



# **SPECIFICATION FOR 11 kV HIGH VOLTAGE UNDERGROUND CABLE (L-S13)**

**JKR 20300-0130-23**

**CAWANGAN KEJURUTERAAN  
ELEKTRIK**

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## **SPECIFICATION FOR 11 kV HIGH VOLTAGE UNDERGROUND CABLE**

### **1.0 GENERAL**

This section of the Specification describes and specifies requirements for the supply, delivery, installation, testing, commissioning, handing over in approved working order and maintenance during the Defects Liability Period of the underground cabling work in accordance with the specifications Supplementary Notes, Bill of Quantities, Conditions of Contracts, Drawing etc.

### **2.0 TYPES OF CABLES**

The cable to be supplied under this specification shall be manufactured and tested in accordance with B.S 6480: Part 1: 1969 and shall be of paper insulated mass impregnated non-raining type to a voltage rating of 6.35/11 kV and suitable for continuous operation on a 11 kV, 3-phase, 50 Hz distribution system.

The cable shall comprise of three high conductivity shaped stranded copper conductors lapped with layers of insulating paper tapes, lead alloy sheathed, P.V.C. bedded and double steel tape armoured with an overall serving. A carbon paper screen shall also be applied over each conductor. The abbreviation used for this type of cable shall be PILCDSTAS.

### **3.0 CABLE ROUTES**

Cable routes shown in the Drawings are for tendering purpose only. The Electrical Contractor shall, after consulting the S.O.'s Representative peg out the cable routes for the approval of the S.O.'s Representative prior to excavation of the cable trenches. The programme of work for excavation of cable trenches, laying of cables, reinstatement of trenches etc. shall be submitted to the S.O.'s Representative for approval one week before execution of the work.

### **4.0 LENGTH OF CABLE**

The length of each cable indicated in the Drawings and/or Bill of Quantities is for tendering purpose only. The Electrical Contractor shall ascertain the actual of the cable required

before ordering. Actual length of each cable installed shall be measured on site and The Electrical Contractor shall be paid according to the rate in the Contract. However, the rates quoted shall include wastage due to cutting to lengths, terminations etc.

#### 5.0 CABLE TRENCH

Unless otherwise specified, cable trenches shall be 750 mm deep. The trenches shall be of sufficient width to enable provision of adequate spacing between cables but in any case shall not be less than 450 mm wide.

Trenches shall be kept as straight as possible and shall have vertical sides which shall be timbered where necessary so as to avoid subsidence and damage. The bottom of the trenches shall be firm and of smooth contour and any other objects likely to damage the cable sheathing shall be removed. The material excavated from the trenches shall be placed or removed so as to prevent nuisance or damage to adjacent areas or buildings.

The trench excavation and filling in shall be so executed that all roads, walls, sewers, drains, pipes, cables, structures etc. shall be reasonably secured against risk of subsidence damage. Provision shall be made, during excavation and until interim restoration has been completed, for reasonable access of persons and vehicles to the areas of buildings adjacent to the trenches.

The Electrical Contractor shall provide pumps and other appliances for the necessary pumping required for the disposal of water so as to prevent any risk of the cables and other materials to be laid in the trenches being detrimentally affected. Where necessary, bailing shall be provided.

Where trenches pass from a footway to a roadway or at other position where a change of level is necessary, the bottom of the trench shall rise or fall gradually.

#### 6.0 CABLE DUCTS

At road crossings, sewerage pipe crossing, water pipe crossings, paved areas, concrete areas and where specified by the S.O.'Representative, cables shall be protected by galvanised steel pipes buried to a depth of 900 mm below finished ground level. The pipes shall be of heavy duty type,

complying with BS 1387 and complete with screwed and socketted joints. Unless otherwise specified the pipes shall be 150 mm in diameter. Where it is necessary to cross drains, culverts or similar obstruction which is too deep for the cables to be buried below, galvanised steel pipes as specified above shall be provided. The pipes shall be supported at each end in a concrete block and shall project through the blocks into the ground at a depth of at least 750 mm. All ducts shall be extended at least 600 mm beyond paved areas, concrete areas, drains, road crossing, pipe crossings etc.

