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PUBLIC ELECTRICITY CORPORATION
SPECIFICATION FOR
LINE INSULATORS
Specification No. IN-01

Date: Aug - 2020

1.0 SCOPE:

- 1.1 This specification covers the requirements of various suspension disc, post, pin, strain and spool type insulators for use in transmission and distribution line construction. 33kV, 6.35/11kV and 230 / 240V lines operating at 50Hz.
- 1.2 The types and quantities as given requirement schedule.

2.0 STANDARDS:

- 2.1 Unless otherwise specified herein, the manufacture and testing of insulators shall meet all applicable minimum requirements constrained in the standards specification listed below, or equivalent:
 - 2.1.1 BS 137 part 1 & 2: for type of insulators and test.
 - 2.1.2 BS 137: for pin insulators.
 - 2.1.3 IEC 383: for Suspension insulators.
 - 2.1.4 BS 137 part 1: for post insulators.
 - 2.1.5 BS 2572 Class 2: for 33KV wood beam stay insulator
 - 2.1.6 BS 729: for Hot dip galvanise

3.0 SERVICE CONDITIONS:

Transformer shall be suitable to ensure satisfactory operation for the following altitude, climatic and atmospheric site conditions:

- a Altitude: from sea level up to 2300m will be subjected to lightning strokes.
- b Ambient temperature: -5°C up to 50°C.
- c Wind pressure: (kg/m²) 80 – 130
- d Seismic acceleration: (g) 0.12 -0.05
- e Isokeraunic level: 10 – 18
- f Relative humidity: 5 – 100

g	Solar radiation:	1200W/m ²
h	Atmosphere:	Heavy salt and dust laden pollution in coastal areas, moderate sandstorm exposure and dust pollution in low to mid altitude and region and light to heavy dust pollution at high altitudes.

4.0 CONSTRUCTION:

General:

4.1 All lines will be constructed on wood pole structures. Three and for four unit suspension insulator strings will be applied at 33 kV angles and deadends respectively. Two unit strings will be applies on all 11 kV angles and deadends. Line design criteria are based on achieving the basic insulation levels.

- 33 kV line BIL 250 kV – 200 kV
- 11 kV line BIL 150 kV

4.2 Suspension insulator shall be disc type, and made of either high quality commercial grade wet process porcelain or toughened glass. Post, pin, strain, and spool type insulators shall be single piece insulators made only of high quality commercial grade wet process porcelain.

4.3 All porcelain shall be sound, free from defects and thoroughly vitrified. Toughened glass shall be sound and free from defects and blemishes.

4.4 All surfaces of porcelain insulators exposed after assembly (excluding a firing surface in the case of spools) shall be glazed. Glazing shall be smooth, hard, and free from significant imperfections. Glaze colour shall be brown or blue.

4.5 All metal parts of insulators shall be made of good commercial grade malleable iron, ductile iron, or steel. All ferrous parts, other than stainless steel, shall be hot dip galvanised in accordance with BS 729 or equivalent. Metal surface should be free of any sharp burrs, ridges, or protrusions.

4.6 The design and manufacture of insulators shall be such that stresses due to expansion and contraction of any part of the insulator shall not lead to deterioration.

4.7 All insulators shall be designed so that they create no significant contribution to radio interference under normally installed operating condition.

5.0 DETAILED REQUIREMENTS:

5.1 LV (380/220V) Insulators:

5.1.1 Reel Insulator (Shackle insulator): (See Fig 5.1.1)

Insulators shall be manufactured in wet porcelain, glazed brown and shall comply with BS 137 or such other standard as may be approved. Each insulator shall be provided with a centre hole of 17.5mm diameter, having a depth of 65mm and a minimum diameter of 76mm. The central peripheral groove shall have a diameter of 19mm.

The reel insulator shall be capable of withstanding the following test when it is mounted on a standard pin in a rigidly held LV insulator bracket. A flexible wire rope of not less than 12mm diameter shall be looped round the conductor groove and shall be pulled at light articles to the pin of the insulate bracket and in line with the bracket. The load shall be increase to 15 kN at a steady rate and held at this load for a period o less Plan 10 Seconds. This test shall not cause fracture of the insulators. The insulator shall be supported in galvanised mild steel D-irons. All bolts, nuts and washers used shall be hot dipped galvanised and wax impregnated felt washers shall protect the ends of insulators.

5.1.2 Coach Screw Insulators: (See Fig 5.1.2)

Coach screw insulators shall be provided for use where a cautionary cable is to be attached, to a wood distribution pole. The insulator must meet the following specifications:

- Hole diameter (mm) 26
- Length of screw (mm) 57
- Length of insulator (mm) 76
- Base diameter (mm) 64

5.1.3 Stud Insulator With Nut: (See Fig 5.1.3)

Stud insulator and nutt shall be manufactured as above and shall meet the following Specifications:

- Centre hole diameter (mm) 26
- Length of screw and nut (kV)mm 76
- Length of insulator (mm) 76
- Base diameter (mm) 64

5.2 HV (11kV- 33 kV) Insulators:

5.2.1 11kV Pin Insulators: (See Fig 5.2.1)

The pin type insulators shall be salt glazed porcelain, brown colour and shall comply to BS 137 or such other standard as may be approved. Insulator shall have a semi-conducting glazed head and shall a minimum total creepage of 375mm for 11 kV Pin insulator. The insulator pins and threads shall be in accordance with BS. 3288: Part 2 or such other standard as may be approved. The pin head size (thimble) shall be the large steel type to BS Ref. 16 or equivalent, and shall have a minimum failing load. A lead alloy thimble with a corresponding thread shall be cemented into the insulator.

The insulator pins (spindle) shall be manufactured from high tensile and hot dip galvanised to include threaded portion, to BS. 1461 or such other standard as may approved. The nuts are also to be hot-dip galvanised and threads, which shall be cut after galvanising, shall be protected from corrosion by greasing. The pin, in addition to the nut shall have a spring washer and plain washer, also galvanised.

The pin shall have a circular collar and the under collar length shall be 50mm, threaded for 45mm.

The insulator must meet the following specifications according to the required creepage distance:

Type	1	2	3
1. Nominal system voltage rating (kV)	11	11	11
2. Highest system voltage (kV)	12	12	12
3. Outside overall diameter of unit (mm)	171	-	-
4. Total creepage distances (mm)	375	318	540
5. Protected creepage distance (mm)	190	161	-
6. Dry arcing distance (mm)	195	165	-
7. Height of insulator [without spindle] (mm)	178	-	-
8. Height of insulator [form solder of spindle] (mm)	100	-	-
9. Minimum 50HZ flashover of unit [dry] (kV)	90	70	110
10. Minimum 50HZ flashover of unit [wet] (kV)	60	50	75
11. Impulse with stand voltage [dry](kV)	125	95	150
12. Impulse with stand voltage [wet](kV)	125	95	150

5.2.2 Disc Insulators: (See Fig 5.2.2)

Disc insulators of cap and pin type brown glazed porcelain or toughened glass alternatively, the insulator shall comply with IEC standards publications No.120 [1977] 305 [1975] 372 and

383 1976. The insulator shall be provided with sacrificial zinc sleeve. The clip shall be W-type and of phosphor-bronze material. he design shall be such as to allow easy removal or replacement of insulator unit or fitting without the necessity to remove the insulator strings from the cross arms. The insulator must meet following specification according to the required creepage distance:

	Type 1	Type 2	Type 3
1. Type of ball and socket coupling IEC,	16mm	16mm	16mm
2. Creepage distance (mm)	467	300	294
3. Electro-mechanical failing load (kN)	120	80	70
4. Dry lightning impulse withstand voltage kV	125	110	95
5. Wet power frequency withstand voltage kV	45	40	45
6. Power -frequency puncture voltage (kV)	140	110	95

Retaining pins or Socking devises for the insulator units shall be of phosphor bronze, supplied in the hard condition. The pin and locking device shall be such that, when set under any condition of handling or service, nothing but extreme deformation shall allow separation of the insulator units or fittings or cause any risk of the retaining pins or locking de being accidentally displaced. The design shall be such as to easy removal for replacement of insulator units or fit without the necessity to remove the insulator strings from the crossarms. Retaining pins or locking devices shall be incapable of rotating when in position. All ball and socket joint insulator sets shall be lightly coated with approved grease. The insulator type may be normal or open profile type according to the schedule of requirement.

5.2.3 33kV Post Insulator: (See Fig. 5.2.3)

5.2.3.1 The Post type insulator shall be solid core porcelain coloured brown, according to the specified standard. The insulator must meet the following specifications according to the required creepage distance:

Area	Type1	type2	Type3
1. Nominal System Voltage rating (kV)	33	33	33
2. Highest System Voltage(kV)	36	36	36
3. Total Creepage Distance(mm)	1320	1016	1485
4. Minimum Failing Load (kN)	12.5	10	-
5. Withstand Test Voltage:			
a) One minute power-Frequency Wet	12090	150	
b) Impulse with stand Voltage (kV)	250	200	250

Title post insulator shall have short stud 19mm

dia, 50mm long and washers manufactured with tensile steel and shall be hot - dip galvanised.

5.2.3.2 Post insulators supplied under this specification shall be furnished with conductor clamps and mounting stud bolts. Insulator shall be furnished with conductor clamping provisions appropriate to the normally insulated orientation of the insulator.

- 5.2.3.2.1 Pole Top Post Insulators to be installed vertically.
- 5.2.3.2.2 Horizontal Post Insulators to be installed at 5°C to 15°C incline above horizontal.
- 5.2.3.2.3 Insulator shall be fabricated, designed to accommodate 15°C line angles and 30°C vertical angles, and of size to accommodate a 28.7mm overall diameter aluminium armoured conductor.
- 5.2.3.2.4 Each post insulator, pole top or horizontal type, shall be furnished with a steel stud bolt. The stud bolt. The stud bolt shall have a 19mm shank diameter and have a nominal mounting shank length of 50mm. Stud bolts shall be furnished with nuts and lockwashers necessary for mounting surface containing a non-tapped mounting hole.
- 5.2.3.2.5 All stud bolt parts shall be hot dip galvanised.
- 5.2.3.2.6 Horizontal post insulators shall have provision for attaching stringing sheaves in proximity of the insulator clamp, without interfering with installation of conductor clamp.

5.3 Stay Insulators: (See Fig 5.3)

5.3.1 Stay insulators shall be of the knuckle type and shall be of porcelain glazed brown manufactured to BS.137. The holes in the insulators shall be smoothly radiused with large radius as practicable to present an even bearing surface the stay strand loop.

Two types for stay insulator are required, these:

	Type 1 (11kV)	Type 2 (0.4kV)	Type 2 (0.4kV)
• Voltage rating (kV)	11	0.4	33
• Minimum failing load (kN)	110	65.0	110
• Electrical impulse withstand (kV)	95	-	150
• Wet power frequency (kV)	16.0	-	48

6.0 TESTS:

6.1 Insulators shall be tested to comply with applicable requirements contained in the IEC, BS standard or equivalent requirements. Such testing shall be based on 50 cycles power frequency when applicable, and be performed at manufacturer's plant at his expenses.

6.2 Testing requirements defined the following tests for each type of insulator:

6.2.1 Electrical Tests:

- Impulse Flashover Tests.
- Low Frequency Flashover Tests.
- Puncture Voltage Tests.
- Radio Influence Voltage Tests.

6.2.2 Combined Electrical-Mechanical Strength:

- Tension Strength Test.
- Cantilever Strength Test.
- Impact Test.
- Proof Tests.
- Dimensional Check.
- Porosity Checks

6.3 Failure of any of the tests specimen to comply with the requirements of this specification shall constitute grounds for rejection of the lot as represented by the specimen.

6.4 Certified test reports in two (2) copies shall be furnished on each lot of insulators before shipment.

7.0 INFORMATION TO BE FURNISHED:

- 7.1 The supplier shall furnish sufficient information's to fulfil technical Particulars in schedule (A1-9).
- 7.2 Detailed outline drawings of each insulator type, including detailed dimensions of coupling or mounting.
- 7.3 Complete catalogue information.

8.0 SHIPPING AND MARKING:

8.1 Stay insulators completely assembled shall be packed in cartons or boxes containing no more than 10 units per carton or box.

- 8.2 Cartons or boxes shall be packed in wooden crates for shipment.
- 8.3 Shipping crates shall be marked durably on the outside with the following information, in addition to other information as may be required:
 - 8.3.1 Name of manufacturer.
 - 8.3.2 PEC name.
 - 8.3.3 Gross and net weight.
 - 8.3.4 Brief description contents (e.g. stay Insulators).

9.0 SCHEDULE (IN-01) TECHNICAL PARTICULARS

Ref No.	Description	Unit	Data/Qty
9.1	LV REEL INSULATOR (Shackle Insulator)		
1	Applicable Standards		
2	Country of manufacture		
3	Manufacture's Type Number		
4	Insulator depth	mm	
5	Insulator diameter	mm	
6	Central hole diameter	mm	
7	Central peripheral grove diameter	mm	
8	Minimum mechanical failing load	kN	
9	Insulator material		
10	Colour		
11	Number of Insulator per carton		
12	Weight of standard carton	kg	

Signature: _____
Date: _____

SCHEDULE (IN-01) TECHNICAL PARTICULARS

Ref No.	Description	Unit	Data/Qty
9.2	LV COACH INSULATOR		
1	Applicable Standards		
2	Country of manufacture		
3	Manufacture's Type Number		
4	Centre hole diameter	mm	
5	Length of screw	mm	
6	Length of insulator	mm	
7	Base diameter	mm	
8	Minimum mechanical failing load	kN	
9	Insulator material		
10	Colour		
11	Number of Insulator per carton		
12	Weight of standard carton	kg	

Signature: _____
Date: _____

SCHEDULE (IN-01) TECHNICAL PARTICULARS

Ref No.	Description	Unit	Data/Qty
9.3	LV STUD INSULATOR		
1	Applicable Standards		
2	Country of manufacture		
3	Manufacture's Type Number		
4	Centre hole diameter	mm	
5	Length of screw	mm	
6	Length of insulator	mm	
7	Base diameter	mm	
8	Minimum mechanical failing load	kN	
9	Insulator material		
10	Colour		
11	Number of Insulator per carton		
12	Weight of standard carton	kg	

Signature: _____
Date: _____

SCHEDULE (IN-01) TECHNICAL PARTICULARS

Ref No.	Description	Unit	Data/Qty
9.4	11kV PIN INSULATOR		
1	Standard		
2	Country of manufacture		
3	Manufacture's Type Number		
4	50 Hz flashover voltage, dry	kV	
5	50 Hz flashover voltage, wet	kV	
6	Wet power-frequency withstand voltage	kV	
7	Dry power-frequency withstand voltage	kV	
8	Nominal minimum creepage distance	mm	
9	Protected creepage distance	mm	
10	Dry arcing distance	mm	
11	Height of insulator without spindle	mm	
12	Height of Insulator from shoulder to spindle	mm	
13	Minimum bending failing load	kN	
14	Thread pattern		
15	Semi-conducting glazed head	Yes/No	
16	Insulator material		
17	Colour		
18	Number of Insulator per carton		
19	Weight of standard carton	kg	

Signature: _____
Date: _____

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SCHEDULE (IN-01) TECHNICAL PARTICULARS

Ref No.	Description	Unit	Data/Qty
9.5	DISC INSULATOR		
1	Standard		
2	Country of manufacture		
3	Manufacture's Type Number		
4	Lightning impulse withstand voltage	kV	
5	Wet power-frequency withstand voltage	kV	
6	Dry power-frequency withstand voltage	kV	
7	Nominal minimum creepage distance	mm	
8	Nominal diameter of insulator	mm	
9	Minimum electro-mechanical failing load	kN	
10	Type of ball and socket coupling	Yes/No	
11	Insulator material		
12	Colour		
13	Number of Insulator per carton		
14	Weight of standard carton	kg	

Signature: _____
Date: _____

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SCHEDULE (IN-01) TECHNICAL PARTICULARS

Ref No.	Description	Unit	Data/Qty
9.6	33kV POST INSULATOR		
1	Standard		
2	Country of manufacture		
3	Manufacture's Type Number		
4	Lightning impulse withstand voltage	kV	
5	Wet power-frequency withstand voltage	kV	
6	Dry power-frequency withstand voltage	kV	
7	Nominal minimum creepage distance	mm	
8	Nominal diameter of insulator	mm	
9	Minimum bending failing load	kN	
10	Type of insulator clamp	Yes/No	
11	Thread pattern		
12	Material of short stud		
13	Insulator material		
14	Colour		
15	Number of Insulator per carton		
16	Weight of standard carton	kg	

Signature: _____
Date: _____

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SCHEDULE (IN-01) TECHNICAL PARTICULARS

Ref No.	Description	Unit	Data/Qty
9.7	LV STAY INSULATOR		
1	Standard		
2	Country of manufacture		
3	Manufacture's Type Number		
4	Length of Insulator	mm	
5	Insulator diameter	mm	
6	Central hole diameter	mm	
7	Minimum electrical-mechanical failing load	kN	
8	Insulator material		
9	Colour		
10	Number of Insulator per carton		
11	Weight of standard carton	kg	

Signature: _____
Date: _____

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SCHEDULE (IN-01) TECHNICAL PARTICULARS

Ref No.	Description	Unit	Data/Qty
9.8	11kV STAY INSULATOR		
1	Standard		
2	Country of manufacture		
3	Manufacture's Type Number		
4	Length of Insulator	mm	
5	Insulator diameter	mm	
6	Central hole diameter	mm	
7	Impulse withstand voltage	kV	
8	Wet power-frequency flashover voltage	kV	
9	Minimum electrical-mechanical failing load	kN	
10	Insulator material		
11	Colour		
12	Number of Insulator per carton		
13	Weight of standard carton	kg	

Signature: _____
Date: _____

SCHEDULE (IN-01) TECHNICAL PARTICULARS

Ref No.	Description	Unit	Data/Qty
9.9	33kV STAY INSULATOR		
1	Standard		
2	Country of manufacture		
3	Manufacture's Type Number		
4	Insulator length	mm	
5	Insulator width	mm	
6	Impulse withstand voltage	kV	
7	Wet power-frequency flashover voltage	kV	
8	Minimum electrical-mechanical failing load	kN	
9	Insulator material		
10	Colour		
11	Number of Insulator per carton		
12	Weight of standard carton	kg	

Signature: _____
Date: _____

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**PUBLIC ELECTRICITY CORPORATION
SPECIFICATION FOR
OVERHEAD LINE ACCESSORIES**

Specification NO: OA-01

Date: Aug. 2020

1.0 SCOPE:

- 1.1 The works shall comprise manufacture factory testing and delivery of overhead line accessories for 33,11& 0.4 kV net work.
- 1.2 Types and quantities as given in attached schedule of requirements.

2.0 STANDARDS:

- 2-1 Materials and components shall confirm to relevant the latest issue of IEC & BS standards.
- 2-2 All steel structure material shall be galvanised and coated according to the latest issue of BS standards.

3.0 SERVICE CONDITIONS:

The equipment shall be suitable to ensure satisfactory operation for the following altitude, climatic and atmospheric site conditions:

- a) Altitude: from sea level up to 2300m will be subjected to lightning strokes.
- b) Ambient temperature: - 5°C up to 50°C.
- c) Wind pressure: (kg/m²) 80 – 130
- d) Seismic acceleration: (g) 0.12 - 0.05
- e) Isokeraunic level: 10 – 18
- f) Relative humidity: 5 – 100 %
- g) Solar radiation: 1200W/m²

Atmosphere: All materials specified here in will be installed out-doors and will be subjected to moisture salt heavy pollution relative humidity up to 100% dust and intense solar radiation.

4.0 DETAILED REQUIREMENTS:

4.1 Construction:

- 4.1.1 The equipment shall be in accordance with the in the schedule of requirements.
- 4.1.2 Rolled steel sections flats, bolt and nut bars brackets shall, unless otherwise approved consist of mild steel to the latest issue of BS. steel shall be free from blisters, scale or other defects. Thomas process steel will not be acceptable.
- 4.1.3 Angle and channel sections shall confirm to the latest issue of the latest issue of BS.
- 4.1.4 Bending of flat strap should be carried out cold.
- 4.1.5 Dimensions shall be subject to the following tolerances, unless otherwise stated.

Dimensions up to and including 100 mm	1 mm
Dimensions greater than 100 mm	2 mm

4.2 Galvanising:

Galvanising shall be applied by the hot dipped process .The preparation for galvanising and galvanising process shall not effect the mechanical properties of the materials being coated.

Drilling punching cutting bending removal of burrs and all machining shall be completed before galvanising.

The zinc coating shall be smooth clean and of uniform thickness and free from defects. The preparation for galvanising and the galvanising itself shall not adversely affect the mechanical properties of the coated materials.

All galvanised steel which has been cut, drilled or worked on site shall be painted with an approved zinc rich paint.

