

## ANNEX 4.5

REF SPEC. NO. 41005/1996

### SPECIFICATION FOR LOW VOLTAGE PVC CABLES RATED UP 1000 VOLTS

#### 1. INTRODUCTION

This Specification calls for supply and delivery of LOW VOLTAGE PVC CABLES.

For information purpose the Supplier all recommend a complete list of suitable jointing and termination kits available on the market for the cables being supplied. They should also list the recommended types of terminating and jointing kits.

The Supplier shall include a complete statement of compliance for this Specification. For every clause in this Specification the Supplier shall state compliance or non-compliance and shall elaborate where appropriate.

The Supplier must complete the Technical Guarantee Schedule (Table A).

#### 2. STANDARDS, UNITS AND LANGUAGE

All cables supplied under this specification shall conform to the following standards:

- a) BS 6746 :1969 and subsequent amendments or equivalent
- b) Any other standard, provided the Bidder can provide documentary evidence that the standard is equal to or better than the above standards.

All the Suppliers, correspondence, and all description upon drawings, illustrations or instruction shall be in the English Language.

SI units of measurements shall be used throughout. The cables shall be manufactured to high quality standards. The companies manufacturing the cables shall have ISO certification. Documentary proof of ISO Certification shall be provided with the bid.

#### 3. PARTICULARS OF ENVIRONMENT

The cables will either be subjected to atmospheric or underground environment or both.

##### 3.1 Particulars of Atmospheric Environment

The cables shall be capable of operation under the following atmospheric conditions:

- (a) At an average altitude of 1,500 m above sea level.
- (b) Ambient air temperatures not exceeding +45 degrees centigrade or below -10 degrees centigrade with a maximum daily average of 35°C.
- (c) Humidity 13 mg/cubic metre absolute and 54% relative before storms with vapour pressure 17mm hg.
- (d) Equipment will operate within the tropics and is subject to sudden ambient air temperature changes of the order to 10 degrees centigrade per hour occurring at the onset of rain, but the barometric pressure at any given time does not vary by more than approximately 10 mm mercury.
- (e) Frequent and severe lightning storms occur during summer months, with isoceraunic levels varying between 50 and 100 thunderstorm days per annum.
- (f) Particular attention should be paid in the design of all equipment to ensure that there is no damage to working parts or insulation through the ingress of dust, insects, vermin which are prevalent for long periods in the year.

### **3.2 Particulars of Underground Environment**

In addition to being exposed to the conditions stated in 4.1 the cables shall be capable of operation in the following underground conditions:

- (a) At a depth of burial from the ground surface to centre of the cable, of 850 mm .
- (b) Mean ground temperature at this depth being 25 degrees centigrade with a maximum value of 30 degrees.
- (c) In soil with a maximum resistivity of 1.2km/W.
- (d) With a foundation or bed of washed pit sand 150 mm deep lain in the trench first, followed by a second 150 mm pit sand above the cable. It is then backfilled by 450 mm of earth before the yellow cable marker ribbon in laid and the trench completely closed.

## **4. ELECTRICAL EQUIPMENT MATERIALS**

All materials incorporated in the equipment supplied shall be new and of first class commercial quality, free from defects and imperfections.

## **5. CABLE DETAILS**

The specification covers from single to multi -core cables with copper or aluminium conductors with PVC insulation.

## **6. CABLE CONSTRUCTION**

The construction of the table shall be as follows:

### **6.1 Conductor**

The conductors shall be plain annealed copper complying with BS 6360 .

### **6.3 Insulation**

The insulation shall be PVC compound and comply with the requirements of BS 6746 Type T11. The identification of the cores shall be by colour as follows:-

- a) **Single Core:** Red or Black
- b) **Two Core** : Red and Black
- c) **Three Core** : Red , Yellow and Blue
- d) **Four Core** : Red , Yellow , Blue and Black
- e) **More than 4 cores** : all cores shall be black - by numbers

### **6.4 Fillers**

The interstices between the laid up cores shall be filled up with either extruded PVC or other non-hygroscopic material. The fillers shall be of suitable materials which shall be compatible with other materials of the cable and shall be capable of operating continuously at maximum operating temperature of the cable with being adversely affected.

### **6.5 Bedding**

The bedding shall consist of extruded PVC.

### **6.6 Wire Armour**

All cables shall be armoured . Armouring for all cables, with the exception of single core cables, shall consist of one layer of galvanised steel round wire. Single core cables shall have non-magnetic Armouring.

Suitable binder tape may be applied over metallic armour at manufacturer's option.

### **6.7 Outer Sheath or Serving**

The overall finish shall comprise a layer of extruded PVC which shall be black in colour. The ends of the cable shall be marked red where the core colours are clockwise and green at the opposite end.

The outer sheath shall consist of a layer of extruded black polyethylene (PE).