Cable entering a building shall be protected by pitch fibre ducts of 150 mm diameter, complying with BS 4108, completed with bend pieces, buried to a depth of 900 mm and encased with 75 mm of concrete all round. The ducts shall be installed with a gradient so as to drain away any water in the ducts. All ducts passing through walls shall be effectively sealed and made water-tight.

Unless otherwise approved by the S.O.'s Representative, the number of cables installed in each duct shall be such that the space factor shall not be less than 60%. A draw wire shall be provided for each duct.

Unless specified to be provided by others, the above galvanised steel pipes and/or pitch fibre ducts shall be provided by the Contractor whether they are shown in the Drawings or not.

#### **7.0 TRAFFIC SAFETY AND CONTROL**

When work is being carried out beside any public road or other existing road, warning signs shall be erected. The form, placing and light of the warning signs must comply with all local and national regulations and safety codes for road works.

Where it is necessary for any trench or pit to be left open overnight, ample flashing warning lamps shall be placed at each end and at intervals not greater than 10 metres. In built up areas barricades shall be erected along the length of the trench or pit in addition to warning lamps.

Where necessary, flag-men shall be stationed at strategic locations to control traffic.

#### **8.0 CABLE LAYING AND INSTALLATION**

All cables shall be handled, laid and installed according to this specification, the IEE Wiring Regulations 15th Edition, the cable manufacturer's recommendations and ERA Reports by using proper installation equipment.

All cables shall be supplied in complete length to suit the circuits they serve and no straight through joints shall be used. Straight through joints in the cable will only be permitted in very exceptional circumstances such as arising from unavoidable limitations in manufacturing length. If straight through joint or other approved joints are permitted by the S.O.'s Representative, the cost of such joints shall be borne by the Electrical Contractor. No joints in the cable will be allowed unless approved in writing by S.O.'s Representative.

The minimum bending radius of the cable shall be in accordance with Table 52C of the IEE Wiring Regulations 15th Edition. Wherever cables are cut, the ends shall be immediately sealed in an approved manner unless; it is intended to proceed with cable jointing for termination straight away.

Unless otherwise permitted by the S.O.'s Representative, no cable shall be laid and covered up in the absence of the S.O.'s Representative.

#### **8.1 CABLE LAID DIRECT IN GROUND**

Before cable is laid, the trench shall be thoroughly inspected and any debris and sharp objects shall be removed. The bottom of the trench shall be covered with a layer of 75 mm of clean sand. The cables shall then be laid on this bedding in an orderly manner without overlapping and crossing each other. After laying the cables, a layer of 75 mm of clean sand shall cover the cables and carefully spread over the trench before placing the cable protective covers.

The cable protective covers shall be of clay bricks. The bricks shall be new, well burnt and in complete pieces. They shall be laid crosswise from end to end along the entire route of the underground cable if the cable size is not more than 120 sq.mm. For cable size more than 120 sq.mm, more than one row of the bricks shall be laid. Each cable shall be separately protected by these bricks and the cover shall have at least 25 mm overhang on each side of the cable.

The trench shall then be backfilled with earth and shall be consolidated after every 150 mm of backfilling using a

mechanical rammer. An orange coloured, multi-strand nylon rope of minimum 6 mm diameter shall be laid at a depth of 300 mm along the trench to identify the cable route. At every 10 metres interval, an extra 2 metres length of nylon rope shall be coiled and laid. The finished surface shall be left proud by 50 mm to allow for subsidence and the Electrical Contractor shall be responsible for the removal of any surplus to a position indicated by the S.O.'s Representative.

The surface of the refilled trench shall be temporarily reinstated and maintained in a thoroughly safe condition until complete consolidation of the soil is achieved. As soon as the soil has consolidated, the trenches shall be made good to the original conditions to the satisfaction of the S.O.'s Representative.

