture of one kilometre of Copper Cable.

TL - Total Length in kilometres of Copper Cable offered.

CC - Currency Conversion rate from the currency of choice of the Bidder to Sri Lanka Rupees prevailing on the data of Bid opening.

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

2 Award Price

The FOB award price of Copper Cables for Foreign Bidders and the ex-factory award price of Local Bidders shall be computed as

$$(B1 \times MT)\ TL + FP \times TL$$

Where ;

B1 - Base Price which is the Cash seller's midday official average price of Copper Grade A, in US Dollars per Metric tone at the LME on the first working day immediately after the date of award.

TL - Total Length in kilometres of Copper Cable awarded.

FP - Fixed Price Margin per kilometre of Copper Cables in the currency allowed under Clause 1(c) above

Intimation of the award will be faxed to the successful Bidder and or to his agent in Sri Lanka on the same day of the award.

3. Conversion of Currency

a) For the purpose of the evaluation the Prices B_o 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). 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.

4. Variation Figures.

The Bidders shall furnish Fixed Price Margin and the Weight of Copper Grade A required to manufacture one kilometre of Copper Cables offered as indicated below. Offers of Bidders who fail to furnish these particulars will be rejected.

Description of the Copper Cables offered;

Voltage Rating **(V)**	Cross sectional Area of the Cu Conductor **(mm^2)**	Fixed Price Margin (FP) for manufacture of one kilometre of Copper Cables in the currency allowed as per Clause 1(c) **(……/km)**	Weight in metric tones (MT) of Copper Grade A required for the manufacture of one Kilometre of Copper Cables **(Metric Ton/km)**

Seal and Signature of the Manufacturer/Bidder

Date:……

Annexure - C

Non Compliance Schedule

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

Clause No.	Non Compliance

Seal & Signature of the Manufacturer/Bidder

Date: