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**Aerial Bunch  
Cables**



## INDEX

### AERIAL BUNCH CABLES

Foreword.....	01
Aerial Bunch Cables For LT Lines (ABC) .....	04

## Dear Fellow Power Engineer & Esteemed Customers

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With our best regards to all our fellow power Engineers, Consultants and valued customers, we take this opportunity to put forward "Revised-updated-conductor Manual" for your reference and imparting further more technical updated details with inclusion of more technical parameters as regards conductor field.

We have had an overwhelming response for our earlier conductor – manual, by which we had put our best possible efforts to elucidate the technical assistance to all Government/Public sector corporates by providing all important technical parameters keeping in view Indian as well as International standards for achieving proper selection aspects as far as overhead conductor selection / usage is concerned.

The publication of this revised-updated conductor-manual, is dedicated to our esteemed customer consultants and all Government/ Private Sector /Public Sector Corporate as a reference guide – which will help all those who are associated and involved in development of overhead transmission and distribution field.

Technical team

## Small beginnings; Big dreams

Back in 1971, Diamond Cables Ltd. began with just one product and one customer in the portfolio. The Company was established with an objective of catering to the escalating demand of the Indian industry for high-performance Cables and Conductors. We adopted a modern approach in terms of technology and capability, enabling us to deliver global standards of quality, right from day one.

Today, Diamond Power infrastructure Ltd. is a USD 441 million Company with end to end manufacturing facilities for comprehensive range of Transmission & Distribution Conductors, Power, HV, EHV & Control Cables. We are the country's first and only integrated Cable manufacturer with Rod to Insulation facility under one roof and have delivered more than 10,00,000 kms. of products to over 150 clients worldwide.



## Fast Facts

- Established in 1971
- Manufacturing facilities at Baroda & Silvassa
- First Indian Company to develop the Alloy Conductor indigenously in 1989
- ISO 9001 : 2008, ISO 14000 & ohsas 18001 certified
- One of the first manufacturers in the world to use a SAP-ERP System
- Installed capacity of 32,000 MT. per annum for Rods.
- Installed capacity of 50,500 MT. per annum for ACSR, AAAC & AAC Conductors
- Installed capacity to make 11,500 kms. per annum of Power, Control and Aerial Bunch Cables

## Backward integration; Forward thinking.

We believe that if the basics are right, progress is inevitable; because the foresight necessary to become a leader comes from the ability to build on hindsight.

To underscore this ethos, we have indigenized several quality-relevant processes and operations to enable a better control over the parameters that define our product characteristics; resulting in better quality delivered to our clients.

As part of our endeavor to be fully integrated, we went in for backward integration way back in 1999 by setting up an Aluminium Wire Rods manufacturing unit. In doing this, DPIL became the country's only integrated manufacturer of Cables and Conductors. In 1989, DPIL became the first company to indigenously develop Alloy Conductors. Our R&D centre has also patented a superior HSHC (High Strength High Conductivity) conductor with better technical and physical characteristics than conventional conductors for transmission systems.

## Pioneering innovation; Delivering quality.

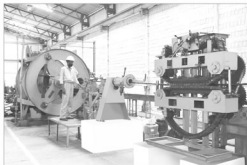
Our endeavour to continuously improve has translated into innovative technologies and products that have broken new ground in the industry. The state-of-the-art Research & Development centre at Vadodra is equipped with sophisticated equipments to facilitate extensive research and generate revolutionary technologies.

Presently, the R&D centre is developing a High Conductivity High Strength Aluminum Alloy, suitable to work in high temperatures with better creep, fatigue and other mechanical properties. This would result in reduced losses and improved voltage regulations in transmission system.

## DPIL Innovates

- Improved Lubrication and Cooling Cycles and superior designs of Wire Drawing Dies to suit High Tensile Aluminum Alloy Drawing at very high speeds
- Heat Treatment Furnace re-designed to reduce heat loss, increasing capacity three times the conventional furnace
- Stranding Machines provided with automatic loading / unloading system and auto wire brakes stop etc.

## Cutting-edge technology; New-age facilities



Our infrastructural base comprises two state-of-the-art manufacturing plants. The facilities are spread over 260 Acres, which also include the Warehouse and the R&D centre of the Company.

### Integrated Plant: Vadadala, Vadodara

The Company's present manufacturing facility was set up at village Vadadala, Ta. Savli, Dist. Vadodara, 400 kms. from India's commercial capital of Mumbai, in 1994 and expanded in 1999. The facility at present manufactures 32,000 MT. of Rods, 50,500 MT. of AAC, AAAC and ACSR Conductors and 11,500 kms. of Power, Control and Aerial Bunch Cables. The key equipments are:

- Two oil fired furnaces with a capacity of 20 MT. each integrated with online solution heat treatment plant & Rod mill
- 10 very high speed fully Automatic Wire Drawing Machines
- 10 stranding machines of 1+6 strands and 12 of multi strands including 3 lines facility to make 61 and 91 stranding conductors for EHV applications in one process
- The Cables division is equipped with 3 extrusion machines, 2 laying machines & other allied machines
- Five DG sets of 625 KVA, Two DG sets of 500 KVA and Three DG sets of 1025 KVA for back-up purposes

## Quality Policy

We firmly believe that quality leads to customer delight, which is why we have developed stringent quality measures and standards. DPIL implements a structured Quality Policy with well-defined objectives and goals.

## Quality Objectives

- Maintaining consistency in product attributes, timely delivery, and services
- Encouraging participation of employees in improving quality and efficiency
- Safe and healthy work environments and optimized utilization of energy resources
- Continual employee training



## Quality Certifications

Third party validation of products is a significant way of measuring quality in the market place. Our products have been type tested at:

- Central Power Research Institute, Bangalore
- Electrical Research and Development Association, Vadodara
- TAG Corporation, Chennai
- Govt. Testing Laboratory, Govt. of Haryana
- Bureau of Indian Standards labs
- CEPRI, China
- SABS, South Africa



## AERIAL BUNCH CABLES FOR LT LINES (ABC)

Preamble :

Due to quick revolutionary growth in various industries in India, people have started migrating in industrial cities/town as a result, cities get thickly populated, and even narrow streets are getting congested.