## **8.2 CABLE INSTALLED IN PRE-CAST CONCRETE TRENCHES**

Method of installation of cables in pre-cast concrete trenches shall be in accordance with method Type L, Type M or Type N of Table 9A of the IEE Wiring Regulations 15th Edition. However, if the method is not specified, the cables shall be installed as directed by the S.O.'s Representative.

Cables laid on bottom of the trenches shall be in accordance with method Type L of Table 9A of the IEE Wiring Regulations 15th Edition. Cables installed on trench walls shall be in accordance with method Type M or Type N of Table 9A of the IEE Wiring Regulations 15th Edition and the cables shall be secured on the cable tray by means of saddles at suitable intervals.

The cable trays shall be fabricated from perforated hot dipped galvanised sheet steel finished in an orange enamel. The minimum thickness of the sheet steel used shall be 1.5 mm for cable tray for width up to 300 mm and shall be 2.0 mm for width exceeding 300 mm. The cable tray shall be supported at least 25 mm from the trench wall by mild steel brackets at 600 mm intervals. The bracket shall be anti-rust treated and painted with one coat of primer. Samples of the cable tray and bracket shall be submitted to the S.O.'s Representative for approval prior to installation.

To provide electrical continuity, all cable tray joints shall

be bridged by means of tinned copper tape of dimension not less than 25 mm x 3 mm. All saddles for cables on cable trays shall be installed by bolts, washers and nuts. All tees, intersection units, adaptor units etc. shall be factory manufactured unless otherwise approved by the S.O.'s Representative. The trenches inside the buildings shall be filled with clean sand up to a level above the cable ducts.

### **8.3 CABLE RUN ON WALLS AND UNDER FLOOR SLABS**

Cables run on walls and under floor slabs shall be mounted on perforated hot dipped galvanised sheet steel cable trays. The construction and finished of the cable trays and the way of installation of the cables on the cable trays shall be as described in Item 8.2 above.

The cable trays shall be suspended from floor slabs by hangers or mounted on wall by brackets at 600mm interval. The material and finishes of the hangers, brackets and other suspending and supporting structures shall be as that described for brackets in Item 8.2 above.

Where cable trays pass through floors or fire resistant walls, the surrounding hole shall be sealed to full thickness of the floor or wall with non-hygroscopic fire-resisting material of minimum 2 hours fire rating approved by the Jabatan Bomba Malaysia.

### **9.0 CABLE TERMINATION AND JOINTING**

Unless otherwise permitted, all cable termination and jointing works shall only be carried out in the presence of the S.O.'s Representative. A plastic laminated plate engraved with details such as size of cable, number of core, date of commissioning, date of jointing, length of cable, distance of cable joint etc. shall be securely fixed near the termination.

#### **9.1 CABLE TERMINATION**

Unless otherwise specified the cables shall be terminated by the heat shrinkable method.

The cables shall be tested for moisture before termination is commenced. Samples of paper both from the layer nearest to and furthest from the conductor shall be immersed in transformer oil or paraffin wax, heated to a temperature of approximately 115 C. If any residual moisture is present this



will be immediately detected by bubbling. Samples of paper should be tested singly and should not be touched by hand but gripped in a pair of tweezers. Phasing and insulation resistance tests shall be taken on each length of cable laid before termination is commenced.

The heat shrinkable termination materials used shall be supplied in a complete kit to suit various sizes of cable and to provide stress control, non-tracking and enviromentally sealed termination. It shall consist of high permittivity, high resistivity, heat shrinkable, stress control, UV stable, non-tracking polymeric materials and heat activated sealant to prevent ingress of moisture and contamination. The termination shall meet the performance test of IEC 112, IEC 446 and IEC 507 section 3. It shall also have the following performance characteristics:-

- a) A.C. Voltage withstand  
for 1 minutes, 10 Hz : 35 kV phase to earth
- b) A.C. Voltage withstand  
for 4 hours, 50Hz : 23 kV phase to earth.
- c) Impulse voltage withstand  
10 positive and 10 negative,  
1.2/ 50 microsec. : 75 kV peak phase to  
earth.
- d) D.C. Voltage withstand  
for 30 minutes. : 46 kV phase to earth.