The average thickness of the zinc coating shall be equivalent to not less than 0.61kg/m2 of zinc for all surfaces, except steel wires. Galvanising will be tested in accordance with the appropriate BS or equivalent standard in order to determine that it complies with this requirement.

4.3 Welding:

Welding shall be carried out in accordance with the latest issue of BS. After welding and before galvanising, welds shall be thoroughly cleaned, particular attention being paid to the prevention of entrapment of slag and spatter. Sand blasting is the preferred method of cleaning weld prior to galvanising.

5.0 LINE ACCESSORIES:

5.1 Steel Angle Cross Arm:

5.1.1 It shall be of galvanised mild steel to the latest issue of BS and hot dipped galvanised to the latest issue of BS drilling patterns will be similar to the latest issue of BS standards patterns.

5.1.2 The size and dimension shall be:

- a) Cross arm length 2230mm, angle section 100x75x10mm (See Fig 5.1 a).
- b) Cross arm length 2400mm, angle section 150x100x10mm (See Fig 5.1 c).

5.2 Tie Strap:

Tie straps shall be used for high voltage; intermediate poles and be supplied with four full nuts. The material of the strap shall be to the latest issue of BS of twisted 38x6.5 mm flat steel to the latest issue of BS, strength grade designation 4.6 and shall meet the requirements for mechanical properties detailed in the latest issue of BS .associated nuts shall be in accordance with the latest issue of BS (see in fig 5.2).

5.3 Stay Rod And Anchor:

5.3.1 The tube section of the adjustable rod shall be manufactured from heavy gauge steel to the latest issue of BS standards.

5.3.2 The stay rod shall have a minimum failing load of 65 kN.

5.3.3 Anchor rods shall be furnished with single or double strand eyes, as specified in attached table 5.3 and Fig No. 5.3(a,b,c) alternatively anchor rods may be furnished with oval eyes together with an equivalent number of wire strand thimble, all thimbles shall be of a size accommodate 11mm diameter stay wire strand and shall be hot dip galvanised.

5.4 Design and performance:

Rods and anchors covered by this specification shall be designed to meet all minimum requirements listed in table 5.3

5.5 Earth anchor and rods:

Shall be designed to enable installation of the anchor of dimension specified on table 5.3 the anchor rod nut retainer which permits controlling of the installed anchor and the removal of the anchor rod from the surface, anchor rods supplied with dimension given in Table No. 5.3 Fig. 5.3.a.

5.6 Expanding Rock Anchor:

Shall be designed to expand firmly and provided full holding capability in a hole no less than 76 mm in diameter Fig 5.3.b.

5.7 Stay Rod Turnbuckle & Thimble:

Shall be designed according to the dimension given table 5.3, Fig 5.3 .C. complete with Anchor plate.

5.8 Stay Wire:

As specified in detail in specification No.OA-02

5.9 Permali Rod (33kV Stay Insulators)

As specified in detail in specification No.OA-03.

5.10 Performed Guy Grips For Steel Stranded Wire:

- 5.9.1 The formed grips shall be designed and constructed in with accepted modern practices used in the manufacture of spring tempered helical rod products .
- 5.9.2 Grips shall be constructed of galvanised steel rods for use on ASTM High strength grade galvanised steel strand. Grip rod galvanised should confirm with the latest issue of ASTM class C coating or equivalent.
- 5.9.3 Grips shall have a rated holding strength equal to the rated breaking strength of the steel strand on which it is intended to be used
- 5.9.4 Steel strand cable size and rating referred to in this specification have dimension as follows:

steel strand size	stranding	Nominal overall	
		diameter	Rated breaking strength
11 mm	7/3.68mm	11.1mm	6500kg
6mm	3/3.05mm	6.4mm	2000kg

5.9.5 Grip covered by this specification shall include designed to accommodate the following application.

5.9.5.1 Grip deadening on groove type fitting anchor rod thimbleyes etc)

5.9.5.2 Grip designed to fasten steel strand stay wire where stay wire is wrapped around pole.

5.9.5.3 Grip shall be assembled in sets containing the appropriate number of rod for individual deadened installation each set should be tagged with proper steel strand size.

(see Fig 5.6)

5.11 Disc Insulator Fittings:

5.10.1 Shall be manufactured from forged steel and have a minimum failing load of 80kn .

5.10.2 Cotter pins and securing pins shall be made of bronze, stainless steel or other equipment Non-corrosive materials.

5.10.3 The following items are included in this specification, See Fig 5.8.3 (1-6)

item	ultimate strength
5.7.3.1 chain link	9000 kg
5.7.3.2 Anchor shackle	8000 kg
5.7.3.3 Hook ball link	11000 kg
5.7.3.4 Socket -eye link	9000 kg
5.7.3.5 Ball clevis	80 kN
5.7.3.6 Socket clevis	80 kN

5.12 Bolts & Nuts:

As specified in detail in specification No. OA-04.

5.13 Washers:(See Fig 5.10)

5.12.1 Washers covered by this specification shall in all respect meet the basic dimension requirements presented in the drawing attached here to.

5.12.2 Washers shall be made from good mild steel in accordance with BS and shall be hot dip galvanised to the latest issue of BS.

5.12.3 Types of washers:

5.12.3.1 Washers Round (Flat):

Round mild steel washers (flat) shall be in accordance with BS table 3 or such other standard as may be approved. (see Fig 5.9 a)

5.12.3.2 Washers -Square (Flat):

Square mild steel washers (flat) shall be in accordance with the latest issue of BS or such other standard as may be approved see Fig (5.9.b).

5.12.3.3 Washers -Square (Curved):

Square mild steel washers (curved) shall be in accordance with Fig No(5.9.c).

5.12.3.4 Spring Washers:

Shall be made from heat treated automotive spring steel, or equivalent in accordance with Fig No. (5.9.d.)

5.12.3.5 Washers Tapered Square Curved:

Malleable iron tapered square (curved) washers shall be in accordance with Fig No. (5.9.e).

5.14 speciality Nuts:
as specified in detail in specification No. OA-05

5.15 O/H Line Brackets:

- 5.14.1 post insulator mounting brackets as specified in detail in specification No. OA-06.
- 5.14.2 swinging angle and shield wire supported brackets as specified in detail in specification No. OA-07.
- 5.14.3 D – Iron brackets for L.V Reel (Shackle) Insulator:
- 5.14.3.1 Shall be made from hot rolled open hearth, basic oxygen or electric furnace and shall be hot dipped galvanised after fabrication in accordance with the latest issue of BS standards.

5.14.3.2 The bracket, shall be complete with bolt and nuts and curved washers.

5.14.3.3 It shall be capable of meeting ultimate strength requirement of :

Dead end loading	1300 kg
Side loading	450 kg

5.14.3.4 Shall be suitable to shackle insulator (reel) dimension as follows:

Depth	65mm
Min Diameter	76mm
Central hole diameter	17.5mm
Central peripheral groove dia.	19mm

5.14.3.5 Dimension and mounting provisions as given in Fig No. 5.11.3

5.14.4 LV out rigger bracket:

5.11.4.1 It shall be made of rolled steel to the latest issue of BS and hot dipped galvanised to the latest issue of BS standards (of general O/H accessories).

5.11.4.2 Dimension and mounting provisions as given in Fig No 5.11.4.

5.14.5 Spindle for Pin insulator :
As specified in detail in specification No. OA-11

5.16 Section and Terminal Straps:

5.12.1 It shall be of galvanised mild steel to the latest issue of BS (grade 43A) and hot dipped galvanised to the latest issue of BS, drilling patterns will be similar to the latest issue of BS standards patterns.

5.12.2 The size and dimension shall be:
 - 550x100x10 (section strap) Fig. 5.12a
 - 150x130x10 (terminal strap) Fig. 5.12b

6.0 TESTS:

6.1 In addition to normal production tests and inspection, a representative number of specimens shall be tested for specified strength requirements in the manufacturer's plant at his expense.

6.2 Certified test report in two (2) copies shall be submitted on each lot of materials before shipment.

7.0 INFORMATION TO BE FURNISHED:

7.1 Bidder shall include in his bid sufficient information to permit a correct evaluation of the bid in relation to this specification, including at least.

7.2 Detailed drawing of each item offered, including accessories, giving dimensions and tolerances.

7.3 The standard specification for screw threads (see paragraph 2.2 above).

7.4 The bidder's declaration on ability to supply screw threads in accordance with paragraph 3.2 above.

7.5 Manufacture's guaranteed bolt strength.

8.0 SHIPPING AND MARKING:

8.1 Bolts should be packed by size and type, together with specified nuts, locknuts and cotters, in cartons or boxes. The packed weight of any carton or box should not exceed 20 kg. Cartons or boxes shall be clearly labelled with name of manufacturer and description and quantity of items.

8.2 Cartons should be packed in wooden crates for shipment.

8.3 Shipping crates shall be durably marked on the outside with the following information in addition to other shipping information as may be required.

- | | Name of manufacturer.
PEC name. | Brief description of contents (e.g. Bolts) | Gross and net weight. |
|-------|------------------------------------|--|-----------------------|
| 8.3.1 | | | |
| 8.3.2 | | | |
| 8.3.3 | | | |
| 8.3.4 | | | |

STAY ANCHOR ROD AND ANCHORS

MINIMUM 12 EQUIVALENT

NO.	ANCHORE ROD TYPE	Plate anchor With rod		Rock anchor expanding type	Rod turn buckle & thimble
		Dia 16 mm	Dia 19 mm		
1	MINIMUM ANCHOR SIZE cm ²	850	1600	N/A	850
2	SPECIAL INSTALLATION FEATURE	Insertin 500mm	Dia	Insertin 60mm Dia	Insertin 500 mm Dia
3	ANCHOR ROD ULTIMATE HOLDING STRENGTH	-12000	-15000	6000kg	25.3 kN
4	MINIMUM ROD LENGTH (mm)	2100	2400	1300	2440
5	MINIMUM ROD DIAMETER (mm)	16	19		
6	ROD EYE PROVISION	Single strand eye 25mm Dia.		Double strand eye	Single strand eye 25mm Dia.

Table 5.3

Signature: _____
Date: _____

9.0 NON COMPLIANCE SCHEDULE

2. NO COMPLIANCE SCHEDULE
The manufacturer 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, operating characteristics and system performance. Each non-compliance shall make reference to the relevant specification clause.

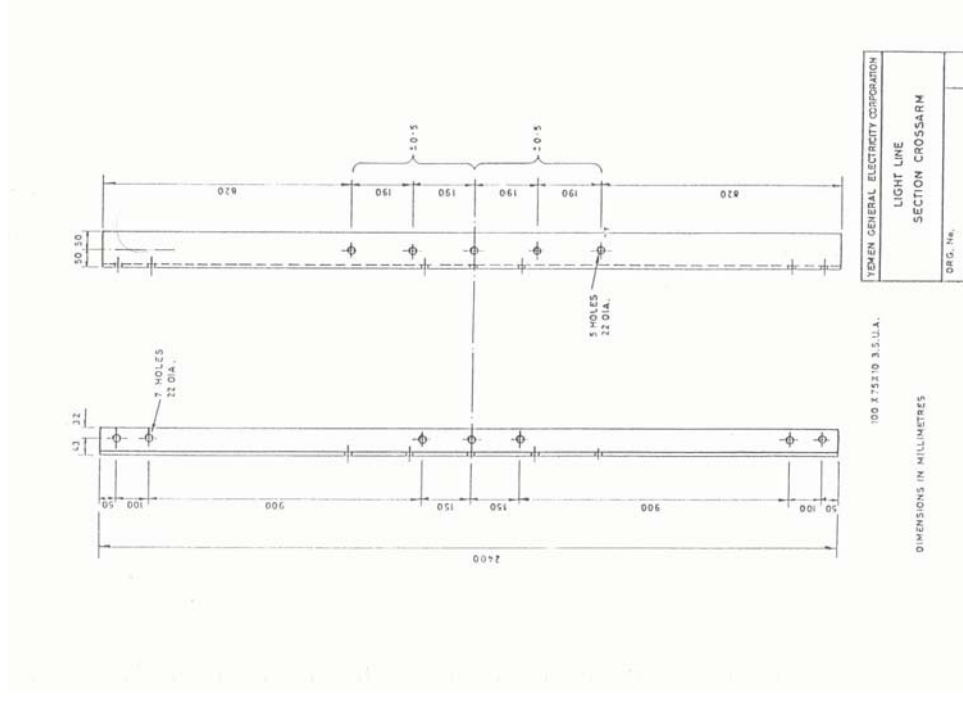
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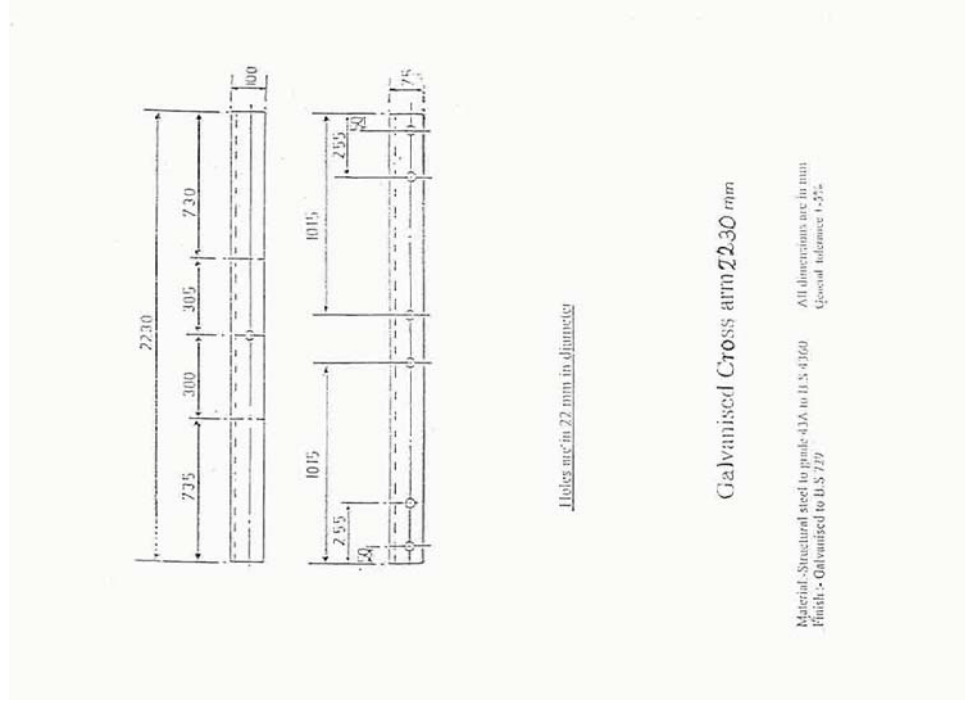
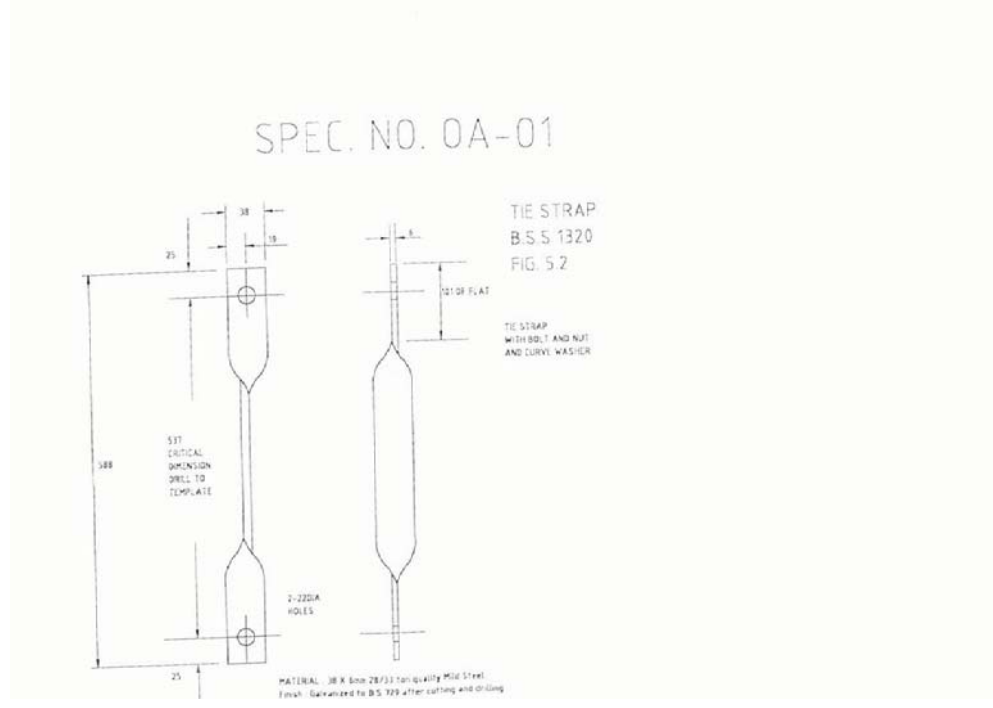
10.0 TEST CERTIFICATES SCHEDULE

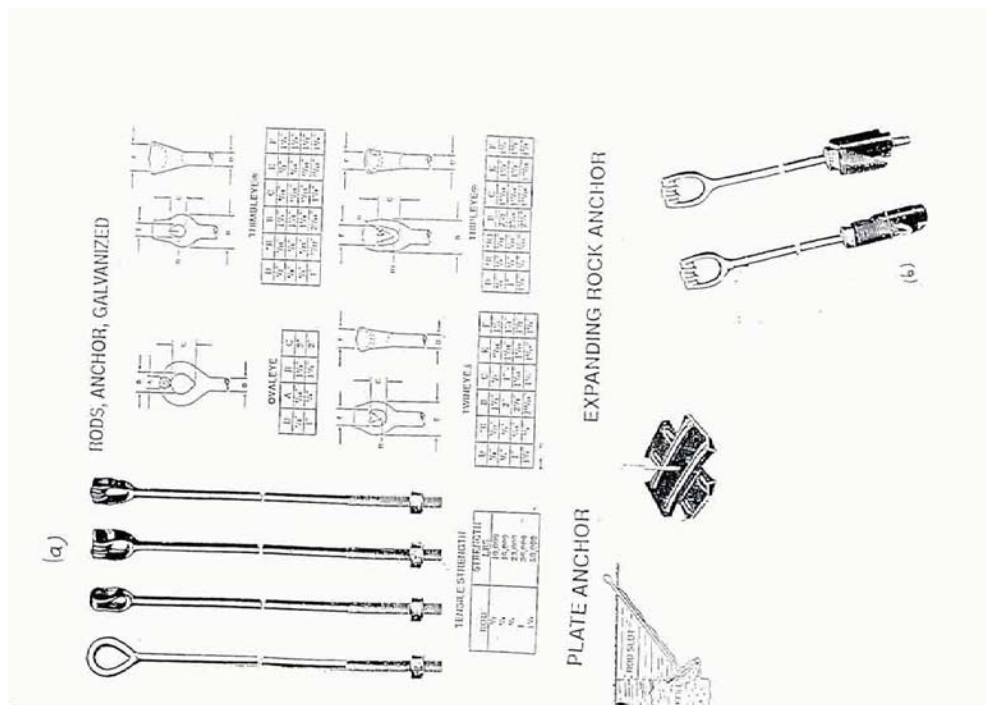
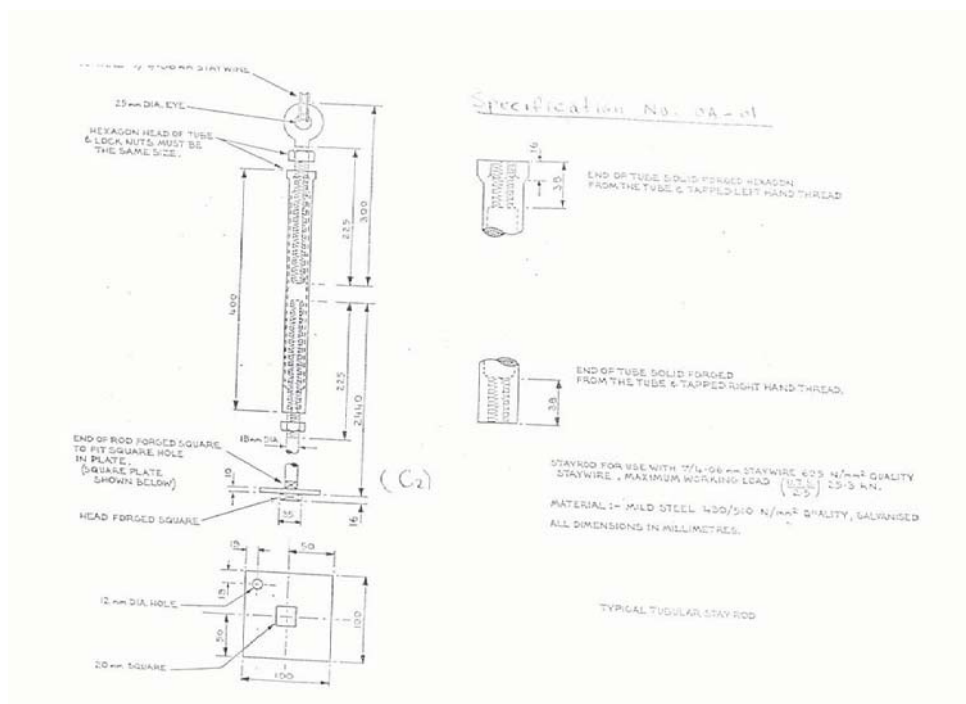
The manufacturer shall provide a list of the test certificates included with the bid. The list shall include type test certificate, routine test report references. Each certificate listed shall as far as possible refer to the relevant specification clause.