## **6.8 Bending Radii**

The bending radius shall be less than:

- 15 times the diameter for armoured cable
- 8 times the diameter for non-armoured cable

## **6.9 Cable Marking**

A marking bearing voltage designation, maker's name, year of manufacture shall be marked on the outer sheath at suitable intervals throughout the cable. The sheath shall be marked at 1m intervals with progressive numbering indicating the length of cable.

## **6.10 Constructional and Technical Schedules**

Unless approved by the Authority, apart from the highlighted parameters above, all other construction and electrical parameters shall conform to BS 6346:1969 .

## **7. ALTERNATIVE CONSTRUCTIONS**

The construction stated in 6. above is the preferred construction. However, suppliers/ manufacturer's can also offer other construction designs provided they can provide documentary evidence that these are an improvement to the preferred designs.

## **8. TESTS**

### **8.1 General**

Tests on cables and cable materials shall be carried out at the manufacturer's premises.

For orders exceeding 15 km of cable a representative from the Employer will witness the tests. The manufacturer/supplier will meet the full costs for the tests including the costs for the Employer's representative witnessing the tests. The supplier has to provide type tests certificates for tests carried on the previously manufactured cables of the type specified herein. Bids that do not include test certificates will be rejected. The tests should have been carried out by

an internationally recognised and unbiased institute (eg. KEEMA). Documentary proof that the Test Institute is internationally recognised shall be provided with the offer. A minimum requirement is that the Test Institute is used by international clients in testing their products.

REF may decide to waive type tests provided the test certificates fulfil the above requirement. All routing tests are to be carried out in full.

## **8.2 Electrical Testing**

The cables shall be tested according to BS 6346: 1969 .The following tests shall be carried out :

- a) During manufacture all cores shall be spark tested at 6,10,12 kV depending on the conductor size
- b) Finished cables shall be tested at 3000 V rms between conductors and between conductor and armour which shall be Earthed. the cables have to withstand the test for five minutes without breakdown.

## **8.3 Non- Electrical Testing**

The insulation and sheath material shall be tested according to methods stipulated in BS 6346:1969 .

## **8.4 SEALING AND DRUMMING**

The cable shall be wound on strung non-returnable drums arranged to take a round spindle of a section adequate to support the loaded cable drum during installation and handling. The drum shall be lagged with strong closely fitting battens which shall be securely fixed to prevent damage to the cable. Wooden drums shall be constructed of seasoned timber to prevent shrinkage of drums during shipment and subsequent unprotected storage on site. Each drum shall be clearly marked in a manner which cannot be obliterated with the particulars of the cable including voltage length, conductor size, number of cores, type of protective covering, section number, gross and net weight, together with the direction for rolling.

The ends of cables shall be suitable sealed to prevent the ingress of moisture. The end of the cable left projecting from the drum shall at all times be securely protected against damage by mishandling during transport or storage.

Gross drum weights shall not exceed 3000 kg.

## 9. RATINGS

### 9.1 Voltage Rating

All cables shall be rated 600/1000 volts.

### 9.2 Current Carrying Capacity and Design Parameters

The maximum continuous current carrying capacity at the maximum permissible continuous conductor temperature of 70°C and the factors for determining such rating shall be based on BS 6346 and subsequent amendments and all conditions prevailing on site as specified herein.

**TABLE A**

<b>TECHNICAL GUARANTEES (to filled in by Bidder for each type)</b>		
<b>Description</b>	<b>Unit</b>	<b>Guarantee</b>
Max. continuous operating voltage	KV	
Max. voltage gradient	kV/mm	
Average voltage gradient	kV/mm	
Less angle ( $\tan \delta$ )	-	
Reference standards	-	
Type designation	-	
Insulator material	-	
Conductor material	-	
Conductor size	sq.mm	
No. of cores	-	
Thickness of insulation	Mm	
Copper tape thickness	Mm	
Sheath thickness	Mm	
Sheath material	Mm	
Nominal screen area	sq.mm	
Diameter of armour wire (if specified)	Mm	
Overall diameter	Mm	
Mass	Kg/km	
Minimum bending radius	Mm	
Peak value of impulse	KV	
Maximum continuous permissible:		
- Phase to earth voltage	KV	
- Phase to phase voltage	KV	
Maximum tensile strength	N	
Maximum conductor temperature	°C	
Impedance at 70 degrees and 50 Hz	ohm/km	
AC resistance at 20 degrees	ohm/km	
DC resistance at 20 degrees	ohm/km	
Inductance	mH/km	
Reactance	ohm/km	
Capacitance	mF/km	
Charging Current	A/km	

Short time current 1 second	KA	
Earth fault short time 1 second	KA	
Nominal current in air:		
- 1-phase triangular formation	A	
- 1-phase flat formation	A	
- 3-phase cable	A	
Nominal current underground	A	
Manufacturer's name:		
- HV cables		
- Conductors		
- Terminations and joints		
Country of Manufacture:		
- HV cables		
- Conductors		
- Terminations and joints		