## 9.2 CABLE JOINTING

The type of cable boxes, compound and jointing materials used shall be factory manufactured. Every cable joint shall be started and finished on the same day. Whenever cables are to be jointed in the open during wet weather conditions, the Electrical Contractor shall take all necessary precautions to prevent moisture getting into the cables. When cable sheath is used as earth continuity conductor, the glands must have necessary contact surfaces to provide a low resistance path under fault conditions. Phasing and insulation resistance tests shall be taken before jointing is commenced.

Core numbers printed on the papers shall be observed when jointing and whenever possible such numbers shall be maintained throughout the system, Core number '1', '2' and

'3' shall denote as red, yellow and blue phases respectively. Crossing of core in the boxes shall be avoided wherever possible but connections shall be consistent with the foregoing requirements. The jointing of cable shall be undertaken only by competent and fully experienced jointer.

#### 10.0 CABLE MARKER

Cable Markers with lettering and sign as shown in Appendix I shall be provided by the Electrical Contractor at every change in direction of underground cable routes and at every 15 m on straight run. Cable markers shall be of heavy duty reinforced concrete construction and approved by S.O.'s Representative.

The cable marker shall be of trapezoidal block with 100 mm square top face, 150 mm square bottom face and 400 mm in height as shown in Appendix 3. The top face shall be indented with bold lettering 'H.V.' and directional sign indicating the direction/directions of the cable route. The cable marker shall be buried to a depth of 300 mm. or any other depths as directed by S.O.'s Representative. Cable joint marker of similar construction but with the lettering and sign as shown in Appendix 2 shall be provided and installed at every cable joint in the similar manner.

#### 11.0 TESTING AND COMMISSIONING

The Electrical Contractor shall be responsible for carrying out tests on the cables before commissioning. The tests shall include:-

1. Continuity test.
2. Phasing out test.
3. Insulation resistance test between conductors and between conductors and sheath by employing a 1000 volt insulation tester.
4. H.V D.C test for 15 minutes.
  - a) Between conductors and Earth - 17.5 kV
  - b) Between conductors - 30 kV

Within one week after the tests have been successfully carried out, a copy of test results certified by competent personnel shall be submitted to the S.O.'s Representative. The date of commissioning shall be agreed by the S.O.'s Representative and the Electrical Contractor shall ensure that the installation is safe before the cable is energised.

## 12.0 MAINTENANCE

During the Defects Liability Period the Electrical Contractor shall perform maintenance work for the complete cabling and associated work. All work labour, materials, tools and parts necessary to rectify the defects due to manufacturing or installation fault shall be supplied and/or executed at no extra cost to the Government. The maintenance work shall be carried out as soon as the Contractor is been informed by the S.O.'s Representative.

The work to be performed shall include but not limited to the following:-

- a) Replace or make good any defective cables, cable joints and cable terminations.
- b) Replace any broken or defective cable markers.
- c) Making good any damage to building, concrete areas, slopes, drains, culverts, existing cables, pipes etc which had not been properly made good arising out of his work.
- d) Any other work deemed necessary by the S.O.'s Representative.

## 13.0 AS INSTALLED DRAWINGS

Within three calender months after the practical completion of the contract, one set true to scale negatives (110/115gm/sq.m) and four set of prints showing the cable routes with reference to easily recognisable buildings and structures, size and type of cables, location and type of joint etc shall be submitted. The drawing size shall be A0 or A1 unless otherwise approved by the S.O.'s Representative.

These drawings shall be properly stenciled and shall have at

the lower right hand corner the Electrical Contractor's name and address, date of commissioning, scale, drawing number, title and any other particulars as required by the S.O.'s Representative and the following particulars:-

**JABATAN KERJA RAYA**

**CAWANGAN ELEKTRIK**

**CONTRACT NO:**

**TENDER NO :**

The numbers for these drawings shall be obtained from the S.O.'s Representative.

In addition to the above, one set of the drawing shall be properly framed up in the switchroom.

If the drawings submitted are not acceptable to the S.O.'s Representative, the Electrical Contractor shall amend and re-submit the drawings within two weeks from the date of return of the drawings.

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