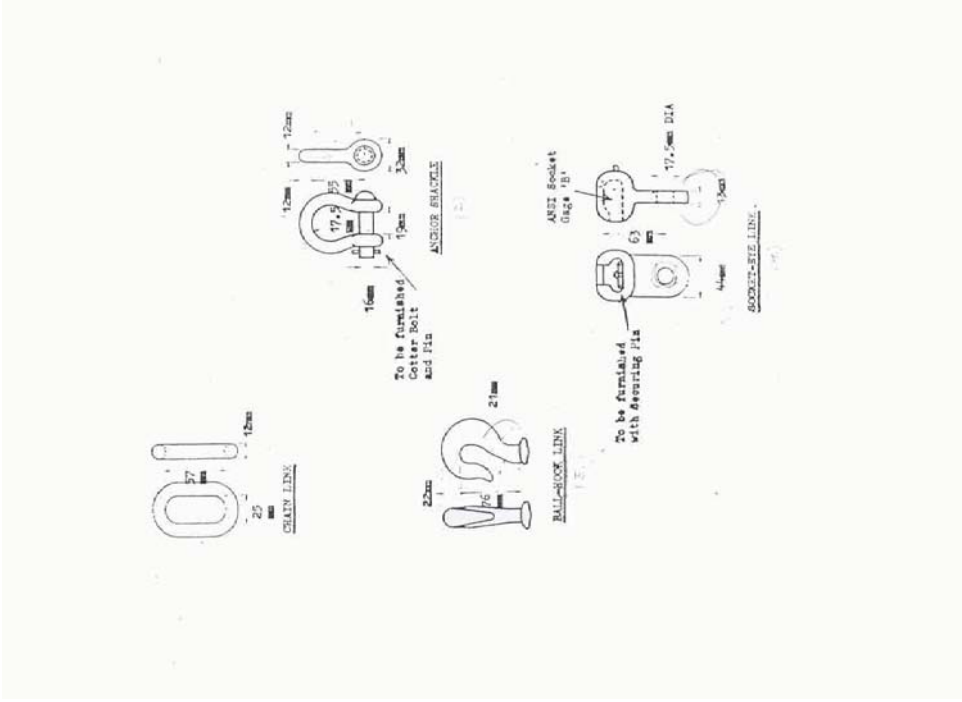
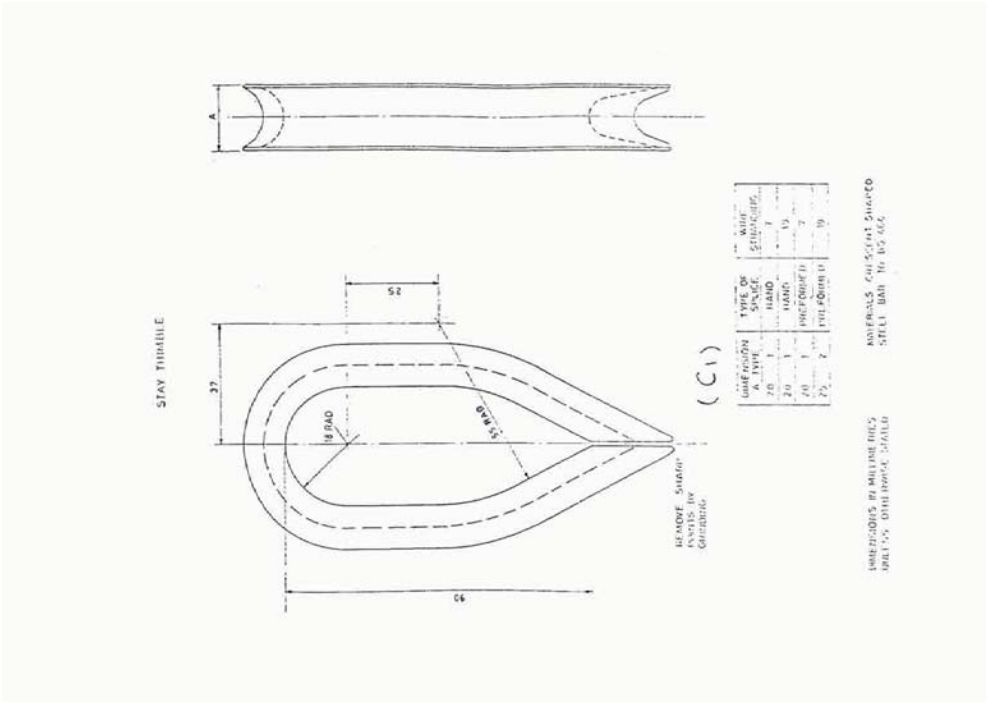
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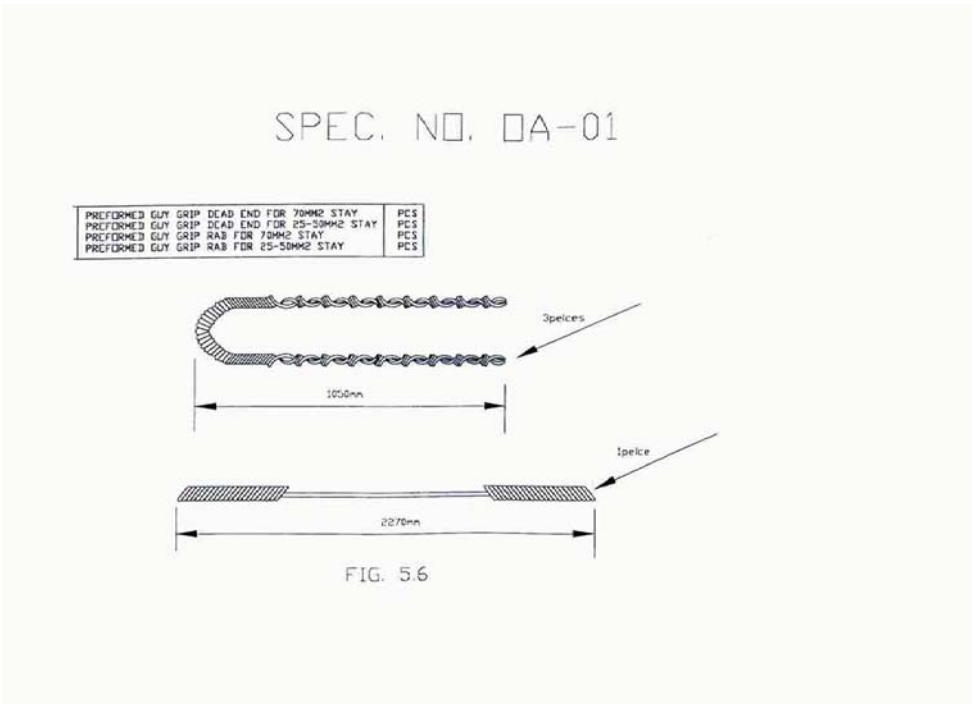
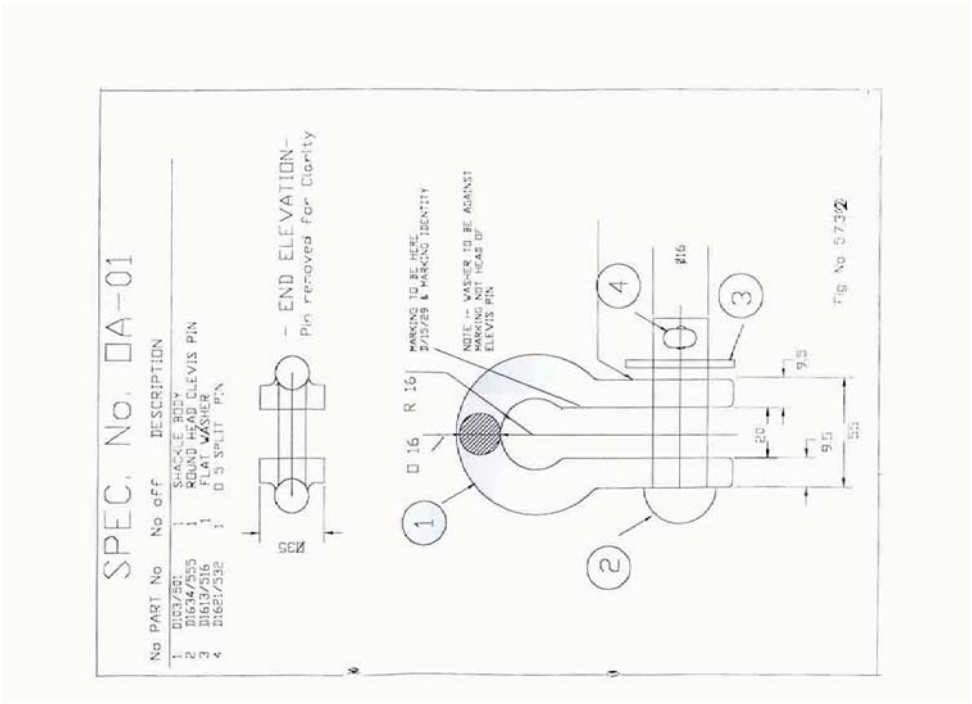
Signature: _____
Date : _____

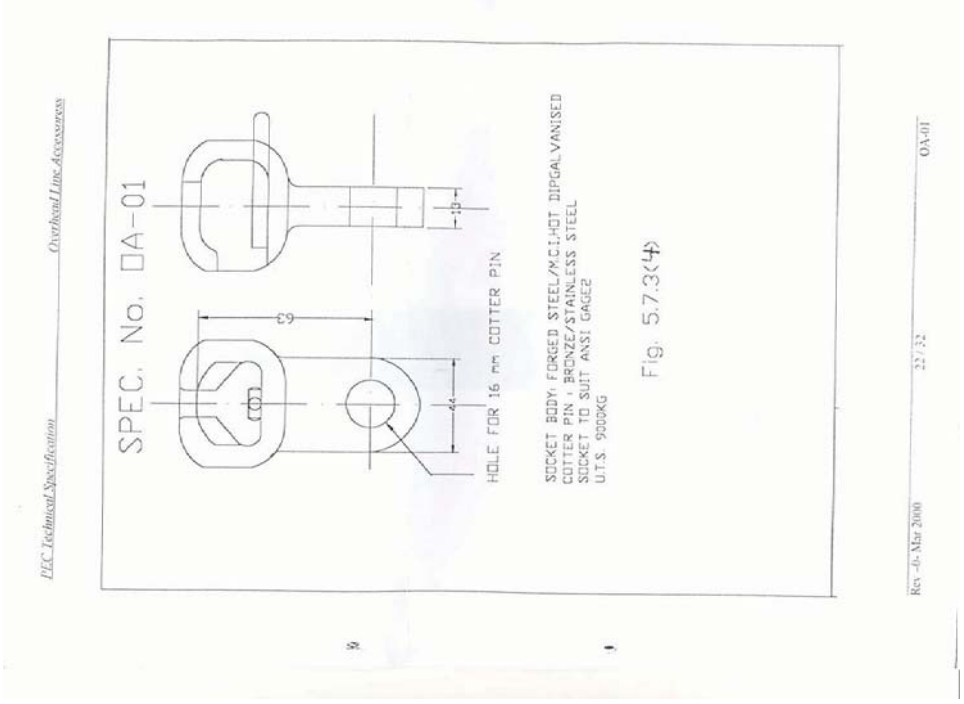
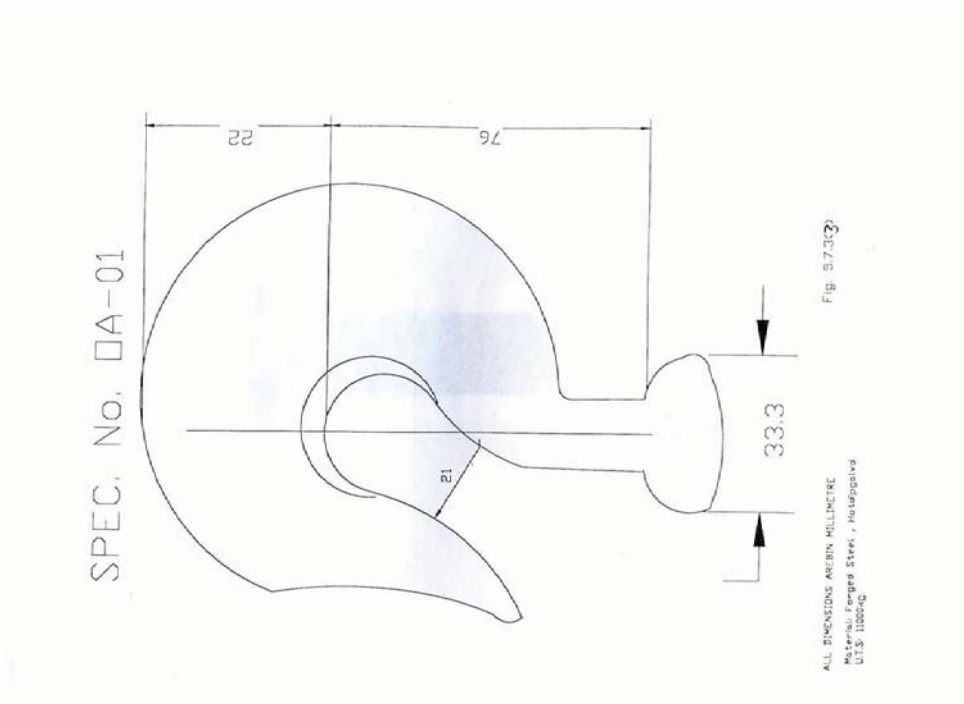












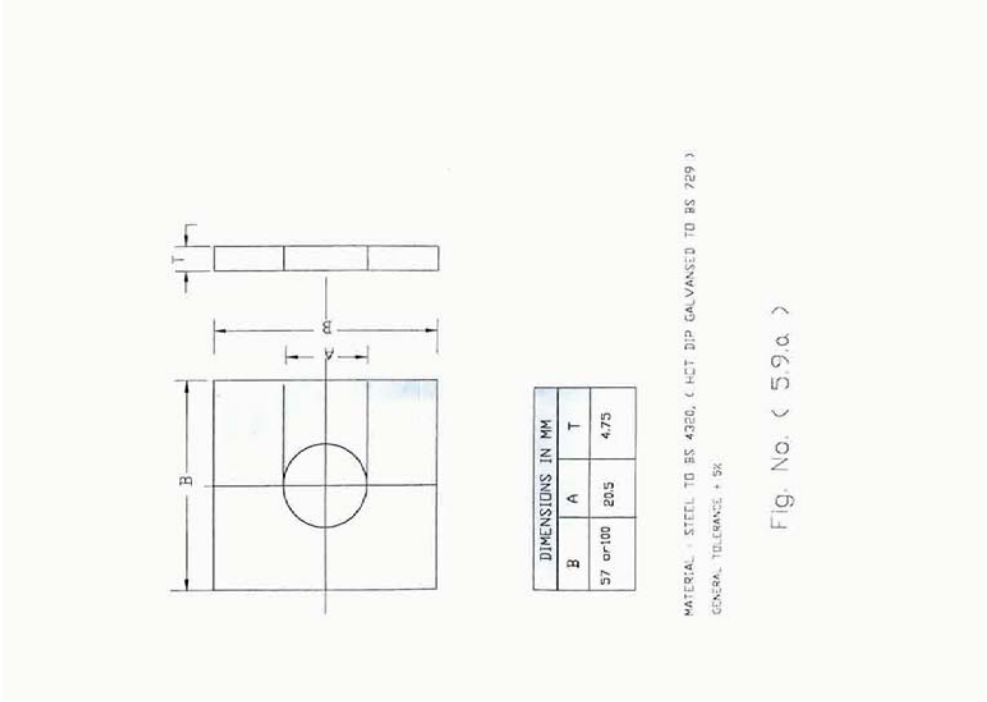
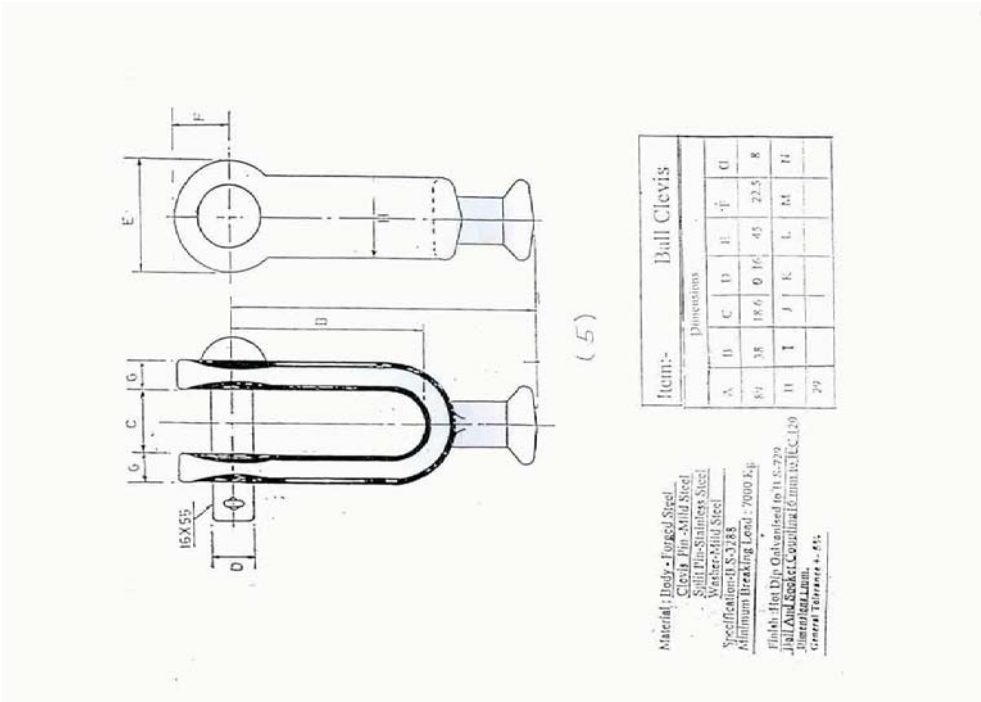
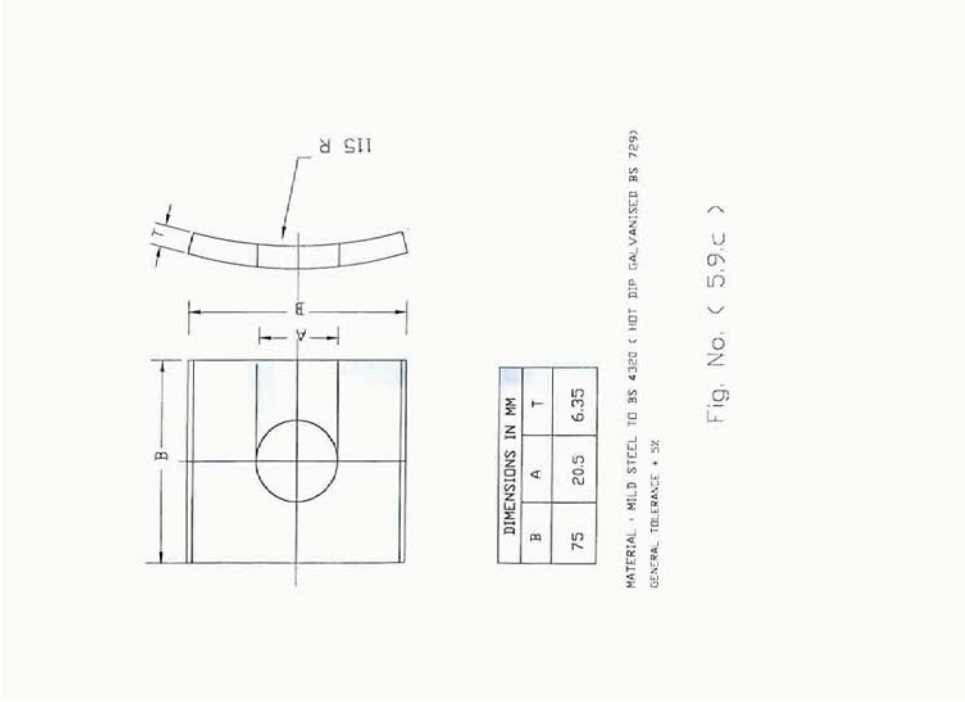
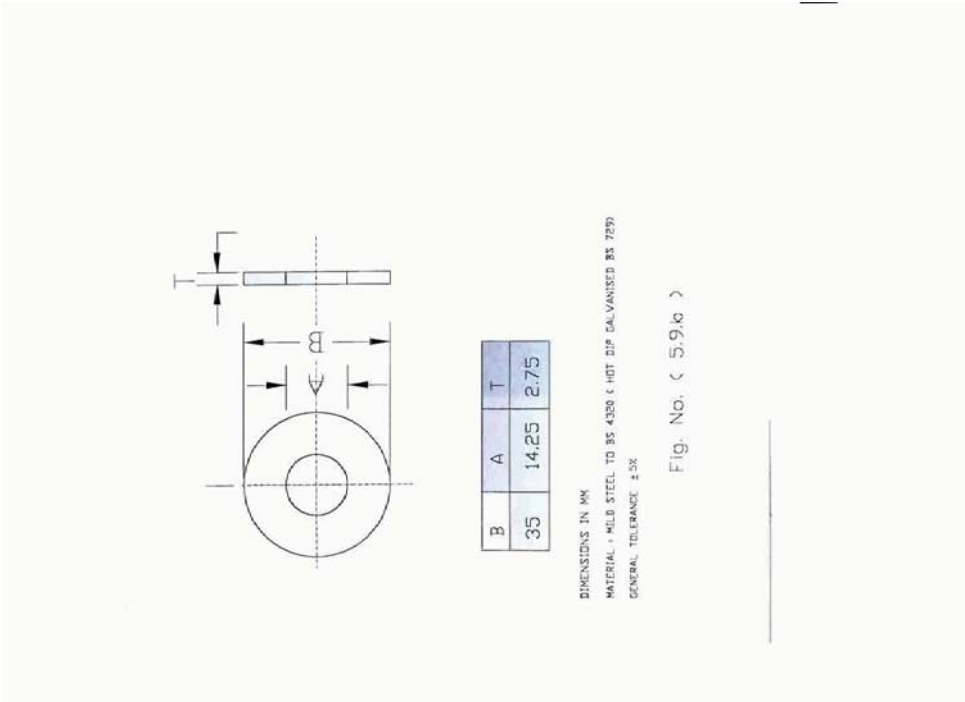
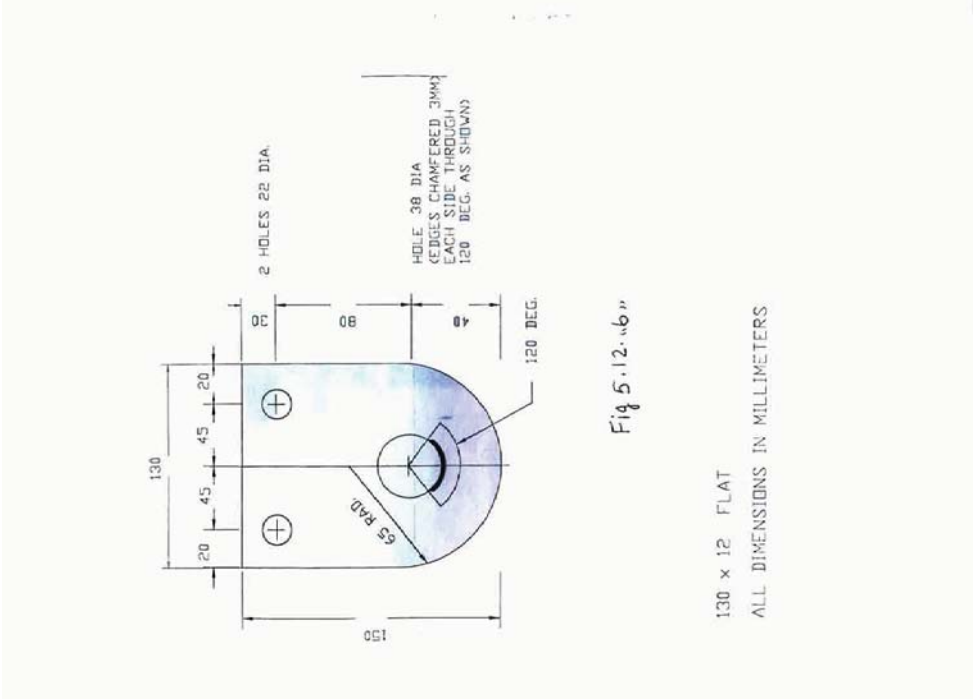
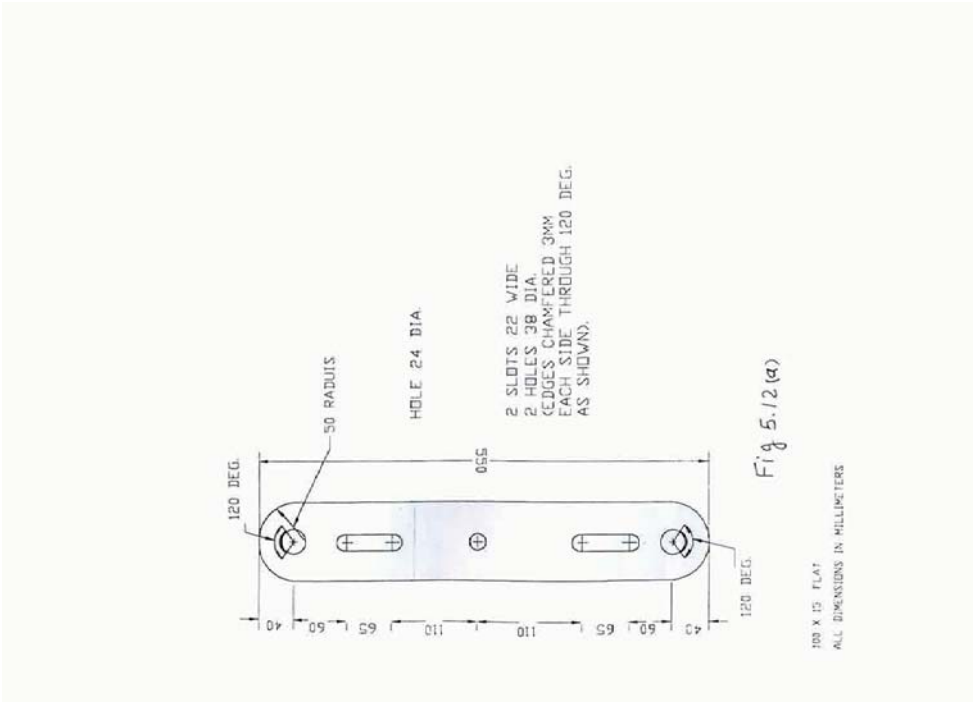