The only solution to distribute power in such areas, the system called ABC has been now widely adopted all over the world, specially in thickly populated areas and Narrow Street.

In the ABC system the insulated aluminium conductors (3 or 4) in number as required on formation can be used in phase conductor as per the specific requirement of site- situation, which twisted around high strength aluminium /ACSR bare /Insulated wire, which carries the main weight and also serve as earth cum neutral wire even streetlight phase can be combined in such formation: As such phase and street light conductors are not under tension:

The system is very safe and more or less maintenance free and faults are practically eliminated. Moreover more power connections can be given from one ABC. Cost of poles hardware for overhead conductors construction can be reduced, and way-leave-clearance problems can be eliminated due to ABC system. Even theft problem of power can be minimized by use of ABC system. As such it also increase the life of precious equipment like transformer and other allied equipments. Problem of clearance in narrow streets also gets minimized.

Diamond Power Infrastructure Ltd.(DPIL) has a pioneered infrastructure facility for manufacturing of all type of ABC for coping up any requirement of customers. In this manual we have tried to cover up all salient technical features of ABC, which will enhance and encourage implementation of ABC-system in distribution network from safety point of view.

Regards

Diamond Power Infrastructure Ltd

## AERIAL BUNCH CABLES FOR LT LINES

In the ABC system, the insulated conductors (3 or 4 numbers as required) are twisted around a high strength aluminum alloy bare wire, which carries the main weight and also serves as the earth-cum-neutral wire. The bare wire (messenger) may be bare or insulated. The phase conductors are not under tension.

The system is very safe and LT faults are practically eliminated. Consequently, interruptions of supply are minimized and the life of transformers is considerably increased, as these are not subjected to frequent faults as happens with the bare conductors. The problem of tree clearance is also minimized.

ABC Cable construction is generally and popularly convenient for catering LT power to more number of consumers without any clumsy requirement of hardware and as such voltage problems are also reduced to notable extent. The phase and street lighting conductors shall be insulated with black weather resistant polyethylene suitable for 1100-volt insulation. Even Cross Linked Polyethylene (XLPE) insulation with special colour requirement is also opted by many countries.

Due to elimination of insulators and associated hardware, ABC system is more convenient as compared to overhead LT lines system as conventional electrical requirement of feeding power to LT consumer is fulfilled in better way.

### GENERAL

The Phase & Street lightening Conductors shall be insulated with Black weather resistant polyethylene Insulation on an optional basis. 1100 V Insulation. If desired, Diamond Power Infrastructure Ltd. can also provide Cross Linked Polyethylene (XLPE) Insulation.

The insulated phase conductors (with additional street lighting conductor, if provided) shall be twisted around the bare aluminum alloy messenger wire, which shall take all the mechanical stress. The messenger wire shall also serve as the earth-cum neutral wire.

### ADVANTAGES (ABC SYSTEM)

- All L.T. line faults are practically eliminated, maintaining uninterrupted supply.
- Tripping of Transformers decreases considerably since the line hardly subjected to faults.
- A problem of Tree clearance is totally avoided due to reduction in pole height.
- Insulators are completely eliminated from the insulation of ABC lines.
- The initial cost of laying the line is more or less same as conventional Conductors.
- The possibility of theft of power is reduced substantially since unauthorized tapping of power cannot be done without removing the insulation.
- In remote areas, it is possible to maintain continued power supply with power.
- High capacitance and low inductance leading to low impedance of lines.
- Lower Voltage Drop, Higher Current capacities, vis-à-vis better system stability.
- Longer spans and longer distance lines are possible with better system stability.
- It can be over hung in dense vegetation and forests.
- Additional connections can be easily and quickly made with hot-line connectors.
- Total lines are reduced and maintenance is very easy. More or less maintenance free.
- Multiple circuits of power and telephone cables could be strung in the same set of poles.

### 1.SCOPE:

- 1.1 This specification covers the requirements of polyethylene/cross linked polyethylene insulated cables with aluminum conductors twisted over a central bare/insulated aluminum alloy messenger wire for use as overhead distribution feeders.
- 1.2 The cables covered in this standard are suitable for use on three-phase ac (earthed or unearthed) system for rated voltage up to and including 1100 V.

Note: The cables conforming to this standard may be operated continuously at a power frequency voltage to percent higher than the rated voltage.

- 1.3 The cables covered in this standard are suitable for use where the combination of ambient temperature and temperature rise due to load, including temperature on exposure to direct sunlight results in conductor temperature not exceeding the following:

Type of Insulation	Normal Continuous Operation	Short Circuit Operation
Polyethylene	70°C	160°C
Cross linked Polyethylene	90°C	250°C

## 2. APPLICABLE STANDARDS:

The rated voltage of the cable shall be 1100 volts. Unless otherwise stipulated in this specification, the following standards shall be applicable.

1. IS: 1596 1984: Polyethylene insulated cable 1100 volts
2. IS: 8130-1984: Conductors for insulated cables
3. IS: 6474 -1984: Polyethylene insulation of cables.
4. IS: 398 -1994: (Part IV) Aluminium alloy conductor.
5. IS: 398 1996: (part II) For ACSR conductor.
6. IS: 14255 1995: Aerial Bunched Cable Specification
7. IS: 7098 (PI) 1988 with latest version.

## 3. TERMINOLOGY

For the purpose of this standard the following definition to those given in IS 1885 (Part 32): 1993 shall apply.

### 3.1 Routine Tests

Tests made by the manufacturers on all finished cable lengths to Demonstrate the integrity of the cables.

### 3.2 Type Tests

Tests required to be made before supply on a general commercial basis on a type of cable in order to demonstrate satisfactory performance characteristics to meet the intended application.

**Note:** These tests are of such a nature that after they have been made, they need not be repeated unless changes are made in the cable materials of design, which might change the performance characteristics.