Fig. No. (5.9.a)





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PUBLIC ELECTRICITY CORPORATION SPECIFICATION FOR STAY WIRE Specification No. OA-02 Date: Aug - 2020

1.0 SCOPE:

- 1.1 This specification covers galvanized steel strand, for use as stay wire and ground wire on electric transmission and distribution lines.
- 1.2 The size and quantities as given in schedule of requirements.

2.0 STANDARDS:

The manufacture and tests of the steel strand shall meet all applicable requirements of Standard Specification of IEC, BS 183 or equivalent standards.

3.0 SERVICE CONDITIONS:

The equipment shall be suitable to ensure satisfactory operation for the following altitude, climatic and atmospheric site conditions:

- | | | |
|---|-------------------------------------|---|
| a | Altitude: | from sea level up to 2300m will be subjected to lightning strokes. |
| b | Ambient temperature: | -5°C up to 50°C. |
| c | Wind pressure: (kg/m ²) | 80 – 130 |
| d | Seismic acceleration: (g) | 0.12 - 0.05 |
| e | Isokeraunic level: | 10 – 18 |
| f | Relative humidity: | 5 – 100 |
| g | Solar radiation: | 1200W/m ² |
| h | Atmosphere: | All materials specified here in will be installed out-doors and will be subjected to moisture salt heavy pollution relative humidity up to 100% dust and intense solar radiation. |

4.0 DETAILED REQUIREMENTS:

4.1 The steel strand shall be High Strength Grade with Class B coating in accordance with ASTM A475, BS.183,BS.443 & BS.3288 or equivalent.

4.2 The steel strand shall have the following physical characteristics:-

System Voltage (kV)	LV	11	33
4.2.1 Nominal over all diameter (mm)	6.4	12	22.2
4.2.2 Number of wires in strand	3	7	
4.2.3 Diameter of wire (mm)	3.05	4	
4.2.4 Minimum breaking strength (kN) of strand.	20.0	61.6	110

5.0 TESTS:

5.1 The following tests, made in accordance with ASTM A475 requirements or equivalent, shall be performed at the manufacturer's plant on his expense:

- 5.1.1 Tension tests.
- 5.1.2 Weight and uniformity of coating tests.
- 5.1.3 Manufacturer's normal production tests.

5.2 Failure of any of the test specimens shall constitute grounds for rejection of the lot as represented by the specimen.

5.3 Certified test reports in two (2) copies shall be furnished on each lot of steel strand before shipment

6.0 INFORMATION TO BE FURNISHED:

The supplier shall submit sufficient information to fulfill with this specification, including in schedule OA-02:

6.1 The promulgating institution(s) and number(s) of standard specification(s) under which the wire and/or tape is manufactured.

6.2 Manufacturer's guaranteed chemical and physical characteristics of the wire and tape offered.

6.3 Shipping details, including drawings showing dimensions and construction details of the shipping reels offered.

Aug 2020

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OA-02

6.4 Complete catalog informations.

7.0 SHIPPING AND MARKING:

7.1 Wires shall be shipped in standard continuous length as follows:

STRAND SIZE (mm)	6	12	22.2
Standard Length (m)	800	800	800
Nominal Gross (kg)	150	500	1000
Weight of Package			
Type Of packing	Spool	Reel	Reel

7.2 The actual length of strand contained in reels or spools may vary to plus or minus 10 percent of the standard length shown.

7.3 An amount not exceeding 10 percent of the total weight of each shipment may be shipped in random lengths. No piece shorter than 50 percent nor longer than 110 percent of the standard length noted in paragraph 6.1 above will be accepted.

7.4 Reels and spools shall be of non-returnable type designed for export shipping in general accordance with the General Instructions of conductor, Cable and accessories included the Bid.

7.5 Reels and spools should be marked inside and outside with waterproof tags showing the following informations, in addition to other shipping information as may be required.

- 7.5.1 Name of the Manufacturer.
- 7.5.2 PEC name
- 7.5.3 Grade of strand.
- 7.5.4 Size of strand in sqmm.
- 7.5.5 Length of strand in meters.
- 7.5.6 No of Strand * Diameter.
- 7.5.7 Gross and net weight.

Aug 2020

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OA-02

10.0 TEST CERTIFICATES SCHEDULE

The bidder shall provide a list of the test certificates included with the bid. The list shall include type test certificate, routine test report references. Each certificate listed shall as far as possible refer to the relevant specification clause.

[illegible]

Signature: _____
Date : _____

SPECIFICATION CONTENTS

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PUBLIC ELECTRICITY CORPORATION
SPECIFICATION FOR
BOLTS & NUTS
Specification NO. OA-04

Date. Aug. 2020

1.0 SCOPE:

1.1 This specification covers various types and size of bolts, together with associated nuts, used in attachment of fitting on overhead transmission and distribution lines.

1.2 The type of bolts covered by this specification include the following:

- 1.2.1 Machine Bolts.
 - 1.2.2 Double Arming Bolts.
 - 1.2.3 Clevis Bolts.
 - 1.2.4 741 Eye Bolts.
 - 1.2.5 Shoulder Eye Bolts.
 - 1.2.6 Hook Bolts.
 - 1.2.7 Shoulder Hook Bolts.
 - 1.2.8 Insulator (Upset) Bolts.
 - 1.2.9 Carriage Bolts.
- (See Fig 1.2 (1-9))

2.0 STANDARDS:

The manufacture and tests of the materials shall meet all applicable requirements of Standard Specification to the latest issue of IEC, BS standards.

3.0 SERVICE CONDITIONS:

The equipment shall be suitable to ensure satisfactory operation for the following altitude, climatic and atmospheric site conditions:

- a) Altitude: from sea level up to 2300m will be subjected to lightning strokes.
- b) Ambient temperature: -5°C up to 50°C.
- c) Wind pressure: (kg/m²) 80 – 130
- d) Seismic acceleration: (g) 0.12 - 0.05
- e) Isokeraunic level: 10 – 18
- f) Relative humidity: 5 – 100 %

g) Solar radiation: 1200W/m²

h) Atmosphere: All materials specified here in will be installed out-doors and will be subjected to moisture salt heavy pollution relative humidity up to 100% dust and intense solar radiation.

4.0 SPECIAL INSTRUCTIONS:

4.1 In order to ensure coordination of screw thread in interface situations involving certain type and size of bolts specified herein with lock nuts and speciality nut fitting covered under other specifications, the purchaser reserves the right to defer specifying the actual screw thread standard (inch or metric) on which purchaser will be made until after Bid evaluation.

4.2 The Bidder shall declare in his ability to manufacture and supply bolts having threads: 1) On inch standard, 2) On metric standards+, or 3) On either inch or metric standards. Bid price adjustment between one thread standard and the other, if any, would also be stated.

4.3 Bolts for which thread specifications shall be deferred until after Bid evaluation are noted on the material schedules.

5.0 DETAILED REQUIREMENTS:

5.1 Material:

5.1.1 Bolts shall of the following materials:

5.1.1.1 Cold - headed machine or carriage bolts shall be made from steel cold heading wire.

5.1.1.2 Hot - headed machine and carriage bolts, and double arming hook and insulator bolts shall be made of hot rolled steel.

5.1.1.3 Clevis eye and insulator bolts shall be made of either drop forged or hot rolled steel.

5.1.1.4 Steel used in bolt manufacture shall have been produced by the open hearth, basic- oxygen or electric - furnace process and which is of a grade and quality suitable to meet the requirements of this specification.

5.1.2 Nuts and locknuts shall be made of hot rolled steel in accordance with the latest issue of BS.

5.1.3 Cotter pins shall be made of stainless steel brass or bronze.

5.2 **Dimensions:**

5.2.1 Bolts shall meet the basic dimensional requirements presented in the drawing attached hereto nominal length and diameters are specified on the material schedule.

5.2.2 Alternative designs of shoulder upset, and celvis type bolts will be acceptable as long as equivalent performance and strength requirements are met, as compared to those designs presented in the drawing attached.

5.2.3 Screw thread dimensions of bolts and nuts shall comply with following standards. The dimensional standards of bolt diameter and screw thread is based on the standard series specified as follows:

5.2.3.1 **Metric Basic:**

In accordance with BSI specifications the latest issue of BS requirements for ISO metric screw threads-tolerance class 7H/8g for bolts and nuts respectively, (free fit) coarse series pitch.

5.2.3.2 The nominal diameter of bolts under this specification shall be as follows for the thread series specified:

Diameter Designation	Metric basis nominal	
	Diameter	
a) 10mm	M10	
b) 12mm	M12	
c) 16mm	M16	
d) 19mm	M20	

5.3 **Strength:**

5.3.1 Tensile Strength: Bolts with nuts assembled shall meet the following tensile requirements failure shall occur in the shank or threaded section, and not at the junction of the head and shank, and threads shall not strip below minimum specification:

Bolt Diameter	Minimum tensile	
	Strength	
3.3.1.1 10 mm	1900kg	
3.3.1.2 12mm	3500kg	
3.3.1.3 16mm	5600kg	
3.3.1.4 19mm	8300kg	

5.3.2 **Cold Bend:**

The unthreaded portion of bolts shall be capable of being bent while at room temperature at any point through an angle of 120 about a diameter of the bolt without cracking the steel on the outside of the bent portion. in the case of completely threaded bolts, the threads shall be removed for cold bend testing.

5.4 **Construction:**

5.4.1 Heads of machine bolts and specified nuts shall be hexagon.

5.4.2 Lock nuts shall be square and concave MF type.

5.4.3 Thread screw may be either machine rolled or cut. Threaded bolt ends (except for carriage bolts) shall have semi-coned points for prevention of thread damage during installation.

5.4.4 All ferrous parts, including nuts, washers and locknuts, shall be hot dip galvanized in accordance with BS. The thread of nuts need not be galvanized.

5.4.5 Finished bolt surfaces and threads shall be free from burrs, seams, lamps, and irregular surfaces that affect serviceability.

5.4.6 Each bolt shall be furnished with the following accessories in the quantities noted:

MACHINE BOLT	NUT	LOCK NUT
16mm dia and larger	1	-
12mm dia and smaller	1	1
Double arming bolt	4	-
Clevis bolts	1	- (plus pin Bolt, nut & cotter)
Eye bolt	1	1
Shoulder eye bolt	1	
Hook bolt	1	1
Shoulder Hook bolt	1	1
Spool insulator bolt	2	1 (plus cotter one nut & washer)
Carriage bolt	1	1

5.4.7 All bolts shall permanently bear the manufacture's mark.

6.0 **TESTS:**

6.1 In addition to normal production tests and inspection, a representative number of specimens shall be tested for specified strength requirements in the manufacturer's plant at his expense.

6.2 Certified test report in two (2) copies shall be submitted on each lot of bolts before shipment.

7.0 INFORMATION TO BE FURNISHED:

- 7.1 Bidder shall include in his bid sufficient information to permit a correct evaluation of the bid in relation to this specification, including at least.
- 7.2 Detailed drawing of each bolt type offered, including accessories, giving dimensions and tolerances.
- 7.3 The standard specification for screw threads.
- 7.4 The bidder's declaration on ability to supply screw threads.
- 7.5 Manufacturer's guaranteed bolt strength.

8.0 SHIPPING AND MARKING:

- 8.1 Bolts should be packed by size and type, together with specified nuts, locknuts and cotters, in cartons or boxes. The packed weight of any carton or box should not exceed 20 kilogram. Cartons or boxes shall be clearly labelled with name of manufacturer and description and quantity of items
- 8.2 Cartons should be packed in wooden crates for shipment.
- 8.3 Shipping crates shall be durably marked on the outside with the following information in addition to other shipping information as may be required.
 - 8.3.1 Name of manufacturer.
 - 8.3.2 PEC name.
 - 8.3.3 Gross and net weight.
 - 8.3.4 Brief description of contents (*eg. Bolts)

9.0 NON COMPLIANCE SCHEDULE

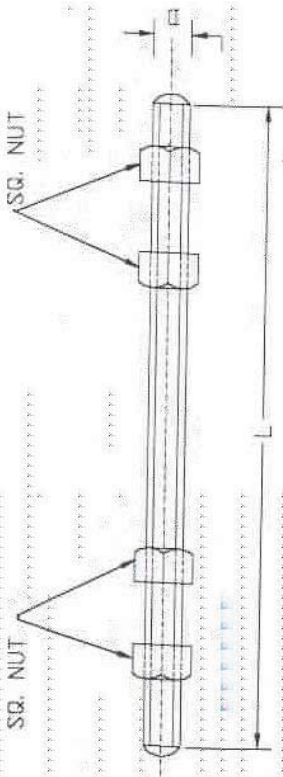
The bidder shall provide a list of non compliances with this specification documenting the effects that such non compliance is likely to have on the equipment's life, operating characteristics and system performance. Each non compliance shall make reference to the relevant specification clause.

[illegible]

Signature: _____
Date: _____

PEC Technical Specification

SPEC. No. OA-04



THRAD FULL LENGTH

Fig.1.2 (2)

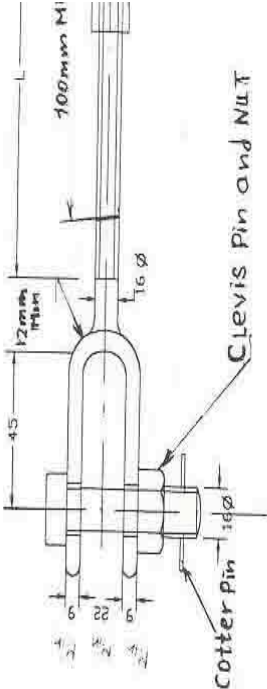
SL. NO.	DIMENSIONS IN mm		ITEM
	D	L	
1	16	400	
2	16	500	
3	16	600	
4	16	650	

MATERIAL: STEEL, HOT DIP GALVANISED

ALL DIMENSIONS IN MILLIMETER

GENERAL TOLERANCE $\pm 5\%$

SPEC. No. OA-04



SL. NO.	L IN MM	ITEM
1	300	
2	350	

MATERIAL: STEEL, HOT DIP GALVANISED
ALL DIMENSIONS IN mm
GENERAL TOLERANCE $\pm 5\%$

Fig. No. (1.2) (3)

SPEC. No. OA-04

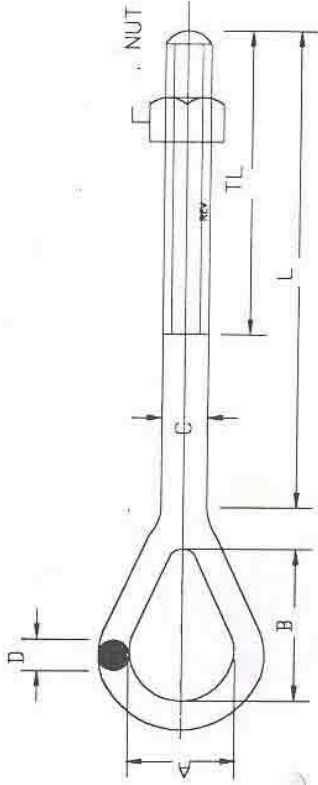


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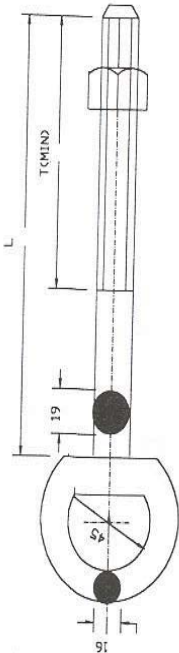
SL NO.	SIZE	DIMENSIONS IN MM						ITEM NO.
		A	B	C	D	L	TL	
1	16X250	38	50	16-20	14	250	100	10
2	16X300	38	50	16-20	14	300	150	11
3	16X350	38	50	16-20	14	350	150	12
4	16X400	38	50	16-20	14	400	150	13

MATERIAL : STEEL,HOT DIP GALVANISED
ALL DIMENSIONS IN MILLIMETER

PEC Technical Specification

Bolts & Nuts

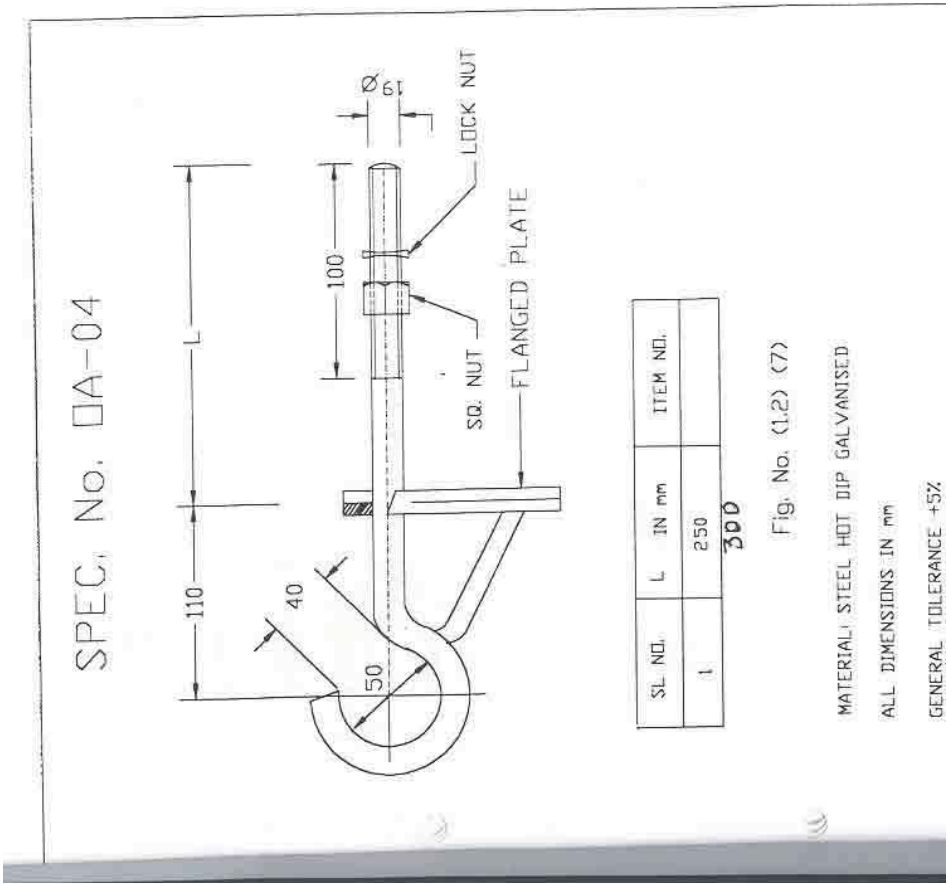
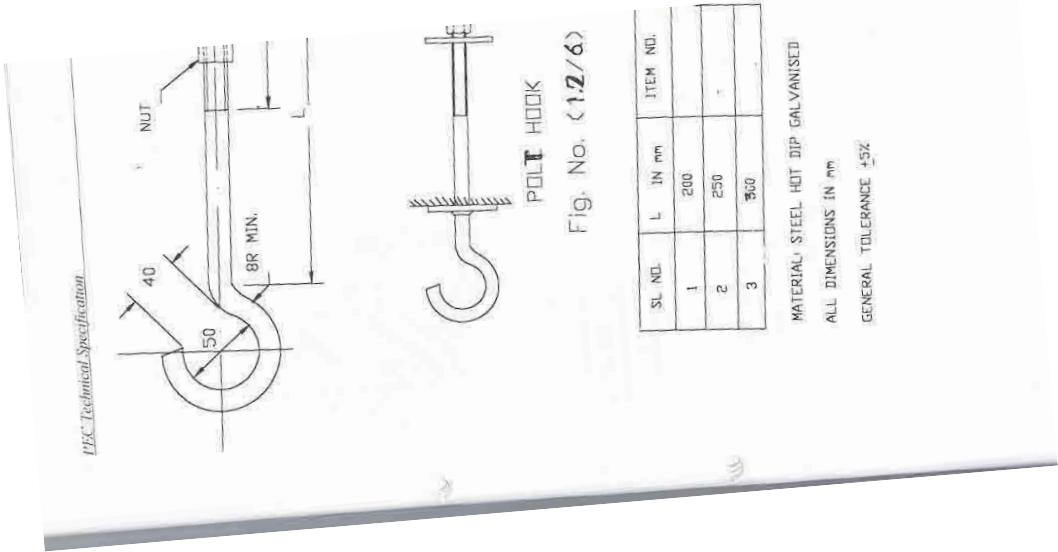
SPEC. No. OA-04



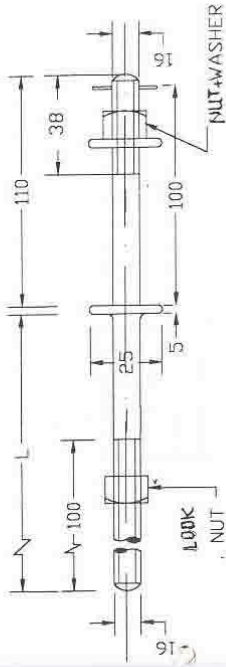
SL NO.	DIMENSIONS IN MM		
	L	T	D
1	300	150	20
2	350	150	20

MATERIAL : STEEL,HOT DIP GALVANISED
ALL DIMENSIONS IN MILLIMETER

Fig. No. (1.2) (5)



SPEC. No. OA-04



SLND.	SIZE	L IN MM
1	16,250	250
2	16,300	300

MATERIAL : STEEL, HOT DIP GALVANISED
GENERAL TOLERANCE : $\pm 5\%$

ALL DIMENSIONS IN MM

Fig. No. (1.2) (8)

PEC. No. OA-04

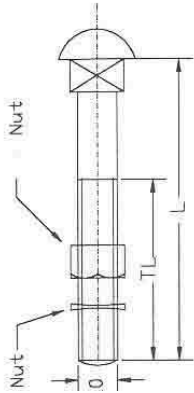


Fig. No. (1.2) (9)

SLND.	SIZE	DIMENSIONS IN MM	
1	10,115	L	TL
		115	75

STEEL, HOT DIP GALVANISED
ADDITIONAL DIMENSIONS ARE IN MM

TOLERANCE $\pm 5\%$

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PUBLIC ELECTRICITY CORPORATION SPECIFICATION FOR LINE DEAD-END TENSION & SUSPENSION CLAMPS Specification NO. OA-08 Date: Aug. 2020

1. SCOPE:

This specification covers various bolt type fittings for deadending and suspending high voltage conductors to be used on overhead transmission and distribution lines.

2. STANDARDS:

Unless otherwise specified here in the clamps shall meet applicable requirements the latest issue of BS standards.

3. SERVICE CONDITIONS:

The equipment shall be suitable to ensure satisfactory operation for the following altitude, climatic and atmospheric site conditions:

- a) Altitude: from sea level up to 2300m will be subjected to lightning strokes.
- b) Ambient temperature: -5°C up to 50°C.
- c) Wind pressure: (kg/m²) 80 – 130
- d) Seismic acceleration: (g) 0.12 - 0.05
- e) Isokeraunic level: 10 – 18
- f) Relative humidity: 5 – 100 %
- g) Solar radiation: 1200W/m²
- h) Atmosphere: All materials specified here in will be installed out-doors and will be subjected to moisture salt heavy pollution relative humidity up to 100% dust and intense solar radiation.

4. DETAILED REQUIREMENTS:

All clamps shall be fabricated to accommodate conductors of sizes within ranges not smaller than those specified for the respective standard products in their respective manufacturer-published catalogs.

Deadend clamps intended for use with ACSR or all aluminum conductors shall be designed to accommodate conductor without requiring armor tape or special liners to protect conductor from damage. (See Fig 3.1)

Suspension clamps offered shall be of adequate size to accommodate the intended conductor with conductor armor rod installed.(See Fig 3.1)

Clamp fabrication should be in accordance with the following:

Aluminum clamp bodies and keepers shall be fabricated of high strength heat treated aluminum alloy meeting the requirements of Standard Specification the latest issue of BS.

Clamp bodies and keepers intended for use with aluminum clad steel conductor shall be fabricated of high strength drop forged steel or malleable iron, hot dip galvanized. Clamps shall be supplied with liners for aluminum conductor.

Bolts, nuts, lock washers, pins, and fittings required for normal installation shall be furnished. Bolts, nuts, and washers shall be fabricated steel.

All exposed ferrous parts shall be hot dip galvanized to the latest issue of BS of general specification of O/H line accessories).

All clamps shall be complete with binding tape to protect the conductor.

All clamps shall be so fabricated and treated that there shall be no electrolytic action occurring between the clamps and conductors or between the various parts of the clamp.

Dead end clamps shall be fabricated with integrated pulling eyes to facilitate installation.

Clamp rated ultimate strengths should nominally be in accordance with rated strengths presented in paragraph 4.1.

Clamp holding performance shall be such that no slippage occurs up through 90 percent of the rated ultimate strength of the clamp.

Clamps shall be designed and fabricated to minimize hysteresis and eddy currents in the clamp and to maintain acceptably cool operating temperatures of clamp and conductor.

Clamps shall bear the manufacturer' mark and the range of

5. STANDARD PRODUCTS:

The body material and rated ultimate strength of the deadend (time) and suspension shall be as follows:-

Size of Clamps	Body Material	Rated Strength (kgs)
150mm ² -100mm ²	Cast Aluminum Alloy	10,400
100-50mm ² ACSR/AAAC	Cast Aluminum Alloy	6,800
35mm ² ACSR/AAAC	Cast Aluminum Alloy	3,200
8,0mm ² Aluminum	Malleable Iron	5,400
150 ACSR/AAAC plus armor rods	Cast Aluminum Alloy	11,300
100mm ² -35mm ² ACSR/AAAC	Cast Aluminum Alloy	11,300
8,0mm Aluminum Clad steel plus armor rods	Forged Steel	6,300

6. TESTS:

In addition to normal production testing, each particular clamp design offered by the Bidder shall undergo tests on a representative quantity of clamps to be supplied, performed by the manufacturer at his expense, which will include but not be limited to:

Ultimate tension and slip strength tests.
Heat cycling tests.

Certified test reports in two (2) copies shall be furnished on each lot of clamps before shipment.

Certified test reports in two (2) copies shall be furnished on each lot of clamps before shipment.

7. INFORMATION TO BE FURNISHED:

The Bidder shall furnish with his Bid sufficient information to permit a correct evaluation of the Bid in relation to this specification, including at least:

Evidence in the form of certified laboratory test records by which the performance characteristics of the clamps can be evaluated.

Manufacturer's guaranteed characteristics with regard to the following as appropriate to each particular clamp being offered:

Material of fabrication.

Range of application—conductor size and type.

Rated strength.

Complete catalogue information.

Outline drawings of clamps with dimensions.

8. SHIPPING AND MARKING:

Clamps shall be packed by type and size in cartons weighing not more than 25kg per carton. Cartons shall be packed in wooden crates for shipment.

Each carton shall be marked with the name of manufacturer and description of item.

Each shipping crate shall be durably marked on the outside with the following information, in addition to other shipping information as may be required.

Name of manufacturer.

PEC name.

Gross and net weight.

Brief description of contents.

9. NON COMPLIANCE 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, operating characteristics and system performance. Each non compliance shall make reference to the relevant specification clause.

[illegible]

Signature: _____
Date: _____

10. TEST CERTIFICATES SCHEDULE

The bidder shall provide a list of the test certificates included with the bid. The list shall include type test certificate, routine test report references. Each certificate listed shall as far as possible refer to the relevant specification clause.

[illegible]

Signature: _____
Date : _____

11. FIGURES

11.1.1. Deadend Clamp (Fig. 3.1)

Specification No. QA-08

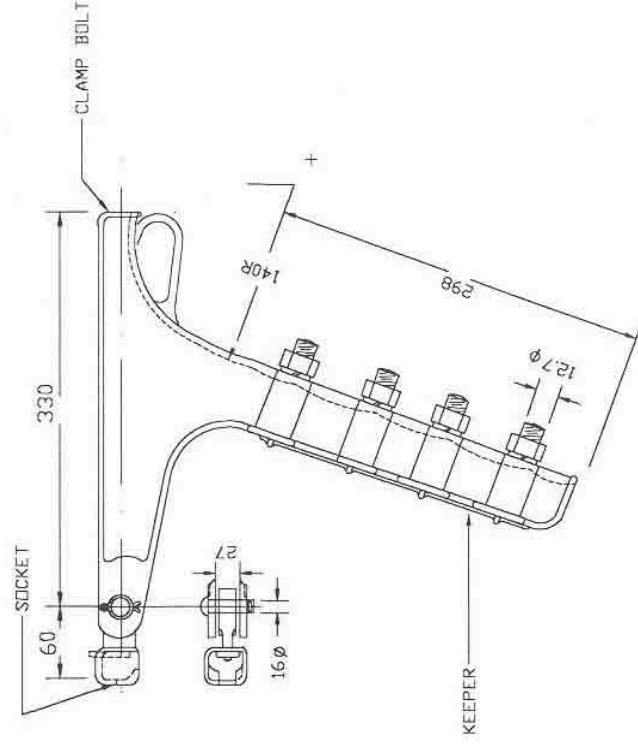


Fig. 3.1

TECHNICAL PARTICULARS:

CLAMP BODY & KEEPER AL ALLOY

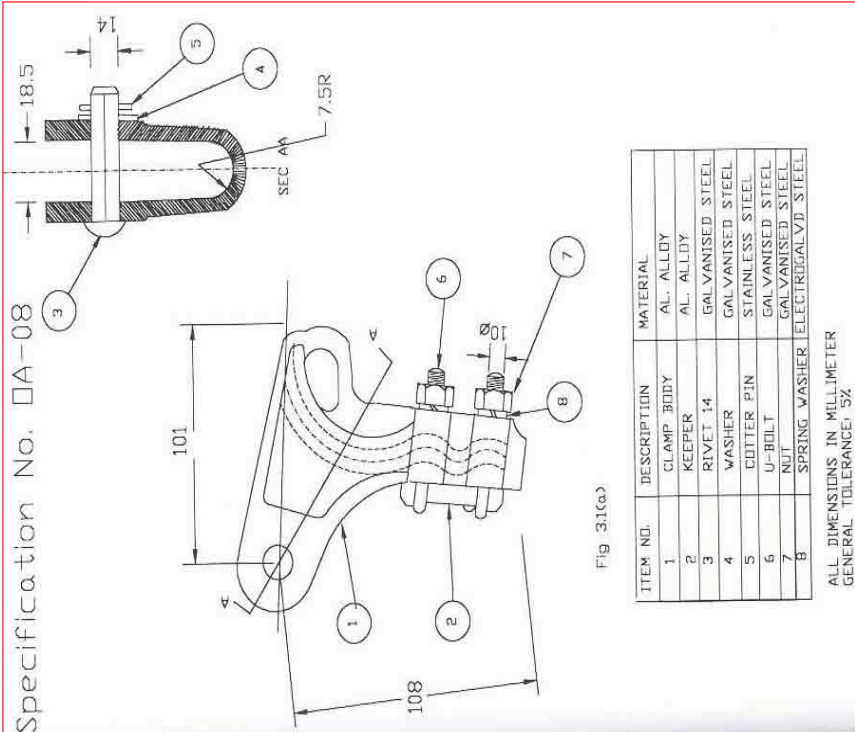
SOCKET MALLEABLE IRON/FORGED STEEL

COTTER, U. BOLTS & FLAT WASHERS. STEEL, HOT DIP GALV. D.

LOCKING KEYS, STAINLESS STEEL

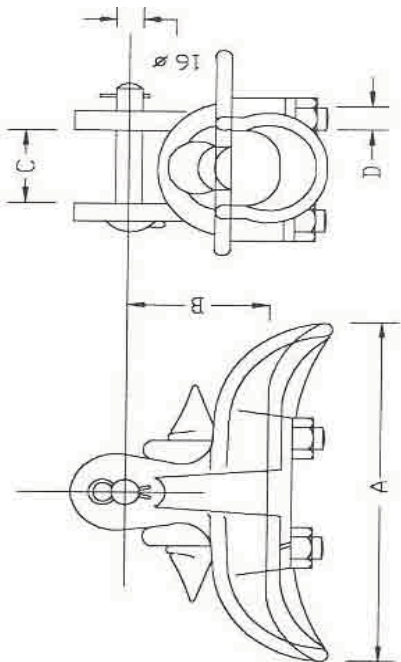
U.T.S 10,450 KGS.

11.2. Deadend Clamp (Fig. 3.1 a)



11.3. Suspension Clamp (Fig. 3.2)

Specification No. OA-08



A	B	C	D	UTS IN KG
203	60	29.4	12.7	11,340

TECHNICAL PARTICULARS
MATERIAL: CAST ALUMINUM ALLOY
CLAMP BODY AND KEEPER : ALUMINUM ALLOY
COTTER PIN, U-BOLTS, NUTS : STEEL, HOT DIP GALV'D.
LOCKING KEYS : STAINLESS STEEL

ALL DIMENSIONS IN MILLIMETERS
GENERAL TOLERANCE +5%

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11.4. Suspension Clamp (Fig. 3.2. b)

Specification No. OA-08

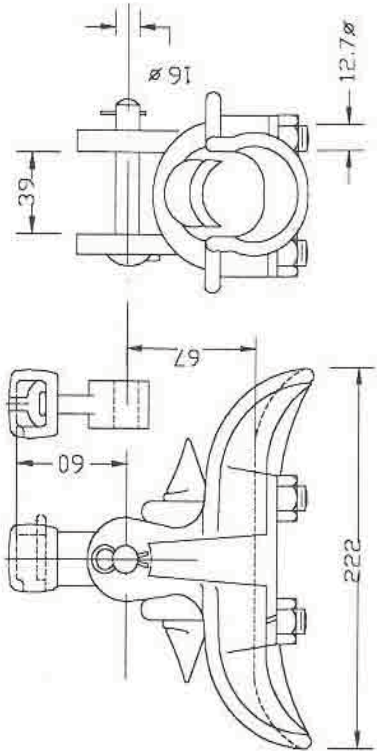


Fig. No. 3.12(b)

TECHNICAL PARTICULARS:

CLAMP BODY AND KEEPER: ALUMINUM ALLOY
COTTER PIN, U-BOLTS, NUTS : STEEL, HOT DIP GALV.D.
SOCKET: MALLEABLE IRON, HOT DIP GALV.D.
LOCKING KEYS: STAINLESS STEEL

ALL DIMENSIONS IN mm.
GENERAL TOLERANCE $\pm 5\%$ -

PUBLIC ELECTRICITY CORPORATION SPECIFICATION FOR

BOLTED TYPE LINE CONNECTORS (Connectors, Parallel Grooves & Line Taps)

Specification NO. OA-09

Date: Aug. 2020

1. SCOPE:

These specification covers bolted type devices used for making electrical connections between various types and sizes of line connectors used in electrical transmission and distribution systems.

2. STANDARDS:

- 2.1 Connectors shall be manufactured according to the latest issue of BS standards.
- 2.2 Connectors shall meet tests requirements contained in applicable NEMA Standard Specification CC3, standards test requirements as may be contained in other acceptable national or international standards.