### 3.3 Acceptance Tests

Tests carried out on samples taken from a lot for the purpose of acceptance of the lot.

### 3.4 Optional Tests

Special tests to be carried out, when required by agreement between the Purchaser and the supplier.

### 3.5 Earthed System

All electric system, which fulfills any of the following conditions:

- a) The neutral point or mid point connection is earthed in such a manner that even fault conditions, the maximum voltage that can between any conductor and earth does not exceed 80 percent of the nominal system voltage;
- B) The neutral point or mid point connection is not earthed but a protective device is installed which automatically cuts out part of the system which accidentally becomes earthed; or
- c) In case of ac system only, the neutral point is earthed through an ARC suppression coil with arrangement for isolation within 1 hour of occurrence of the fault provided that total of such periods in a year does not exceed 125 hours.

### 3.6 Unearthed System

An electric system which does not fulfill the requirements of earthed system (see 3.5 (a), (b), (c)).



## MATERIALS

### 4. CONDUCTOR

- 4.1 The power/outer insulated neutral/street lighting conductors shall conform to flexibility class 2 of IS 8130: 1984.
- 4.2 The messenger (Neutral conductor) or otherwise shall be either stranded circular or compacted circular type and shall have minimum 7 strands. The surface of the conductor shall be smooth.
- 4.3 A protective barrier may be applied between the conductor and insulation, if required. Such barrier when used, shall be compatible with insulating material and suitable for the operating temperature of the cable.
- 4.4 The size of street lighting conductor shall be (16mm<sup>2</sup>).
- 4.5 The size of messenger conductor and its breaking load shall be as per Table 1.

**TABLE 1 SIZE AND REQUIREMENTS OF  
MESSENGER CONDUCTOR**

**(CLAUSE 4.5)**

Sr. No.	Nominal Cross Sectional Area of phase	Messenger Conductor		
		Nominal Cross Sectional Area	Maximum dc Resistance at 20° C	Minimum Breaking Load
	mm <sup>2</sup>	mm <sup>2</sup>	Ohm/km	Kn
(1)	(2)	(3)	(4)	(5)
i)	16	25	1.38	7.0
ii)	25	25	1.38	7.0
iii)	35	25	1.38	7.0
iv)	50	35	0.986	9.8
v)	70	50	0.689	14.0
vi)	95	70	0.492	19.7

- 4.6 There shall be no joints in any wire of the messenger conductor except those made in the base rod or wires before final drawing. The direction of outer layer of wires in messenger conductors shall be right hand.

### 4.7 CORE IDENTIFICATION:

The phase conductors shall be provided with one, two or three 'ridges' and Outer neutral insulated conductor, if provided, shall have four 'ridges' as shown in Fig. 1 for quick identification. The street lighting conductor and messenger conductor (if insulated) shall not have any identification mark.

Identification by other means, as agreed between the supplier and purchaser, is also permissible.

### 4.8 ASSEMBLY (LAYING UP):

Three insulated phase conductors, one insulated neutral conductor (if required) and a street lighting conductor (if required) shall be twisted around the bare (or insulated) as required messenger conductor without fillers with a lay not exceeding 35 times the diameter of the insulated phase conductor.

The direction of lay shall be right hand.

## PHASE CONDUCTOR & NEUTRAL CONDUCTOR

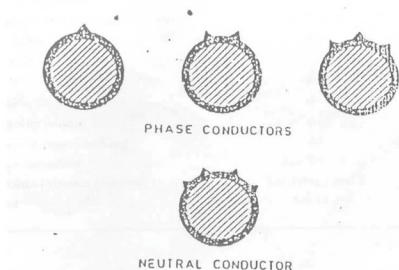


FIG. 1 CORE IDENTIFICATION

### 4.9 Phase/Street Lighting Conductor

The conductor shall be of H2 or H4 grade aluminium complying with the Requirements of IS 8130: 1984.

#### PHASE CONDUCTOR

1. The phase conductor and street lighting conductors shall be insulated with black weather resistant, polyethylene suitable for 1100 v insulation, the insulated conductors shall generally conform to the standards, applicable standards.
2. The phase conductors shall be suitable compacted and the outer diameter shall be within the limits specified.
3. The phase conductors shall be provided with one, two and three 'ridges' for quick identification.
4. The tensile strength of aluminium wire used in the conductors shall not be less than 90 N/mm<sup>2</sup>.
5. The standard sizes and technical characteristics of the phase and street lighting conductors shall be as shown in the following table.

Nominal sectional area (mm <sup>2</sup> )	No. Of strands	Dia. Of compacted Conductor (mm)	Approx. mass (Kg/km)	Max.D.C. resistance NCE at 20°C	Insulation Thickness (mm)
16	7	4.4	42	1.91	1.0
25	7	5.8	65	1.20	1.0
35	7	6.8	95	0.868	1.0
50	7	7.9	127	0.641	1.2

Note: The resistance value given in Col. 5 are the max. permissible Tolerance of +/-5% is allowable on diameters shown in col.3

#### 4.10 Messenger (Neutral Conductor or Otherwise)

The conductor shall be of heat-treated aluminium magnesium-silicon alloy wires containing approximate 0.5% magnesium and approximately 0.5% silicon conforming to IS 398 (Part-4): 1979.

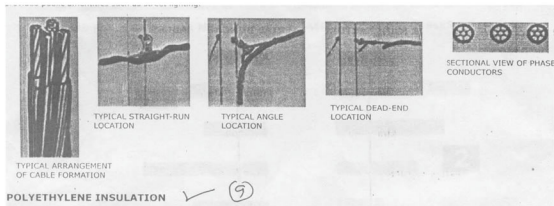
Customers can opt for ACSR as messenger wire. Messenger wire can be either bare OR insulated as per customer's requirement.