3. SERVICE CONDITIONS:

The equipment shall be suitable to ensure satisfactory operation for the following altitude, climatic and atmospheric site conditions:

- | | |
|--|---|
| a) Altitude: | from sea level up to 2300m will be subjected to lightning strokes. |
| b) Ambient temperature: | -5°C up to 50°C. |
| c) Wind pressure: (kg/m ²) | 80 – 130 |
| d) Seismic acceleration: (g) | 0.12 - 0.05 |
| e) Isokeraunic level: | 10 – 18 |
| f) Relative humidity: | 5 – 100 % |
| g) Solar radiation: | 1200W/m ² |
| h) Atmosphere: | All materials specified here in will be installed out-doors and will be subjected to moisture salt heavy pollution relative humidity up to 100% dust and intense solar radiation. |

Aug. 2020

2-9

OA-09

4. DETAILED REQUIREMENTS:

- 4.1 All body of the connector whether designed for aluminium to aluminium or aluminium to copper connections shall be fabricated of aluminium alloy. Aluminium alloy used in connectors shall be of a composition and grade adequate to provide the strength and conductivity required by this specification.
- 4.2 Bolts, nuts, and washers shall be of aluminium alloy or steel. Steel bolts, nuts, and washers, if not stainless steel, shall be protected by one of the following:
- 4.3 Hot dipped galvanising in according with the latest issue of BS (General O/H accessories) standards.
- 4.4 Electro-deposited zinc or cadmium with a minimum thickness of 0.012 mm.
- 4.5 For connector intended for aluminium to copper connections, the copper conductor shall be in contact with the connector though one of the following:
- 4.6 A copper insert, which shall be either cast integrally with the aluminium body or swaged or soldered firmly and permanently into place, providing that no corrosive soldering fluxes remain in the bind area.
- 4.7 A bimetallic strip made of aluminium and copper sheets bonded together, such strip being firmly attached to the aluminium body or to an aluminium spacer of such mass as to minimise corrosion of the aluminium portion of the bimetallic strip. The use of bimetallic strip alone between aluminium and copper conductors is not acceptable.
- 4.8 Direct contact with aluminium alloy body when the alloy and design results in proven performance in effectively minimising stress, corrosion, and deterioration by galvanic action. Proper with acceptable laboratory test records
- 4.9 Connector grooves shall be so designed that the conductor will not be nicked or otherwise damaged in the application of the connector.
- 4.10 Connector intended for use on stranded conductors should be so designed that all strands in the other layer will be in good contact with the connector and strands will not be spread.
- 4.11 Bolts shall not be in contact with the conductor. Adequate lock washers shall be provided to prevent loosening during service.

Aug. 2020

3-9

OA-09

4.12 When copper and aluminium are used in the same connector, the junction between the dissimilar metals should be made so that moisture cannot collect between the two surfaces.

4.13 All connectors shall be designed to accommodate conductors of sizes within ranges not smaller than those specified for the respective standard products in their respective manufacture published catalogues.

4.14 The connectors for 170 mm² and 100 mm² conductors should not be designed for a wide range of size, but rather to provide a good fit to a limited range of size. The contact length should preferably be not less than five times the diameter of the conductor for which it is intended. Connectors for those size conductors should incorporate two or three bolts. (See Fig. 3/a).

4.15 The connectors intended for conductor sizes 70 mm² and smaller should be wide range, and preferably universal types that accept all combinations of aluminium and copper conductors. (See Fig. 3/b)

4.16 For bare copper conductor lines, all line tap and parallel groove connectors shall be of copper alloy, all bolts, nuts, and washers to be of stainless steel. The size of the tap and parallel groove shall be suitable to the conductor size. (See Fig. 3.11)

5. TESTS:

5.1 Mechanical and heat cycling tests of connectors in accordance with test requirements of Standard Specification NEMA CC-3 standards shall be performed at the manufacture's plant at his expense.

5.2 Failure of any of the test specimens to comply with the requirements of this specification shall constitute grounds for rejection of the lot as represented by the specimen.

5.3 Certified test reports in two (2) copies shall be furnished on each lot of clamps before shipment.

6. INFORMATION TO BE FURNISHED:

The Bidder shall furnish with his Bid sufficient information to permit a correct evaluation of the Bid in relation to this specification, including at least:

6.1 The promulgating institution(s) and number(s) of Standard Specification(s) under which the connectors are manufactured and tested.

6.2 Evidence in the form of certified laboratory test records by which the performance characteristics of the clamps can be evaluated.

6.3 Manufacturer's guaranteed characteristics of the connectors and covers being offered:

6.3.1 Material of fabrication.

6.3.2 Range of application—conductor size and type.

6.3.3 Operating temperatures.

6.4 Complete catalogue information.

7. SHIPPING AND MARKING:

7.1 All connectors with appropriate covers shall be packed by type and size in cartons of no more than 50 connectors per carton, and then packed in wooden crates for shipment.

7.2 Each connector shall bear the manufacturer's mark. In addition, each connector shall be permanently marked with the appropriate range of conductor size.

7.3 Each carton shall be marked with the name of manufacturer, quantity and description of item.

7.4 Each shipping crate shall be durably marked on the outside with the following information, in addition to other shipping information as may be required.

7.4.1 Name of manufacturer.

7.4.2 PEC name.

7.4.3 Gross and net weight.

7.4.4 Brief description of contents (e.g. Connectors).

8. NON COMPLIANCE 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, operating characteristics and system performance. Each non compliance shall make reference to the relevant specification clause.

[illegible]

Signature: _____
Date: _____

9. TEST CERTIFICATES SCHEDULE

The bidder shall provide a list of the test certificates included with the bid. The list shall include type test certificate, routine test report references. Each certificate listed shall as far as possible refer to the relevant specification clause.

[illegible]

Signature: _____
Date : _____

10. Figure
10.1. Potted Type Conductors (See Fig. 3/b) & (See Fig. 3/h)

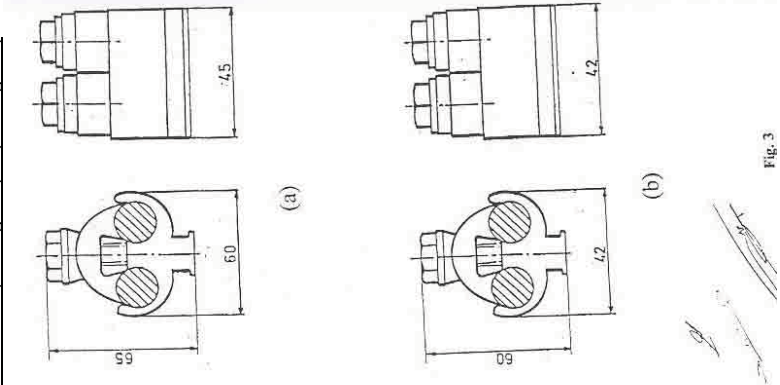
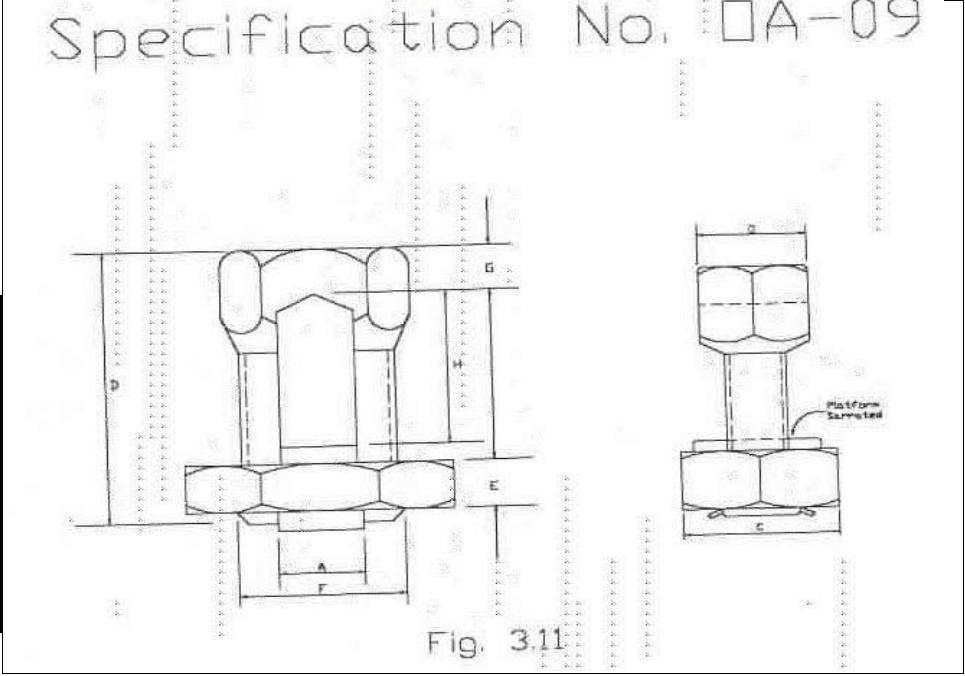


Fig. 3

10.2. Pelted Type Conductors size (Fig. 3.11)



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PUBLIC ELECTRICITY CORPORATION
SPECIFICATION FOR
BARE ALUMINIUM CONDUCTOR STEEL REINFORCED
(ACSR)

Specification No. OC-01

Date: Aug. 2020

1.0 SCOPE:

- 1.1 This specification covers bare aluminium conductor, steel reinforced (ACSR). Concentric-lay-stranded, for use as transmission and distribution line conductor.
- 1.2 The size and quantities as given in attached schedule of requirements.

2.0 STANDARDS:

- 2.1 Unless otherwise specified herein the ACSR conductor shall meet all applicable requirements contained in IEC 209, BS. 4569, BS. 215, ASTM B232-74 Standards or equivalent.
- 2.2 Steel wire shall be zinc coated hot dip galvanised to BS 443.

3.0 SERVICE CONDITIONS:

Conductor shall be suitable to ensure satisfactory operation for the following altitude, climatic and atmospheric site conditions:

- One) Altitude: from sea level up to 2300m will be subjected to lightning strokes.
- Two) Ambient temperature: -5°C up to 50°C.
- Three) Wind pressure: (kg/m²) 80 – 130
- Four) Seismic acceleration: (g) 0.12 - 0.05
- Five) Isokeraunic level: 10 – 18
- Six) Relative humidity: 5 – 100
- Seven) Atmosphere: Heavy salt and dust laden pollution in coastal areas, moderate sandstorm exposure and dust pollution in low to mid altitude and region and light to heavy dust pollution at high altitudes.

4.0 DETAILED REQUIREMENTS:

4.1 Acceptable physical and electrical characteristics of conductor shall be the same as or equivalent to the standard conductors listed on table OC-01 (1-4) attached hereto.

4.2 The conductor characteristics offered should in all cases strictly comply with the limit set by the governing criteria designated on table OC-01 (1-4).

4.3 Manufacture of ACSR Conductors:

The manufacture of the ACSR conductor shall be carried out in a portion of the works specially set aside for such purposes. Precautions shall be taken during the manufacture and storage of ACSR conductor to prevent the possibility of contamination by copper or other materials, which may adversely affect the aluminium. In the event of any machinery used for conductor manufacture being used for materials other than aluminium or galvanised steel strand, the supplier shall furnish the PEC with a certificate that the machinery has been thoroughly cleaned before use on aluminium or galvanised steel wire and the conductor supplied under this contract is free from contamination.

The aluminium shall be of the highest purity commercially obtainable and the supplier submit certificates of analyses giving the percentage and nature of any impurities in the metal of which the aluminium wire are made.

There shall be no joints in steel wires forming the core of composite conductors, excepting those made in the base rod or wire before drawing, unless the core consists of seven or more wires. In the latter case joints in individual wires are permitted, additionally to these made in the base rod or wire before drawing, but no two joints shall be less than 15m apart in the complete steel core. There shall be no joints in the individual wires of the outer layers of the aluminium wire.

The steel strands shall be performed so that they remain inert and do not move relative to each other when the conductor is cut. The steel core wires shall be uniformly covered with approved grease. In addition the inner aluminium wires shall be similarly treated. The grease shall fill all internal spaces except that excess grease shall be removed from the conductor before the application of the final layer of wires.

The outermost layer of all conductors shall be stranded with the right-hand lay.

4.4 Galvanising:

Galvanising shall be applied by the hot dip process and shall consist of a thickness of zinc coating equivalent to not less than 610 grams of zinc per square meter (2 ounces of zinc per square foot) of surface. Galvanising shall only be applied when all machining of the material is completed. Galvanising will be tested in accordance with the appropriate British or equivalent Standards in order to determine that it complies with this requirement.

The zinc coating shall be smooth, clean and of uniform thickness and free from defects. The preparation for galvanising and the galvanising itself shall not adversely affect the mechanical properties of the coated material.

4.5 Joints:

Tension joints, shall not damage the conductor and shall not allow it to slip or fail at less than 95% of the ultimate strength of the conductor for which it is provided.

Non-tension joints and clamps shall not damage the conductor and shall not allow it to slip or fail at less than 25% of the ultimate strength of the conductor for which it is provided. Such joints and clamps must have a safe current rating not less than that of the conductor for which they are provided.

4.6 Grease:

The grease to be used in the conductor shall be chemically inert, shall not flow within nor exude from the conductor when at a temperature of 80°C nor shall its characteristics be impaired after heating to 20°C above its drop point for 168 hours. The grease shall be suitable for service temperatures in the range -10°C to +75°C. The suitability of the grease shall have been proven by tests of a form acceptable to the PEC.

5.0 TESTS:

The following-tests in accordance with standard IEC 209, BS or equivalent tests, shall be performed at the manufacture's plant at his expense:

5.1 Tests for individual aluminium & steel wires shall include, but necessarily be limited to:

- 5.1.1 Chemical composite tests
- 5.1.2 Tension tests
- 5.1.3 Electrical resistivity tests (aluminium wire only).
- 5.1.4 Tests for weight and adherence of zinc coating (steel wire only).
- 5.1.5 Dimensional checks.

- 5.2 In addition to the above tests on component wires, the complete conductor shall be tested for its compliance to this specification.
- 5.3 Failure of any of the test specimen comply with the requirements of this specification shall constitute grounds for rejection of the lot represented by the specimen.
- 5.4 Certified test reports in (2) copies shall be furnished on each lot of conductor before shipment.

6.0 INFORMATION TO BE FURNISHED:

- 6.1 The supplier shall furnish sufficient information to fulfil to this specification, including in attached schedule OC-01 (1-4).
- 6.2 Shipping details, including drawings showing dimensions and Construction details of the shipping reels offered.
- 6.3 Complete catalogue information.

7.0 SHIPPING AND MARKING:

- 7.1 Conductor shall be furnished on reels designed for export shipment in accordance with requirements presented in the General Instruction for Conductor included in this specification document.
- 7.2 The standard length of each piece of ACSR conductor to be shipped in each reel shall be: 2500-3000m according to the conductor sizes required in schedule.
- 7.3 Drums shall be non returnable and shall be made timber, pressure impregnated against fungal and insect attach, or made of steel suitably protected against corrosion. They shall be lagged with closely fitting battens in accordance with BS. 1559 or equivalent to National Standard. The required information shall be clearly shown on the flange.
- 7.4 Protection of conductors:
The drum barrel shall be covered with a layer of waterproof sheet plastic or shall be painted with aluminium flake paint secured immediately under the circumstance battens so that it is not in contact with the conductor.
- 7.5 Each reel shall be durably marked on the outside and tagged on the inside with the following information, in addition to other shipping information as may be required:

- 7.5.1 Manufacture's name.
- 7.5.2 PEC name.
- 7.5.3 Size of conductor.
- 7.5.4 Type of conductor.
- 7.5.5 Length of conductor in meters.
- 7.5.6 Gross and net weight.

7.1 SCHEDULE (OC-01/1) TECHNICAL PARTICULARS

Ref. No.	ACSR Conductor	Description	Unit	Data
8.2			mm ²	100
1	Manufacturer			
2	Material			
3	Standards for design			
4	Stranding and wire diameter : - Aluminium - Steel		No/mm No/mm	6/4.72 7/1.57
5	Code / Name			
6	Design cross – sectional areas (Total)		mm ²	
7	Diameter		mm	
8	Weight per km		kg/km	
9	Calculated breaking load		kN	32.7
10	Long term thermal carrying capacity (for 45°C) Ambient temperature, 0.6 m/sec wind velocity under effect of 1200 w/m ² solar radiation for 80°C conductor temperature.		A	
11	Resistance / km at 20°C by D.C.		Ω/km	0.2733
12	Coefficient of linear expansion		1/°C	
13	Modulus of elasticity		N/mm ²	
14	Standard delivery length per drum		m	
15	Gross weight per drum including conductor		kg	
16	Standard for drums			

Signature: _____
Date: _____

7.2 SCHEDULE (OC-01/2) TECHNICAL PARTICULARS

Ref. No.	ACSR Conductor	Description	Unit	Data
8.3			mm ²	50
1	Manufacturer			
2	Material			
3	Standards for design			
4	Stranding and wire diameter : - Aluminium - Steel		No/mm No/mm	7/2.37 1/3.37
5	Code / Name			
6	Design cross – sectional areas (Total)		mm ²	
7	Diameter		mm	
8	Weight per km		kg/km	
9	Calculated breaking load		kN	19.4
10	Long term thermal carrying capacity (for 45°C) Ambient temperature, 0.6 m/sec wind velocity under effect of 1200 w/m ² solar radiation for 80°C conductor temperature.		A	
11	Resistance / km at 20°C by D.C.		Ω/km	0.5364
12	Coefficient of linear expansion		1/°C	
13	Modulus of elasticity		N/mm ²	
14	Standard delivery length per drum		m	
15	Gross weight per drum including conductor		kg	
16	Standard for drums			

Signature: _____
Date: _____

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PUBLIC ELECTRICITY CORPORATION SPECIFICATION FOR LV DISTRIBUTION FUSE BOARDS

Specification No. SW-08

Date: Mar-2000

1.0 SCOPE:

This specification covers distribution fuse boards of following types for use in the PEC LV distribution networks.

Fuse boards for use in indoor substation only (subsequently referred to as indoor fuse boards).

Pillar mounted fuse boards-cable connected for use the doors (subsequently referred to as fuse-pillar).

The fuse boards are for use on 3 phase, 4 wire a.c. system at a frequency of 50 Hz and at a nominal voltage of 433 V. between phases.

The type and quantities as given in schedule of requirements.

2.0 STANDARDS:

Unless otherwise specified herein it shall comply in all respect to requirements contained in the IEC, BS standards specification, or equivalent.

3.0 SERVICE CONDITIONS:

Equipment shall be suitable to ensure satisfactory operation for the following altitude, climatic and atmospheric site conditions:

- | | | |
|---|-------------------------------------|--|
| a | Altitude: | from sea level up to 2300m will be subjected to lightning strokes. |
| b | Ambient temperature: | -5°C up to 50°C. |
| c | Wind pressure: (kg/m ²) | 80 – 130 |
| d | Seismic acceleration: (g) | 0.12 - 0.05 |
| e | Isokeraunic level: | 10 – 18 |
| f | Relative humidity: | 5 – 100 |
| g | Solar radiation: | 1200W/m ² |

- h Atmosphere: Heavy salt and dust laden pollution in coastal areas, moderate sandstorm exposure and dust pollution in low to mid altitude and region and light to heavy dust pollution at high altitudes.

4.0 GENERAL REQUIREMENTS:

4.1 Type and Design:

4.1.1 General:

Fuse boards shall be complete with supporting members as required, on which shall be mounted an incoming transformer unit and outgoing distribution units with busbars, and an instrumental; in accordance with the specified arrangement. The design shall be such that the cables can be readily joined from the front.

All parts of the distribution equipment shall, as far as practicable, be readily accessible and replaceable without excessive dismantling. Insulating materials shall be as nearly non-hygroscopic and resistant to tracking as parse good manufacturing technique permits.

All parts of equal size and rating shall be interchangeable.

The general design shall be such that the number of joints shall be kept to a minimum.

All isolated electrical joints shall be secured by lesion - proof locking features.

Each distribution unit position shall be drilled for mounting at 145 (+ - 5mm) centers and fixing provided for the future fitting of units.

The fuse board shall be designed to take the following arrangement:

- 1600A busbar.
- 1600A Incoming transformer unit.
- 600A Outgoing distributor units (the number of ways as specified in the requirements).

The framework shall be arranged to accommodate the equipment in the following order reading from the front left to right.

- Instrument panel
- Transformer unit

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A minimum of two spare positions for distributor units shall be provided.

The arrangement of the incoming and outgoing units shall be suitable for cables approaching front below.

4.1.2 Incoming Transformer Unit:

The rated normal current of the incoming unit shall be 1600A.

A pole-operated isolator shall be provided in each phase incoming transformer circuit.

The isolator contacts shall include a contact-tightening device on both the top fixed contact and the bottom hinged vibration and good contact shall not depend on the neutral spring of the contact.

Reasonably good contact shall be made on closing the isolator so that current can be safely carried in to the isolator to the tightening of the contacts.