1. The bare messenger wire shall be generally made of aluminium alloy wire/ACSR conforming to IS: 398 (Part IV) 1994/398 (PartII) 1996 with latest amendment composed of 7 strands and shall be suitably completed to have smooth surface to avoid damage to the polyethylene insulation of the phase conductors twisted around the messenger.
2. There shall be no joints in any wire of the stranded messenger conductor except those made in the base rod or wires before final drawing the size and other technical characteristics of the messenger wire shall be given in the following table.

Normal Sectional area	No. of strands	Dia of compacted cond. (mm)	Approx. Mass (kg/km)	Max. D.C.resistance NCE at 20% ohm /km	Min. Tensile Strength (KN)
25	7	5.8	65	1.380	7.4
35	7	6.8	95	1.380	10.3

Note: While the limiting values in col.5 & 6 are to be guaranteed and 5% plus tolerance will be permissible on values in col.3.

The number of the insulated Phase Conductor in an ABC cable will vary depending on the specifications and requirement of customer. Whereas, the ABC Cable with a single Insulated conductor is called Duplex, the one with two insulated Conductors is called Triplex, and the one with three insulated Conductors is called Quadruple. In addition to this, a street lighting or an emergency service conductor may also be provided public amenities such as street lighting.



#### COMPOSITION AND DESIGNATION OF FINISHED CABLES

- 4.11 The composition and designation of finished cables are given in the following table.

Sr. No.	Designation	Complete Bunched Cables overall Dia in mm (Approx)	Total Mass approx in Kg/km
1	3X16+25	19	250
2	3X16+16+25	19	310
3	3X25+25	22	330
4	3X25+16+25	22	390
5	3X35+25	24	430
6	3X35+16+25	24	490
7	3X50+35	32	580
8	3X50+16+35	32	640

Note: The first part of the designation refers to the number and size of the phase conductor, the middle to the street lighting conductor (were provided) and the last to the bare messenger wire. The sizes shown are the nominal sectional areas.

1. Polyethylene insulation will generally conform to IS1596:1984 and IS-6474:1984 and XLPE insulation conforming to IS 7098 (P.I)/IS 14255.
2. Cable Phase or street Lightning will conform to IS-8130/1984 duly compacted.
3. The messenger (neutral conductor) will generally conform to IS-398 (Part 4) 1994/IS 398 Part II/1996 for aluminium Alloy Conductors or ACSR Conductors duly compacted.

## 5. INSULATION:

- 5.1 The insulation shall be either of cross-linked polyethylene compound or of ordinary PVC compound. Conforming to requirement given in Tables 1 and 2 respectively.

**TABLE 2 Properties of XLPE Insulation  
(Clause 5.1)**

Sr.No. (1)	Tests (2)	Requirements (3)
1	Tensile strength	12.5 N/mm <sup>2</sup> , Min
2	Elongation at break	200 percent, Min
3	Ageing in air oven: a) Treatment: Temperature Duration  b) Tensile strength variation c) Elongation variation	135 °C ± 3 °C 7 days  ± 25 percent, Max  ± 25 percent, Max
4	Hot set: a) Treatment: Temperature Time under load Mechanical Stress  b) Elongation under load c) Permanent elongation (set) after cooling	200 +/- 3 °C 15 Min 20 N/cm <sup>2</sup>  175 percent, Max  15 percent, Max
5	Shrinkage: a) Treatment: Temperature Duration  b) Shrinkage:	130 °C ± 3 °C 1 hour  4 percent, Max
6	Water absorption (Gravimetric): a) Treatment: Temperature Duration b) Water absorbed	85 °C ± 2 °C 14 days 1 mg/cm <sup>2</sup> , Max
7	Volume resistivity: a) at 27 °C b) at 90 °C	1X10 <sup>13</sup> ohm-cm, Min 1X10 <sup>11</sup> ohm-cm, Min
8	Carbon Black: a) Content b) Dispersion	Under consideration

**TABLE 3 PROPERTIES OF PE INSULATION  
(CLAUSE 5.1)**

Sr.No.	Property	Requirements
1	Volume /resistivity: a) at 27°C b) at 70°C	1 X 10 <sup>14</sup> ohm-cm, Min 1 X 10 <sup>12</sup> ohm-cm, Min
2	Tensile Strength	10 N/mm <sup>2</sup> , Min
3	Elongation at break	300 percent, Min
4	Melt flow index	3, Max
5	Vacant softening point	85°C, Min
6	Carbon black: a) Content b) Dispersion	Under consideration
7	Environmental stress cracking	No cracks shall be visible to marked eye

The conductor (with protective barrier, wherever applied) shall be Provided with cross-linked polyethylene or polyethylene insulation applied by extrusion.

#### Thickness Of Insulation

This average thickness of insulation shall be not less than the nominal value (t<sub>i</sub>) specified in Table-4.

**TABLE 4 THICKNESS OF INSULATION**

Nominal Area of Conductor	Nominal Thickness (t <sub>i</sub> )
mm <sup>2</sup>	mm
(1)	(2)
16	1.2
25	1.2
35	1.2
50	1.5
70	1.5
95	1.5

#### Tolerance on Thickness of Insulation

The smallest of measured values of thickness of insulation shall not fall below the nominal value (t<sub>i</sub>) specified in Table 4 by more than 0.1 mm ± 0.1 (t<sub>i</sub>).

#### Application of Insulation

The insulation shall be so applied that it is close to the conductor (or barrier, if any) and it shall be possible to remove it without damaging the conductor.

The colour of insulation shall be black. Customer can opt other colour of insulation on specific demand.

#### POLYETHYLENE INSULATION

The Polyethylene insulation shall generally conform to IS: 6474-1971. The following properties shall be guaranteed by us:

Melt Flow Index	:	0.5 or less
Yield Stress	:	Not less than 8N/mm <sup>2</sup>
Percentage Elongation	:	Not less than 350
Carbon Black Content	:	Between 2 & 3
Vicat Softening Point	:	Not less than 85°C
Volume		
At 27°C	:	1 X 10 <sup>15</sup> Ohm Cm (min)
At 70°C	:	1 X 10 <sup>13</sup> Ohm Cm (min)

## 6. CLASSIFICATION OF TESTS:

### 6.1 TYPE TESTS

#### THE FOLLOWING SHALL CONSTITUTE TYPE TEST

Sr. no.	Tests	Requirement	Test method (Ref to part IS 10801)
(1)	(2)	(3)	(4)
a)	Tests on phase/street light conductor i) Tensile test ii) Wrapping test iii) Resistance test	See IS 8130: 1984 See IS 8130: 1984 See IS 8130: 1984	2 3
b)	Test on messenger conductor: i) Breaking load ii) Elongation test iii) Resistance test	Section table 1 Sec 11.3 Sec Table 1	2 11.3 5
c)	Physical tests for XLPE Insulation: i) Tensile strength and elongation at break ii) Ageing in air oven iii) Hot set test iv) Shrinkage test v) Water absorption (Gravimetric) vi) Carbon Black: 1) Content: 2) Dispersion	See Table 2 See Table 2 See Table 2 See Table 2 See Table 2 Under Consideration	7 11 30 12 33
d)	Physical test for PE Insulation: i) Tensile strength and elongation at break ii) Melt flow index iii) Carbon black: 1) Content 2) Dispersion  iv) Vicat softening Point v) Environmental stress cracking	See Table 3 See Table 3 See Table 3 See Table 3  See Table 3 See Table 3	7 23 32 Under Consideration  22 2
e)	Test for thickness insulation	See Table 4	8
f)	Insulation resistance (Volume receptivity)	See Table 2 & 3	43
g)	High voltage test	See 6.2	45

### 6.2 Acceptance Test

The following shall constitute acceptance tests:

- |   |   |
|---|---|
| a) Tensile test (for phase/street light conductor). | f) Test for thickness of insulation.              |
| b) Wrapping test (for phase/streetlight conductor). | g) Tensile strength and elongation at break test. |
| c) Breaking load test for messenger conductor.      | h) Hot set test for XLPE insulation.              |
| d) Elongation test for messenger conductor.         | i) Insulation resistance test, and                |
| e) Conductor resistance test,                       | j) High voltage test, and                         |

#### INSPECTION:

All tests and inspection shall be made at the place of manufacture unless otherwise especially agreed upon by the manufacturer and purchaser at the time of purchase. The manufacturer shall afford the inspector representing the purchaser all reasonable facilities, without charge, to satisfy him that the material is being furnished in accordance with this specification.

6.2.1 A recommended sampling plan for acceptance tests is given in Annexe

## ANNEXE

(Clause 6.2.1)

### SAMPLING OF CABLES

#### A-1 LOT

A-1.1 In any consignment the cables of the same size manufactured under essentially similar conditions of production shall be grouped together to constitute a lot.

#### A-2 SCALE OF SAMPLING

A-2.1 Sample shall be taken and tested from each lot for ascertaining the Conformity of the lot to the requirements of the specification.

A-2.2 The number of drums (n) to be selected from the lot of drums (N) of Consignment of cable shall be in accordance with col 2 and 1 of Table 5 respectively. These samples shall be taken at random.

In order to ensure the randomness of selection, random number labels shall be used (see IS 4905: 1968 Methods of random sampling).

#### A-3 NUMBER OF TESTS AND CRITERION FOR CONFORMITY

A-3.1 Suitable length of test sample shall be taken from each of the drums selected. These test samples shall be subjected to each of the acceptance to each of the acceptance tests (see 9.2) A. test sample is called defective if it fails in any of the acceptance tests. If the number of defectives is less than or equal to the corresponding permissible number (a) given in col 3 of Table 5 the lot shall be declared as conforming to the requirements of acceptance test, otherwise not.

**TABLE 5 NUMBER OF DRUMS TO BE SELECTED FOR  
SAMPLING AND PERMISSIBLE NUMBER OF DEFECTIVES.**

Number of Drums in The Lot	Number of Drums to be Taken as Sample	Permissible Number of Defectives
N	N	a
Up to 50	2	0
51 to 100	5	0
101 to 300	13	0
301 to 500	20	1
501 and above	32	2

#### 6.3 Routine Tests

The following shall constitute routine tests:

- Conductor resistance test, and
- High voltage test.

#### 6.4 Optional Test

The following shall constitute optional test:

#### 6.5 Bending test

## 7. DETAILS OF TEST:

### 7.1 General

Unless otherwise stated in this standard, the tests shall be carried out in accordance with appropriate parts of IS 10810 taking into account additional information given in this standard.

### 7.2 High Voltage Test

High voltage at room temperature (Type, Acceptance and Routine Test): The cable shall withstand a voltage of (3kvac (rms) at a frequency of 40 to 60 Hz or a dc voltage of 7.2 kV between conductor for 5 minutes.

### 7.3 Elongation Test on Messenger Conductor

Test shall be carried out on wires before stranding. The specimen shall be straightened by hand and an original gauge length of 200 mm shall be marked on the wire. A tensile load shall be applied by means of a suitable tensile testing machine. The load shall be applied gradually and the rate of separation of the jaws of the testing machine shall be not less than 25, per minute and not greater than 100 mm per minute. The elongation shall be measured after the fractured ends have been fitted together. If the fracture occurs outside the gauge marks, of within 25 mm of either mark, and the required elongation is not obtained, the test shall be disregarded and another test made.

The elongation of the specimen shall not be less than 4 percent on a gauge length of 200 mm.

The test shall be performed on a sample of complete cable. The sample shall be bent around a test mandrel at room temperature for at least one complete turn. It shall then be unwound and the process shall be repeated after turning the sample around its axis by 180 degrees. The cycle of these operations shall then be repeated twice. The diameter of the mandrel shall be

$$10 (D + d)$$

Where

D = actual diameter of the cable, for example,

Minimum circumscribing diameter,

mm; and

d = actual diameter of the phase conductor, mm.

Requirement: No cracks visible to the naked eye are allowed.