The contact tightening device shall be pole operated by action using the isolator operating pole, the same end of the operating pole shall be used for opening or closing the isolator blades.

An insulated pole shall be provided for operating the isolators and clips shall be provided on the framework to start this when not in use.

The amount of bare metal on the pole must be kept to a minimum.

Provision shall be made on each phase for one current transformer as specified in clause 6 "Current transformers". It shall be possible to easily change current formers.

A bolted link rated at not less than 800 A shall be added for disconnection of the neutral.

Insulated dividing carriers shall be provided in phase contact assemblies and between phase and neutral contact.

Assemblies and between phase and neutral contact assemblies.

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The design shall permit the use of the following arrangements.

7 Single core 600/1000V stranded copper conductor cables XLPE insulation Up to 630mm².

Cable termination arrangements shall be suitable for compression lugs.

Wooden cable cleats shall be provided adequate to the cables in normal service and when subjected to the short circuit duty specified in clause 3. "Short-Circuit rating " cable sockets shall be provided.

4.1.3 Outgoing Distributor Unit:

The rated normal current of an outgoing circuit shall be 600 A.

Cable termination arrangements up to 300-mm² copper conductor XLPE insulated cable with compression lugs. These lugs shall be lad with the units. 4 cable sockets shall be supplied with each distribution unit.

A bolted link rated not less than 300 A shall be provided for disconnection of the neutral.

There shall be one standard size of fixed contact assembly of one-piece construction, which shall be suitable for accommodating a fuse carrier with a 92 mm terminal center fuse-link.

Each fuse-carrier shall be suitable for inserting in a phase of the unit by hinge action pivoted on the lower contact and with drawing by switch action. The contacts shall be arranged to permit tightening and the contact surfaces shall be flat and accurately aligned in pairs.

It shall be possible with ease and safety when both outgoing circuits are alive to fit a current transformer ratio 600/5. 5VA output class D accuracy over the red phase fuse contacts of any outgoing distributor unit, and to use a clip-on ammeter over any assembly when a C.T. is not fitted.

Insulated dividing carriers shall be provided Between phase contact assembled and phase and neutral contact assemblies which shall make it impossible to insert a fuse-link between contacts of different phases.

4.1.4 Busbars:

Busbars shall be of hard drawn high conductivity; the rated normal current of the phase busbars shall be 1600 A.

The neutral busbars shall be rated at not less than 800 A.

A separate earth bar shall be provided of an adequate capacity.

Busbar shall be situated at the rear of the equipment. busbar shall be color marked in sequence from top to bottom, Red, Yellow, Blue and neutral busbar mounted at the bottom, shall be color marked black.

The coloring of leg busbar shall not be continuous and be such that it cannot be mistaken for an insulation covering.

4.2 Construction:

4.2.1 Indoor Fuse Boards:

Supporting structures shall comprise frame works constructed from rolled steel members. The structured shall be arranged for wall and floor mounting with horizontal support from a wall.

All fixing holes shall be drilled to give clearance of M16 bolts. For floor mounting the structure shall have four suitably drilled fixing holes.

The frame work Shall designed to ensure that adequate clearance, not less than the clearances specified in clause 4, "Clearances" Shall be provided to permit the incoming transformer circuit isolators to be left in an open or closed position and alive with the locking device in position.

All indoor fuse boards shall be with lifting devices mounted one at each end.

Any equipment which is not stable on its own supports be fitted for transit and storage with a detachable extension. To provide stability.

A data plate shall be fixed to each indoor fuse board detailing the following information:

- i. Serial Number
- ii. Purchaser Number(empty space for ten digits to be provided)
- iii. Normal current rating of busbars
- iv. Normal current rating of incoming and distributor units

- v. Gross weight when fully equipped (kg).
- vi. Manufacturer's name and type number
- vii. Year of Manufacture.
- viii. Purchaser name (PEC).

4.2.2 Outdoor Fuses Pillars:

The shells of fuse-pillars shall be weatherproof and of robust construction and shall be provided with water shed tops. They shall be manufactured from sheet steel.

Adequate ventilation shall be provided to permit circulation of air.

They ventilation apertures shall be suitably screened to prevent the entry of dust, vermin and other foreign bodies.

The shall be designed to ensure that adequate clearances, not less than the clearance specified in clause 4 "Clearances" shall be provided to permit the incoming transformer circuit isolators to be left in an open or closed position and alive the doors closed and with the locking device in position.

The design of the pillar shall be such that it is suitable for mounting directly on the ground or on a flat base or pier . A detachable roof shall be provided such that when the shell is mounted directly on the ground this roof is buried underground in of mounting on a flat base or pier (concrete) the roof shall be removed and fixing of the pillar to the foundation shall be effected by M 16 foundation bolts. Access to the front of the pillar shall be by means of hinged doors, which shall be fitted with a locking to secure them top and bottom.

The locking bar shall be operated by a control handle, which shall be arranged to permit locking by a padlock. The front Of the pillar shall be removable. Rear access to the pillar shall be provided by removing the back plate. A 65 watt iron clad heater shall be provided.

All fuse-pillars shall be fitted with removable lifting devices mounted one at each end and as near as possible to the balance .Any equipment which is not stable on its own support shall be fitted for transit and storage with detachable extension feet to provide stability.

A data plate shall be fixed to the fuse-pillar detailing the following information:

- i. Serial number

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- ii. Purchaser number (empty space for 10 digits to be provided)
- iii. Normal current rating of incoming and distributor units.
- iv. Gross weight, when fully equipped (kg).
- v. Manufactures name and type number.
- vi. Year of manufacture.
- vii. Purchaser name (PEC).

4.2.3 Painting:

All ferrous surfaces and edges shall be cleaned of scales and rust by shot blasting and shall then be treated on the same, with out outdoor exposure ,with a zinc spray.

The zinc shall be applied by a flame gun process the average of the zinc deposited shall be not less than 550 gm/m² .

This treatment shall be followed by the application of coat of zinc chromate base priming paint applied as soon as suitable after the zinc spraying .Two coats of durable oil and weather sining colors shall subsequently be applied. The final coat be dark admiralty Grey ,color No. 632 in BS 381 C.

The underground roots shall be treated with 2 coats of black bitumenastic paint after the zinc spraying.

4.3 Short-Circuit Rating:

The distribution equipment contained in the fuse board shall be capable of carrying without permanent distortion or deterioration the following 3-phase or I-phase currents for 0.50 second with an initial peak of 2.0 times this value 33 kA - r.m.s.

Evidence shall be submitted to show that a complete distribution fuse board of the basic design offered has been red for compliance with this clause.

4.4 Clearances:

For all connections in air the clearance and creepage distance shall be not less than 25 mm between conductors and 20mm from conductors to earth.

When these clearance cannot be obtained, or where special is exist, adequate self-extinguishing solid insulation shall be provided .

4.5 Fuse and Fuse-Carriers:

4.5.1 Fuses For Distribution Circuits:

4.5.1.1 Fuse - Links:

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Fuse - links shall be of the "J" pattern H.R.C cartridge type and shall have 92 mm terminal centers.

4.5.1.2 Fuse - Carriers:

A through grib shrouded fuse-carrier of porcelain or r approved insulating material shall be provided on each phase.

Each Carrier shall be complete with two inserting fuse carrier so that current can be safely carried in the interval prior to the tightening of the contact tightening thumbscrews.

There shall be one standard size of fuse-carriers which shall carry a 92 mm terminal center fuse link.

4.5.2 Fuse for Auxiliary Supply:

Fuse carrier for auxiliary circuits shall be of the withdrawable handle insulated type (NS type) with rating of 30A.

And shall accommodate cartridge type fuse links of NS type with rating of 15 A and 30 A.

4.6 Current Transformers:

Three Current transformers of ratios 1200/600 shall be provided on the incoming circuit. The current transformers shall comply with the requirement of BS 3938 and shall be of 5VA output class accuracy. They shall be suitable for the operation of maximum demand diameters.

4.7 Instrument Panels and Auxiliary Supply Circuits:

An instrument panel suitable wired Shall be provided to accommodate three maximum demand ammeters With direct reading scales 0-720 reverse 0-1440 A. The wire connections shall be sufficient length to allow for the removal of the ammeters from front of the panel.

The following additional equipment's shall be provided:

- 1-13 A Switched Socket outlet to BS 1363.
- 2-30 A Fuse - base and carriers to be used as follows:
- 1-30 A Circuit for fuse pillar heating circuit and socket outlet.
- 1-30 A Circuit for general substation lighting also (for fuse-pillars only).
- 1-Switch for heating circuit.

The fuse pillar heating circuit shall be switched separately by a 5A tumbler switch mounted on the instrument panel distantly labeled.

Accommodation and mounting arrangement shall be provided for a voltage transformer for use in conjunction with an earth fault indicator.

4.8 Small Wiring:

Small wiring Shall carried out in PVC insulated cable colored black With 7/0.67mm conductor and with cores ferruled.

The Secondary wiring of the group of current transformers shall be connected to earth at a single point.

5.0 TESTS:

Type tests and routine tests shall be done in accordance with the relevant IEC Standards and checks shall be undertaken on equipment and components as indicated in the Technical Specifications. For material and non-electrical components, the Contractor shall submit lists of inspection and tests to be applied together with a list of test standards and approval prior to the inspections and tests being undertaken. Inspection and test results

6.0 INFORMATION TO BE FURNISHED:

6.1 Information to be furnished with tender document:

- 6.1.1 The supplier shall submit the information required in attached schedule SW-08 .
- 6.1.2 Detail drawings of the equipment's.

6.2 Information to be furnished before delivery the equipment's:

The supplier shall supply the following information and drawings, in the English language, to reach purchaser not later than the date that the equipment contracted is to be ready for delivery from the supplier's factory:

- 6.2.1 Three (3) sets of finally corrected certified drawings of all equipment, including details of outline, arrangement, and construction.
- 6.2.2 Three (3) sets of installation, operation, and maintenance booklets.

7.0 SHIPPING, PACKING AND MARKING:

The Contractor shall provide such packing of the Goods as is required to prevent either damage or deterioration during transit to their final destination as indicated in the Contract. The packing shall be sufficient to withstand, without limitation, rough handling during transit and exposure to extreme temperatures, salt and precipitation during transit

and open storage. Packing case size and weights shall take into consideration, where appropriate, and the remoteness of the Good's final destination and the absence of heavy handling facilities at all points in transit.

The packing marking and documentation within and outside the packages shall comply strictly with such special requirements as shall be provided for in the Contract and, in any subsequent instructions ordered by the Purchaser, such as manufacture name, purchaser name (PEC), brief description of the content, etc.

8.0 SPARE PARTS:

As specified here may be required to provide any or all of the following materials and notifications pertaining to spare parts manufactured or distributed by the Contractor:

- a) Consumable spare parts such as distributor unit, contacts, gaskets, plugs, washers, Ammeter, Voltmeter the Purchaser may elect to purchase from the Contractor, providing that this election shall not relieve the Contractor of any warranty obligations under the Contract; and
- b) In the event of termination of production of the spare parts:

- One. advance notification to the Purchaser of the pending termination, in sufficient time to permit the Purchaser to procure needed requirements; and
- Two. the blueprints, drawings and specifications of the spare parts, if and when requested.

SCHEDULE SW-08 TECHNICAL PARTICULARS

Ref No.	Description	Unit	Data/Quantity
	LV Distribution Board Unit Detail		
1	Manufacturer and country of manufacture		
2	Manufacturer's Type/Model No.		
3	Applicable Standards		
4	Rated Voltage	kV	
5	Rated Frequency	Hz	

6	Rating for Busbars Unit Incoming/Isolator Neutral Busbar	A A	
7	Short circuit rating	KA/Sec	
8	Distribution unit fuse link (type)		
9	Auxiliary supply fuse (type)		
10	CT's Incoming circuit: - Ratio Output - Class		
12	CT's Outgoing distribution unit Ratio Output Class		
13	Over all dimension Length Width Height Total / mass	mm mm mm kg	

Signature: _____

Date: _____

9.0 NON COMPLIANCE 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, operating characteristics and system performance. Each non compliance shall make reference to the relevant specification clause.

Specification Clause	Non Compliance Description

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PUBLIC ELECTRICITY CORPORATION

SPECIFICATION FOR

THREE PHASE STEP DOWN POLE MOUNTLD DISTRIBUTION TRANSFORMER

Specification No. Tr.- 03

Date: Aug. 2020

1.0 SCOPE:

- 1.1 This specification covers design, manufacture, factory testing and inspection, packing & shipping of three phase outdoor distribution pole mounted step down transformers complete with oil and spare parts.
- 1.2 The transformer ratings and quantities as schedule attached hereto.

2.0 STANDARDS:

Unless otherwise specified herein, construction, performance and testing of all equipment shall comply in all respects to requirements contained in the following IEC, BS standard specification or equivalent.

- | | | |
|-----|-------------|------------------------------------|
| 2.1 | IEC 76 | Power transformer (Part 1-6 incl.) |
| 2.2 | BS 148 | Transformer oil |
| 2.3 | BS 381c | Painting |
| 2.4 | BS 171:1970 | Insulation |

3.0 SERVICE CONDITIONS:

Transformer shall be suitable to ensure satisfactory operation for the following altitude, climatic and atmospheric site conditions:

- | | | |
|-------|-------------------------------------|--|
| One | Altitude: | from sea level up to 2300m will be subjected to lightning strokes. |
| Two | Ambient temperature: | -5°C up to 50°C. |
| Three | Wind pressure: (kg/m ²) | 80 – 130 |
| Four | Seismic acceleration: (g) | 0.12 - 0.05 |
| Five | Isokeraunic level: | 10 – 18 |
| Six | Relative humidity: | 5 – 100 |

Seven	Solar radiation:	1200W/m ²
Eight	Atmosphere:	Heavy salt and dust laden pollution in coastal areas, moderate sandstorm exposure and dust pollution in low to mid altitude and region and light to heavy dust pollution at high altitudes.

4.0 DETAILED REQUIREMENTS:

4.1	<u>Type:</u> Distributions transformer, step down, outdoor double wound core type, ONAN cooling oil immersed.
4.2	<u>Rating:</u> Voltage ratio at no load No. of phases Frequency Connected to vector group Tapping Transformer rating The flux density
	11/0.415kV. 3phase 50Hz Dyn11 On H.V. winding of +/- 7.5% in step of +/-2.5% by means of manually and externally operated off load tapping switch with position indicator and padlocking device. as indicated in schedule. at any point of the magnetic circuit when transformer is connected on the principle tapping and rational normal voltage and frequency shall not exceed 1.65 Tesla.

5.0 CONSTRUCTION:

5.1	<u>H.V. Termination:</u> Outdoors weatherproof bushings shall be provided within duplex arcing horns and mounted on the tank side. The creepage distance of the insulator bushings should be (about 1320mm) for 33kV and (about 440mm) for 11kV system.
5.2	<u>L.V. Termination:</u> Outdoors-weatherproof bushings shall be fixed on the transformer tank side opposite to the H.V bushings.
5.3	<u>Transformer Tank:</u> The tank covers shall be of such design and shall be fixed to a flange on the tank top to form a weatherproof flint.

The distance from the inner edge of the flange to the holes for the studs or bolts securing the tank cover shall not be less than 12 mm. All gaskets shall be of synthetic rubber and cork composition Complete

transformers arranged for service, but with arcing horns removed, shall be capable of with standing an impulse voltage on the higher windings of 170 kV peak (1.2/50 wave) for 33kV system and 95kV for 11 kV system.

All transformers shall be dispatched filled with oil to the correct level ready for service. The oil shall meet the requirements of BS 148.

5.4

Cores:

The cores shall be square in section, built of allow loss grain orientated silicone steel with laminations adequately insulated.

Joints shall be mitred and interleaved to provide continuity of the magnetic Circuit.

The yoke laminations shall be securely clamped between specially designed steel frames held by external bolts.

The limbs shall be secured by insulated bandying and radial packing strips against the low voltage coils.

5.5

Windings:

The windings shall have uniform insulation as in BS.171: 1970 and Neutral points shall be insulated to withstand the applied voltage tests in accordance with this standard.

The winding shall be located in two manners, which will ensure that they remain electrostatically balanced and their magnetic centres remain coincident under all conditions.

5.6

Temperature Rise:

The temperature rise shall not exceed the value stated in IEC.76-2 or BS 171 for 50°C maximum ambient temperature.

5.7

Fittings:

The following fittings shall be supplied:

- Plain horizontal base.
- Earthing Terminals.
- Silica Gel Breather.
- Rating and connecting plate.
- Tank drain valve and plug.
- Oil level gauge.
- Oil fitting hole and plug.
- Oil conservator.
- 4"/6" dia type thermometer with maximum pointer.
- Lifting lugs.

5.8

Cleaning and Painting:

Paint shall be applied by the flood or spray method. The inside and the outside of the tank covers shall be treated in the same manner as the inside and outside of the tanks.

The interior of the tanks shall be thoroughly cleaned by shoot blasting and the surfaces shall be given one coat of oil resisting paint or varnish.

The exterior of steel tanks, complete with tubes or radiators where applicable, shall be thoroughly cleaned by shoot blasting after fabrication and shall be zinc sprayed.

The zinc shall be applied by the flame gun process and the average weight of zinc deposited shall be not less than 600g/m². This treatment shall be applied immediately after shoot blasting as a follow-up process, on the same day without outdoor exposure.

After the above treatment, the interior of the tanks shall be given one coat of zinc chromate base priming paint, applied as soon as practicable after the zinc spraying.

Two coats durable oil and weather resisting paint of contrasting colours shall subsequently be applied. The final coat shall preferably be dark admirals grey, colour no. 632 of BS 381c.

6.0 TEST:

All tests shall be made by and at the expense of the manufacturer in accordance with the IEC 76 requirements, or equivalent.

7.0 INFORMATION TO BE FURNISHED:

The following minimum technical information shall be supplied with the tender:

- NO -load loss.
- Load loss.
- Rating (kVA).
- NO load voltage ratio.
- Temperature rises.
- Basic impulse level.
- Total weight including oil.
- Oil quantity.
- Approximate length, width and height.
- Thickness of tanks (walls, base and cover).
- General arrangement drawings.
- H.V. and L.V. Bushing assembly drawings.

The above shall be regarded as the basic information Specific data relating to any particular design shall also be provided according to attached schedule Tr-03.

8.0 DRAWING AND OPERATION AND MAINTENANCE MANUAL:

Drawings together with Operation and Maintenance manual shall be provided three copies per transformer.

9.0 TEST CERTIFICATES:

Three copies of the test certificates shall be submitted for each transformer supplied. Two copies of the test certificates shall be sent to the purchaser separately and one copy shall affixed to the transformer and dispatched with it in a weatherproof envelope.

10.0 SHIPPING AND MARKING:

10.1 All equipment shall be suitably prepared for ocean shipment through tropic zones. Transformers shall be shipped with oil filled and sealed.

10.2 High voltage bushing shall be dismantled and individually packed for ocean shipment if necessary. The bushing shall be individually cartoned and packed in carefully constructed boxes suitably lagged to protect the bushings against both mechanical damage and insulation deterioration.

10.3 All packing enclosures shall be such that slings for handling may be readily attached during transport. Where it is unsafe to attach slings to boxes and crates, boxed and crated parts shall be packed with slings attached to the content, and slings shall project through the box or crate so that pickup attachment can be readily made. The purchaser name (PEC) should be indicated on the carts.

10.4 All projecting parts such as valves, gauges and similar equipment shall be removed, wherever possible and shipped separately. Where removal is not possible, they shall be provided wherever necessary with welded protective steel plate boxes.

10.5 All finished non-ferrous metal work and devices liable to be subjected to damage shall be suitably wrapped or otherwise protected. All finished ferrous surfaces shall be coated with a readily removable rust preventive compound.

10.6 All boxes containing equipment liable to corrode in a high humidity, tropical saline atmosphere shall be double lined with suitable weatherproof packing and ample supplies of silicon gel dehydrating agent shall be enclosed in such boxes

to prevent condensation occurring within the boxes during transportation.

10.7 All parts shall be adequately marked to facilitate field erection and all packages shall have at least one copy of the packing list, in English and enclosed showing the parts contained therein.

11.0 SPARE PARTS:

As specified here may be required to provide any or all of the following materials and notifications pertaining to spare parts manufactured or distributed by the Contractor:

One) Consumable spare parts such as bushings, contacts, gaskets, plugs, washers, tapchanger, the Purchaser may elect to purchase from the Contractor, providing that this election shall not relieve the Contractor of any warranty obligations under the Contract; and

Two) In the event of termination of production of the spare parts:

- advance notification to the Purchaser of the pending termination, in sufficient time to permit the Purchaser to procure needed requirements; and
- following such termination, furnishing at no cost the Purchaser, the blueprints, drawings and specifications of the spare parts, if and when requested.