## SECTIONS IDENTIFICATION, PACKING AND MARKING

## 8. IDENTIFICATION:

### 8.1 Manufacturer's Identification

The manufacturer shall be identified throughout the length of the cable by means of a tape bearing the manufacturers name or trademark and year of manufacture. In case the above method cannot be employed, or if the purchaser so desires, colour identification threads in accordance with a scheme to be approved by the Bureau of Indian Standards (BIS) shall be employed.

### 8.2 Cable Identification

Cables with cross-linked polyethylene insulation shall be identified throughout the length of the cable by the legend 'XLPE 90' and year of manufacture by a printed tape. No identification is required for polyethylene insulation.

**NOTES:** 1 Single tape bearing manufacturer's name or trademark and the cable identification, that is, XLPE 90, if provided shall be acceptable against the requirement of 8.1 and 8.2.

2. Identification required in 8.1 and 8.2 shall be given on any one of the insulated conductor of cables.



## 9. PACKING AND MARKING:

- 9.1 The cable shall be wound on a drum (see IS 10418: 1982) of suitable size and packed. The ends of the cable shall be sealed by non-hygroscopic material.
- 9.2 The cable shall carry the following information either stenciled on the drum or contained in a label attached to it:
- Reference to this Indian Standard, for example, Ref IS 14255:
  - Manufacturer's name or trade-mark:
  - Type of cable and voltage grade:
  - Nominal cross-sectional area of phase conductor:
  - Length of cable on the drum:
  - Number of lengths on the drum (if more than one):
  - Direction of rotation of drum (by means of an arrow):
  - Gross mass;
  - Country of manufacture; and
  - Year of manufacture.
- 9.2.1 The cable (drum or label) may also be marked with the Standard Mark.
- Note:** The use of the Standard Mark is governed by the provision of Bureau of Indian Standards Act, 1986 and the Rules and Regulations made there under. The details of conditions under which the license for the use of Standard Mark may be granted to manufacturers of producers may be obtained from the Bureau of Indian Standards.
- 9.3 **Standard Length:**  
The standard length of 500 with  $\pm 5\%$  and longer length shall be acceptable.
- 9.4 **Non Standard Length:**  
Non Standard Length not less than 50% of the standard length shall be accepted to the extent of 10% of the ordered quantity.

## TECHNICAL PARTICULARS

LT Aerial Bunched Cable 1100 Volts (4 core). References Standard: Generally to IS:7098(I)88

Sr. No.	Description	(3 x 25) + (1 x 16) + (1 x 35)	(3 x 35) + (1 x 16) + (1 x 35)	(2 x 50) + (1 x 25) + (1 x 35)	(3 x 70) + (1 x 25) + (1 x 55)	(3 x 95) + (1 x 50) + (1 x 55)
1.	Power /Neutral Core					
1.1	Conductors					
	(a) Nom. Cross sectional area					
	i) Power Cores (mm <sup>2</sup> )	25	35	50	70	95
	ii) Neutral Core (mm <sup>2</sup> )	16	16	25	35	50
	(b) Max. D. C. resistance conductor At 20° C					
	i) Power Cores (Ω /Km)	1.20	0.868	0.641	0.443	0.320
	ii) Neutral Core (Ω /Km)	1.91	1.91	1.2	0.868	0.641
	(c) Approx. diameter of conductor					
	i) Power Cores (mm)	6.2	7.3	8.35	10.1	12.0
	ii) Neutral Core (mm)	5.1	5.1	6.2	7.3	8.35
1.2	Insulation					
	Minimum thickness					
	i) Power Cores (mm)	0.9	0.9	1.0	1.1	1.1
	ii) Neutral Cores (mm)	0.7	0.7	0.9	0.9	1.0
2.	Messenger Wire (Bare)					
	i) Nom. Cross sectional area (Sq. mm)	35	35	35	55	55
	ii) Approx. breaking load kN	41	41	41	62	62
3.	Current ratings					
	Continuous current carrying	99	122	149	190	235
	Capacity of cable in Air at					
	Ambient temp. 40° C (Amp)					
4.	Approx. weight (Kg./Km.)	580	665	810	1165	1430
5.	Number of cores					
	i) Power Cores (No.)	: 3				
	ii) Neutral core (No.)	: 1				
	iii) Bare messenger (No.)	: 1				
6.	Derating factor					
	Deration factors for variation					
	In Air temperature					
	Air Temp (° C)	30	35	40	45	45
	Rating factor	1.12	1.06	0.94	0.88	0.83
7.1	Identification of Power Cables	By providing ridges on the insulation				
7.2	Laying	Three power cables and one neutral core shall be suitably twisted around bare H. T. Steel Messenger / AAAC				
8.	Details of the Power cores					
8.1	Conductor					
	a) Material	Aluminum to IS: 8120/84				
	b) Flexibility class as per IS: 8130/84	Class-2				
	c) Form of conductor	Compacted circular				
8.2	Insulation					
	a) Material	Cross linked Polyethylene to IS: 7098 (I) /88				
	b) Color of insulation	Black				
9.	Details of the Messenger wire (Bare)					
	a) Material	ACSR/AAAC Conductor to IS: 398 (II) and (IV) respectively				
	b) Form of conductor	Standard circular /compacted circular				

# TECHNICAL PARTICULARS

LT AB Cable 1.1kv (5 core) with Street Lighting Conductor (Ref. Std.): Generally to IS:64+4-71

Sr. No.	Description	(3 x 16) + (1 x 16) + (1 x 35)	(3 x 25) + (1 x 16) + (1 x 35)	(3 x 35) + (1 x 16) + (1 x 35)	(2 x 50) + (1 x 25) + (1 x 35)	(3 x 70) + (1 x 25) + (1 x 55)	(3 x 95) + (1 x 50) + (1 x 55)	(3 x 120) + (1 x 16) + (1 x 35)
1.	Power /Neutral Core							
1.1	Conductors							
	(a) Nom. Cross sectional area							
	(i) Power Cores (mm <sup>2</sup> )	16	25	35	50	70	95	120
	(ii) Street Lighting Conductor (mm <sup>2</sup> )	16	16	16	16	16	16	16
	(b) Max. D. C. resistance conductor At 20° C							
	(i) Power Cores (Ω /Km)	1.91	1.20	0.868	0.641	0.443	0.320	0.253
	(ii) Street Lighting Conductor (Ω /Km)	1.91	1.91	1.910	1.910	1.910	1.910	1.910
	(c) Approx. diameter of conductor							
	(i) Power Cores (mm)	4.4	5.5	6.8	7.9	9.6	11.3	12.7
	(ii) Street Lighting Conductor (mm)	4.4	4.4	4.4	4.4	4.4	4.4	4.4
1.2	Insulation							
	Minimum thickness							
	(i) Power Cores (mm)	1.0	1.0	1.0	1.2	1.4	1.4	1.6
	(ii) Street Lighting Conductor (mm)	1.0	1.0	1.0	1.0	1.0	1.0	1.0
2.	Messenger Wire (Bare)							
	(i) Nom. Cross sectional area (Sq. mm)	25	25	25	35	50	70	70
	(ii) Approx. breaking load (kN)	7.4	7.4	7.4	10.3	14.7	20.6	20.6
3.	Current ratings							
	Continuous current carrying							
	Capacity of cable in Air at Ambient temp. 40° C (Amp)	51	70	86	105	130	155	180
4.	Approx. weight (Kg./Km.)	310	390	490	640	890	1180	1430
5.	Number of cores							
	(i) Power Cores (No.)	3						
	(ii) Neutral core (No.)	1						
	(iii) Bare messenger (No.)	1						
6.	Derating factor							
	Deration factors for variation In Air temperature							
	Air Temp (° C)	30	35	40	45	50	55	
	Rating factor	1.12	1.06	1.0	0.94	0.88	0.83	
7.1	Identification of Power Cables	By providing ridges on the insulation						
7.2	Laying	Three power cables and one neutral core shall be suitably twisted around bare AAAC Steel Messenger /						
8.	Details of the Power cores							
8.1	Conductor							
	a) Material	Aluminum to IS: 8130/84						
	b) Flexibility class as per IS: 8130/84	Class-2						
	c) Form of conductor	Compacted circular						
8.2	Insulation							
	a) Material	High Density Polyethylene to IS: 6474-1971						
	b) Color of insulation	Black						
9.	Details of the Messenger wire (Bare)							
	a) Material	All Alloy Aluminum Conductor to IS: 398 (IV)						
	b) Form of conductor	Standard circular /compacted circular						

## TECHNICAL PARTICULARS

LT Aerial Bunched Cable 1100 Volts (4 core). References Standard: Generally to IS:6474/71

Sr. No.	Description	(3 x 16) + (1 x 25)	(3 x 25) + (1 x 25)	(3 x 35) + (1 x 25)	(3 x 50) + (1 x 35)		
1.	Power /Neutral Core						
1.1	Conductors						
	(a) Nom. Cross sectional area						
	(i) Power Cores (mm <sup>2</sup> )	16	25	35	50		
	(ii) Neutral Conductors (mm <sup>2</sup> )	25	25	25	35		
	(b) Max. D. C. resistance conductor at 20° C						
	i) Power Cores (Ω /Km)	1.91	1.20	0.868	0.641		
	ii) Neutral Conductors (Ω /Km)	1.38	1.38	1.38	0.968		
	(c) Approx. diameter of conductor						
	i) Power Cores (mm)	4.4	5.5	6.8	7.9		
	ii) Neutral Conductors (mm)	5.8	5.8	5.8	6.8		
1.2	Insulation						
	Minimum thickness						
	i) Power Conductor (mm)	1.0	1.0	1.0	1.2		
2.	Messenger Wire (Bare)						
	i) Nom. Cross sectional area (Sq. mm)	25	25	25	35		
	ii) Approx. breaking load (kN)	7.4	7.4	7.4	10.3		
3.	Current ratings						
	Continuous current carrying						
	Capacity of cable in Air at						
	Ambient temp. 40° C (Amp)	60	76	92	110		
4.	Approx. weight (Kg./Km.)	250	330	430	580		
5.	Number of cores						
	i) Power Cores (No.)	: 3					
	ii) Neutral messenger core (No.)	: 1					
6.	Derating factor						
	Deration factors for variation						
	In Air temperature						
	Air Temp (° C)	30	35	40	45	50	55
	Rating factor	1.12	1.06	1.0	0.94	0.88	0.83
7.1	Identification of Power Cables	By providing ridges on the insulation					
7.2	Laying	Three power cables and one neutral core shall be suitably twisted around bare AAAC Steel Messenger /					
8.	Details of the Power cores						
8.1	Conductor						
	a) Material	Aluminum to IS: 8130/84					
	b) Flexibility class as per IS: 8130/84	Class-2					
	c) Form of conductor	Compacted circular					
8.2	Insulation						
	a) Material	Cross linked Polyethylene to IS: 6474-1971					
	b) Color of insulation	Black					
9.	Details of the Messenger wire (Bare)						
	a) Material	All Alloy Aluminum Conductor to IS: 398 (IV)					
	b) Form of conductor	Standard circular /compacted circular					

## Quality Assurance Plan For ABC Cables

Sr. No.	Parameters	Method of Test	Frequency of Test	Acceptance Norms
1	Test on Conductor Phase & Street light.	As per IS 10810 & 8130		
a)	Tensile Test	IS 8130 :1984 IS 10810 Pt-2	One drum of each size & Type Manufacturing in a month /each control unit of 5000 mtr or less.	AS Per IS 8130
b)	Wrapping Test	10810-Part-3	One drum of each size & Type Manufacturing in a month /each control unit of 5000 mtr or less..	AS Per IS 8130
c)	Resistance Test	IS 10810-Part-5	Every Drum	AS Per IS 8130
2	Test on messenger conductor	As per IS 10810 & IS 14255-1995		
a)	Breaking load	IS –10810 Part-2	Each Control Unit of 5000 mtr or less	Clause-2 , 6.5 on IS 14255 :1995
b)	Elongation Test	IS 14255-1995 clause 11.3	Each Control Unit of 5000 mtr or less	Clause 11.3 Of IS 14255 :1995
c)	Resistance Test	IS 10810 Part- 5	Every drum	As per IS 14255-1995 & IS-8130
3	Test for thickness (Thickness of Insulation)	IS 10810 Part-8	Every drum	As per IS 14255-1995
4	Physical test on insulation XLPE			
a)	Tensile strength & elongation at break	IS-10810 Part-7	One drum of each size & type Manufacturing in a month	As per IS 14255-1995
b)	Aging in air oven	IS-10810 Part-11	one drum or each size & type Manufacturing in a month	As per IS 14255-1995
c)	Hot Set Test	IS–10810 Part-30	Every Drum	As per IS 14255-1995
5	Shrinkage Test	IS 10810 Part-11	Each control unit of 5000 mtr or lots of one drum of each size & type manufacturing in a month	IS 14255-1995
4-6	Water absorption Test (gravimetric)	IS 10810 Part 33	Each control unit of 5000 mtr or lots of one drum of each size & type manufacturing in a month	IS 14255-1995
7	Electrical Test on insulation			
a)	Volume resistivity at 27°C & at 90°C	IS 10810 Part-43	Each control unit of 5000 mtr or lots of one drum of each size & type manufacturing in a month	IS 14255 –1995
b)	High voltage A.C. Test at room Temp.	IS 10810 Part-45	Every Drum	IS 14255 –1995
c)	High voltage test( Water Immersion Test )	IS 10810 Part-45	One drum of each type & size manufacturing in a month	IS 14255 –1995
d)	Spark Test	IS 10810 Part-44	Entire length of core after extrusion/insulation	IS 14255 –1995
8	Bending Test on Corrupted Cable	Clause 11.4. of IS 14255-1995	Each size of Type Manufacturing in a month	IS 14255 –1995
9	Physical Test for PE insulation			
a)	Tensile strength Elongation at break	IS 10810 Part-7	Every Drum	IS 14255 –1995
b)	Melt Flow index test	IS 10810 Part-23	One drum of each size & Type manufacturing in a month	IS 14255 –1995
c)	Carbon black content	IS 10810 Part-32	One drum of each size & Type manufacturing in a month	IS 14255 –1995
d)	Vicat Softening Point	IS 10810 Part-22	One drum of each size & Type manufacturing in a month	IS 14255 –1995
e)	Environmental Stress Cracking	IS 10810 part-29	One drum of each size & Type manufacturing in a month	IS 14255 –1995
10	Packing & Marking	IS 10418-1982	Every Drum	IS 14255 –1995



COMPACTED  
CROSS SECTION OF  
PHASES CONDUCTORS



COMPACTED  
UN-INSULATED  
NEUTRAL CONDUCTOR

NEUTRAL  
CAN BE INSULATED  
OR MAY BE UN-INSULATED  
IS OPTIONAL

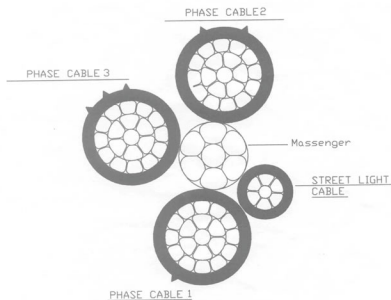


INSULATED COMPACTED  
NEUTRAL OR MESSENGER  
CONDUCTOR



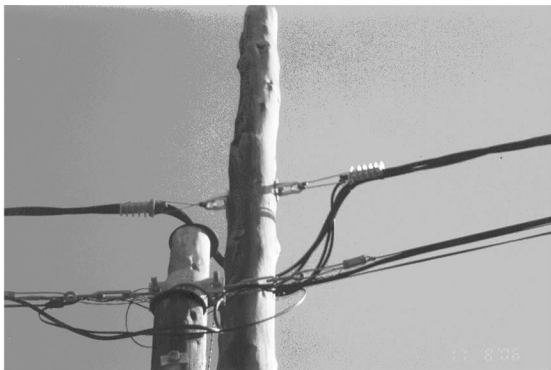
COMPACTED  
STREET LIGHT  
CONDUCTOR

CHOISE OF  
STREET LIGHT  
CONDUCTOR IS  
ALSO OPTIONAL



PHASE CABLE 1

cross-section of  
4+1 A.B.C. CABLE







**Corporate Office**

"Essen House", 5/9-10, B.I.D.C., Gorwa, Vadodara, 390016  
Tel.: 0265-2294328, 2283969, 2280973  
Fax: 0265-2280528 • Email: [marketing@dicabs.com](mailto:marketing@dicabs.com)

**GLOBAL Office**

DIAMOND POWER GLOBAL HOLDINGS LTD  
Office No-108, Al Wasl Building, Opp. Burj Khalifa 1<sup>st</sup> Interchange,  
Sheikh Zayed Road, Next to Porsche Showroom, P.o. Box: 11765 Dubai, U.A.E  
Tel.: +971-43804030 • Fax: +971-43804110 • Email: [marketing@dicabs.ae](mailto:marketing@dicabs.ae)

**Branch Offices**

New Delhi - B-62, 6th Floor, Himalaya House, 23, Kasturba Gandhi Marg, New Delhi-110001  
Tel.: +011-45662531 • Email: [delhi@dicabs.com](mailto:delhi@dicabs.com)

Mumbai - '349 Business Point' Office No. 401, Western Express Highway, Andheri East, Mumbai - 400069  
Tel.: 022-28314733 • Email: [mumbai@dicabs.com](mailto:mumbai@dicabs.com)

Ahmedabad - +91 9714856569

Chennai - +91 9327237171

Meerut - +91 9958372727

Surat - +91 8140368464

Hyderabad - +91 9703398866

**[www.dicabs.com](http://www.dicabs.com)**