12.0 SCHEDULE Tr-03 TECHNICAL PARTICULARS

Ref No.	Description	Unit	Data
	POLE MOUNTED DISTRIBUTION TRANSFORMER		
1	Applicable Standards		
2	Country of manufacture		
3	Manufacturer's Type Number		
4	Rated Power output	kVA	300
5	Number of phases		
6	Rated frequency	Hz	
7	Rated Primary voltage	kV	
8	Rated Secondary voltage	kV	
9	Vector group		
10	Off- load tapping of primary winding	%	
11	Ambient temperature	°C	
12	Temperature rise in inding W T op oil Core Pr Seco	°C °C °C	
13	Applied test voltage, Imin, 50 Hz inary winding inary winding	kV kV	
14	Impulse test voltage, full wave, primary winding	kV	
15	No-load losses	kW	
16	Load losses	kW	

Signature: _____
Date: _____

12.1 SCHEDULE Tr-03 TECHNICAL PARTICULARS
(continued)

[illegible]

13.0 NON COMPLIANCE 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, operating characteristics and system performance. Each non compliance shall make reference to the relevant specification clause.

[illegible]

Signature: _____
Date: _____

The bidder shall provide a list of the test certificates included with the bid. The list shall include type test certificate, routine test report references. Each certificate listed shall as far as possible refer to the relevant specification clause.

Signature: _____
Date: _____

DESCRIPTION.....	PAGE NO.....
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PUBLIC ELECTRICITY CORPORATION
SPECIFICATION FOR**600/1000V XLPE INSULATED CABLE**

Specification No UC-03

Date: Aug. 2020

1.0 SCOPE:

1.1 This specification applies to four core low voltage cables with an extruded solid dielectric.

1.2 The size and quantities as required in schedule attached.

2.0 STANDARDS:

Unless otherwise specified herein, cables shall comply in all respect to requirements contained in the following IEC, BS specification, or equivalent

- | | | |
|-----|--------------|----------------------|
| 2.1 | IEC 502 | Cables requirements. |
| 2.2 | BS 6622:1977 | Cables requirements. |
| 2.3 | IEC 228 | Conductors. |
| 2.4 | BS 5467:1977 | Insulation. |

3.0 SERVICE CONDITIONS:

Conductor shall be suitable to ensure satisfactory operation for the following altitude, climatic and atmospheric site conditions:

One Altitude: from sea level up to 2300m will be subjected to lightning strokes.

Two Ambient temperature: -5°C up to 50°C.

Three Wind pressure: (kg/m²) 80 – 130

Four Seismic acceleration: (g) 0.12 - 0.05

Five Isokeraunic level: 10 – 18

Six Relative humidity: 5 – 100

Seven Average thermal resistivity of soil: 1.5°C.m/W

Eight Solar radiation: 1200W/m²

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Nine Atmosphere:

Heavy salt and dust laden pollution in coastal areas, moderate sandstorm exposure and dust pollution in low to mid altitude and region and light to heavy dust pollution at high altitudes.

4.0 DETAILED REQUIREMENT:

4.1

Conductors:

Conductors shall consist of stranded copper or aluminium conductor to BS 6360, BS 6791:1969, IEC 228 or such other standards may be approved.

Plain circular stranded copper conductors for cable size less than 70mm², and sector stranded copper conductor for cable size 70mm² and above.

4.2

Insulation:

The insulating compounds shall consist of chemically cross-linked polyethylene (XLPE) extruded in accordance with clause 4 of IEC 502 clauses 6&7, BS 5467:1977 or such other standards as may be approved.

4.3

Bedding:

The insulating compounds shall consist of chemically cross-linked polyethylene (XLPE) extruded in accordance with class 4 of IEC 502 or class 6 & 7 of BS 5467: 1977 or such other standards as may be approved.

4.4

Core Identification:

The core of the cable shall be identifying by the color in accordance with clauses 8 of BS 5467: 1977 or such other standard as may be approved. Or may be identified by means of semi-conducting tape marked with a colored rip applied in combination with a metallic tape over each core in accordance with clauses 5.3 & 8 of IEC.502 or such other standards; may be approved.

4.5

Manufactures Identification Tape:

The identify of manufacture shall be provided through out the length of the cable by means of a plastic tape on which is intact the name of the manufacture and cable nominal voltage at intervals not more than 300mm.

4.6

Laying-Up:

On four core cables, the insulated cores and the manufactures identification tape shall be laid up with non-hygroscopic performed fillers to make a circular cable and bound overall in accordance with clauses 9 of BS 5467:1977 or such other standards as may be approved.

4.7

Earth Fault Current:

The cable core screen and armour shall be designed to carry an earth fault current of 13kA

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4.8

Armour Bedding:

On three core cables, the armour bedding shall consist of 1 laided or alternatively may be in the form of an extruded PVC compound accordance with BS 5467: 1977 or with clauses 6.6 of IEC 502 or such other standard as may be approved.

4.9

Armour:

The armour for the cable shall be consist of one layer of galvanised steel wire complying with BS 1442 and BS 5467: 1977 or IEC 502 or such other standards as may be approved.

4.10

Outer Covering:

The outer protective covering shall be extruded black PVC compound type (9) in accordance with BS 6746:1976 or such other standard as may be approved. As a protection against termite attack, the outer coverings shall preferably contain an evenly dispersed mixture of adrian and dieltrin in the ratio of 0.25% each by weight of PVC, or other suitable deterrent which shall be stated in the tender for approved by the PEC.

5.0 TEST:

5.1

Routine Tests at Works:

Drum lengths of cable shall be subjected to the following tests:

- One) Conductor and Copper screen resistance measurement as per IEC 502/1983 Clause 14.2.
- Two) Voltage test as per IEC 502/1983 Clause 14.4.
- Three) Partial discharge test.
- Four) Voltage test on PVC outer covering.
- Five) Measurement checks as per IEC 502 Clause 15.3, 15.4, 15.5 and 15.8

6.0 CABLE IDENTIFICATIONS:

In order to ascertain the cable lengths, a varnished paper, cellulose acetate or similar tape bearing lengths in meters shall be applied longitudinally immediately under the protection outer sheath. The tape shall be nominally 0.13mm thick, 10mm wide and figures approximately 6.5mm high. Alternatively the length in meters may be embossed on the outer PVC sheath.

The outer jacket surface of each individual insulated conductor shall be durably marked throughout its length with the manufacturer's name, conductor size, type of insulation voltage, rating and year of manufacture.

Cables which consist more than one insulated conductor shall have the outer surface of individual insulated conductor cables durably marked throughout the cables length with means of individual phase identification.

7.0 CABLE LENGTHS:

Where applicable, cable shall be supplied in maximum drum lengths not exceeding 500 meter. No drum shall contain more than one length.

8.0 INFORMATION TO BE FRNISHED:

The contractor shall furnished sufficient information as given in the schedule UC-03 of particulars guarantees, shipping details including drawings showing dimensions and construction details of the shipping reels and complete catalogue information.

9.0 SHIPPING AND MARKING:

9.1 Cable shall be furnished on reels designed for export shipment in accordance with requirements presented in the General Instruction for Cables included in this specification document.

9.2 The standard length of each piece of cables to be shipped in each drum shall be 250-500m according the cable sizes required in schedule.

9.3 Drums shall be non returnable and shall be made timber, pressure impregnated against fungal and insect attach, or made of steel suitably protected against corrosion. They shall be lagged with closely fitting battens in accordance with BS 1559 or equivalent national standard the required information shall be clearly shown on the flange.

9.4 Each drum shall be durably marked on the outside and tagged on the inside with the following information, in addition to other shipping information as may be required.

- 9.3.1 Manufacture's name.
- 9.3.2 PEC name.
- 9.3.3 Type of conductor.
- 9.3.4 Size of conductor.
- 9.3.5 Length of conductor.
- 9.3.6 Gross and net weight.

Protection of conductors:

The drum barrel shall be covered with a layer of waterproof sheet plastic or shall be painted with aluminium flake paint secured immediately under the circumstance battens so that it is not in contact with the conductor.

10.0 SCHEDULE UC-03 TECHNICAL PARTICULARS AND GUARANTEES LOW VOLTAGE CABLES:

Item	Description	Unit	Data
1	Voltage between phases of three phase circuit=U or phase to earth.	kV	
2	Standard		
3	Number of cores		
4	Cross Sectional Area of conductor	mm ²	
5	Conductor materials		
6	Diameter or conductor	mm	
7	Min. thickness of insulation between conductor and screen	mm	
8	Type of filler material		
9	Number / Diameter of core wires	No/m m	
10	Minimum thickness of the sheath	mm	
11	Outer covering type		
12	Completed cable: Thickness Overall diameter Weight/metre Maximum drum length	mm mm kg m	
13	Resistance of each core per 1000 metres at 20°C	Ohm	
14	Star reactance per 1000m of completed 2 phase circuit at 50Hz	Ohm	
15	Mean electrostatic capacity of each conductor to earth/1000m of completed cable	UF	
16	Charging current/cond/1000m of completed cable at normal voltage		
17	Minimum radius of bend around which cable can be laid	m	
18	Maximum conductor temperature	°C	
19	Distance between supports (vertical and horizontal Cleating)	m	
20	Ultimate tensile strength of cable	tonne	

Signature: _____
Date : _____

11.0 NON COMPLIANCE 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, operating characteristics and system performance. Each non compliance shall make reference to the relevant specification clause.

[illegible]

Signature: _____
Date: _____

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PUBLIC ELECTRICITY CORPORATION SPECIFICATION FOR WOOD POLES

Specification No. WP- 01

Date: **Aug- 2020**

1.0 SCOPE:

This Specification provides for the selection, seasoning, fabrication, impregnation treatment, and shipment of wood poles for use in the reinforcement and extension of the 33, 15 and 11kv lines and low voltage networks.

2.0 STANDARDS:

The contract Works shall comply with the recommendation contained in the latest issue of the following National Standards. The Tenderer shall define the Specifications used for the preparation of the Tender.

2.1 **British Standards Institute**

Wood Poles for overhead lines:

-BS.1990 (Part 2 1971) IEC 76
(With ADM.1592.8/11/1974)

Preservation Treatment:

Creosotes to:

- BS. 913

- BS. 144

2.2 American National Standards:

Specification & Dimensions for Wood Poles: ASA 05.1

With treatment to the requirement of:

- AWWA.

3.0 SERVICE CONDITIONS:

Wood poles shall be suitable to ensure satisfactory operation for the following altitude, climatic and atmospheric site conditions:

- a) Altitude: from sea level up to 2300m will be subjected to lightning strokes.
- b) Ambient temperature: - 5°C up to 50°C.
- c) Wind pressure: (kg/m²) 80 – 130
- d) Seismic acceleration: (g) 0.12 - 0.05
- e) Isokeraunic level: 10 – 18
- f) Relative humidity: 5 – 100%
- g) Atmosphere: Heavy salt and dust laden pollution in coastal areas, moderate sandstorm exposure and dust pollution in low to mid altitude and region and light to heavy dust pollution at high altitudes.

4.0 QUALITY OF MATERIALS:

All materials supplied or used in the treatment and processing of the poles shall be of the best quality and of the class most suitable for use under the climatic conditions prevailing in Yemen. The materials shall be suitable for use in the high ambient temperatures and high relative humidity at the coast and in the cooler condition up on the high plateau.

5.0 ACCEPTABLE TIMBER SPECIES FOR WOOD POLES:

Only timber species with proven long life characteristics and in full compliance with this specification will be accepted.

The Tenderer is required to demonstrate the durability of the poles offered, including results of recent tests to define the average ultimate fiber stress, the modulus of elasticity and the density of typical samples at defined moisture content just prior to impregnation treatment.

The pole shall have guaranteed min. ultimate head load equal 53.8 N/mm². Wood poles shall be slow grown pinus sylvestris grown in northern altitudes.

All Tenders must indicate in the Schedules the full details of the materials offered.

6.0 DIMENSION OF POLES:

Pole of three given grades are required. The length and diameter dimensions are shown in Table 1.

Poles of the following lengths are required:-

Light grade 7 meters to 13 meters
Medium grade 8 meters to 14 meters
Stout grade 8 meters to 15 meters

7.0 WOOD BAULKS:

Wood baulks for kicking blocks in the pole foundations shall be to the sizes and numbers as specified in the Schedules. The timber shall be sound, free of all major knots, shakes and splits and impregnated as for the wood poles.

8.0 SELECTION AND PREPARATION OF POLES:

The trees must be felled in the non-growing season; in the winter for northern latitudes. The trees should be carefully debarked immediately after felling and both the inner and outer bark should be completely removed, and all branches trimmed down to the trunk. The sapwood must not be damaged.

TABLE 1: POLE DIMENSIONS BY GRADES

The diameters are to be measured by a diameter tape, within 100 mm from the top and 1.5 m from the butt of the sample. Such diameter measurements shall have a tolerance of plus 15 mm, minus 0 mm.

Grade	Pole Length M	Diameter at the Top		Diameter 1.5 from the Butt	
		Minimum	Maximum	Minimum	Maximum
Light	7.5	125	150	175	190
	8.0	125	150	175	190
	8.5	"	"	180	198
	9.0	"	"	"	200
	9.5	"	160	185	203
	10.0	"	"	"	205
	10.5	"	"	190	209
	11.0	"	"	195	214
	11.5	"	165	200	220
	12.0	"	"	205	225
	13.0	130	160	215	231
Medium	8.5	150	180	215	236
	9.0	"	"	220	242
	9.5	"	"	225	247
	10.0	"	185	230	253
	10.5	155	190	235	259
	11.0	"	"	240	264
	11.5	160	195	245	269
	12.0	"	"	250	275
	13.0	170	200	260	286
	14.0	175	205	276	302
Stout	8.5	190	240	265	291
	9.0	"	"	275	302
	9.5	"	245	280	308
	10.0	195	"	285	313
	10.5	"	250	290	319
	11.0	"	"	295	324
	11.5	"	"	300	330
	12.0	"	"	305	335
	13.0	200	255	320	352
	14.0	"	"	335	368
	15.0	"	260	350	385

8.1 Length:

The final length of the poles shall not exceed the specified length by more than 25mm for each 3 m of pole length. The poles shall not be shorter than the specified length by more than 25mm for any poles. This does not apply to the length of the poles as stacked for seasoning.

8.2 Diameter and Circularity:

Since the poles are not perfectly round and direct measurement of the poles is most important for the use of diameter tapes or by normal tape with adjustments for π should be used.

The least diameter of the pole measured at the plane where the girth, or diameter, is specified to be measured shall be not less than minimum diameters shown in Table 1.

8.3 Ground Line:

This is the assumed location of the surface of the pole as it is buried in the foundations. For the purposes of this Specification the ground lines shall be 1.5 meters up from the butt of the pole.

8.4 Straightness:

Sweeps and crooks, if present in the poles, shall be within the following limits of straightness: -

a) Single Sweep:

The distance from the surface of a pole, to a line stretched between the pole top and the ground line, on the surface of the pole and in the same aerial plane, shall not exceed $5 \times L$ in mm, when L is the pole length from the top of the pole to the ground line in meters.

b) Double Sweep:

A straight line through the center of the cross-section at the pole top and at the ground line of a pole shall be within the pole throughout the full length of the pole.

c) Crooks and Short Deviation:

The distance from the surfaces of a pole to a line stretched between any two points above the ground line on the surface of the pole in the same aerial plane either one quarter of the length of the pole or 2 m apart whichever is the greater, shall not exceed $1.62 \times k$ in mm, when k = the distance in meters between the points.

8.5 Knots:

Knots shall be permitted if sound, smoothly trimmed, and do not plainly impair the strength of the pole. The average superficial diameter of any knot shall not exceed one-sixth of the girth of the pole at the point of measurement. Where groups of tight knots occur, the sum of their average diameters within any 150 mm of the length of the pole shall not exceed one-third of the average girth of the pole at the height concerned.

8.6 Splits:

The length of any split at the top end of a pole shall not exceed twice, and at the butt end, four times the diameter at the end concerned.

At the pole top any split shall be across the line of pole bolts. At no point shall a split gap more than one-twentieth ($1/20$) of the diameter at the point of measurement.

Splits, which develop after the preservation treatment is complete, shall render the pole unacceptable.

8.7 Sapwood:

Poles shall not contain sapwood having a radial width of less than 13 mm in the case of hardwoods. Sapwood shall not be removed from that part of the pole, which will be planted in the ground or along one-fifth of the overall length of the pole as measured from the butt end.

8.8 Decay:

Apparent decay of live fungal fruiting bodies shall not be present in any pole.

8.9 Gum and Resin Pockets and Resin Scar:

A pole shall not contain gum or resin deposits within the first 25 mm of the wood when measured radially from the periphery of the pole.

8.10 Insect damage:

Poles shall be free from all insect damage with the following exceptions:

- a) Scoring and/or channeling up to a depth of 3 mm of the surface of a pole shall not be classified as insect damage.
- b) A maximum of 20 holes definitely identified as pin-hole borer (ambrosia) damage shall be allowed in any 1 meter length of pole, except that no such damage shall be permitted in the lower 3 m of the pole.

8.11 Spirality:

Spirality of the grain in Eucalyptus species poles shall not exceed the equivalent of one complete turn in the pole length.

For Pine species poles the maximum spirality allowable is half a turn.

8.12 Ring Shakes:

Poles showing this type of structural defect, involving cracks appearing as an arc of complete circle, caused by lack of cohesion between any adjacent growth rings in the hard wood section are unacceptable under any circumstances.

8.13 Initial Banding:

Hardwood poles must be protected against end splitting during the seasoning period by banding. This initial banding must be done in the forest as soon as the de-barking has been completed, and before the poles are moved to the roadside.

8.14 Removal to Storage Yard:

Pole timber should not be allowed to lie on the forest floor but should be taken to the storage yard adjacent to the preserving plant as soon as possible after felling.

9.0 SEASONING:

9.1 Moisture Content:

When the poles arrive at the Pole Plant, they will have a moisture content by weight of 110-150%. This is reduced by natural air drying to as low a value as possible, not more than 25-28% on average of samples taken from each stack. These tests should be carried out immediately prior to fabrication and preservation.

9.2

Stacking:

The correct stacking of poles is important, to avoid uneven drying and splitting at the ends of the poles. The site for the pole stacks should be located on firm, well drained ground and partial shade is desirable, although not imperative.

The stacks should up on timber bases, these bases being made of pole uprights, set into the ground, at from 1.5 to 2 m apart, spanned horizontally by medium grade treated poles. Soundness of construction is paramount since the collapse of a pole stack is very difficult to clear and disrupts the smooth working of the plant. The area below and adjacent the stacks must be kept free of weeds, vegetation, litter and insects, etc., to limit the fire risk and attack on the untreated timber by insects, termites of wood-boring species. It is important to avoid pools of water under the stacks as this reduce their effectiveness and delays the seasoning process as well as providing a situation where viruses can flourish.

9.3

Seasoning Periods:

The seasoning time for the timber in the stacks depends on the climatic conditions and the General Classification of the Timber Species.

Hardwood, Eucalyptus and Gums must be seasoned for at least one day for each mm of pole butt diameter, i.e. 175 – 180 days.

During the seasoning period the timber shrinks due to the moisture loss, the banding at head and butt becomes slack and should be replaced or tightened to limit the tendency of end splitting.

Kiln drying of pole timber is not acceptable.

9.4

Final Selection and Rebinding:

The poles shall be examined in the stack for splits, shakes and strengtheners etc. They are selected for length and grade, “light”, “medium” “stout”. The banding at the butt is replaced, and a new and is fitted at the pole tip, before the pole is finally cross-cut to length.

10.0 FABRICATION OF POLES:

10.1

General:

Shaping, cutting and fabrication shall be carried out before preservation treatment. In the case of poles from which 300mm or more has been trimmed, at least 7 days shall have elapsed after trimming before preservation is effected.

10.2

Swelling:

Occlusion swellings shall not be removed but where poles are damaged, for example during the removal of bark or the trimming of branches, these shall not be regarded as a defect, provided that the requirements latest issue IEC & BS stander.

10.3 Pole Marking:

All poles shall be marked as such marking to include:-

- a) The 3 m gouge mark.
- b) Pole length in meters.
- c) Pole Diameter at 1.5 m from butt (ground line).
- d) Identification of timber species.
- e) Year of impregnation.
- f) Suppliers name and mark.
- g) PEC name.

All such making shall be cut into the pole to sufficient depth to ensure that the information can be easily read. Such marking can be carried out by cutting or burning of the timber before treatment.

The length and grade details, i.e., 10L, or 85 for ten meters light or eight meters stout etc. are also to be marked deep into the butt end grain of the poles. Such marking to be readable when the poles are stacked.

10.4 Cutting and Scarfing:

As much as possible of the pole scarfing and fabrication is to be carried out using jigs and simple fixings. All drilling for pole bolts are to be square with the axis and in line. All drilling where more than in hole is involved shall be jigged.

10.5 Banding:

a) General:

The initial banding carried out in the forest shall remain on the poles during their seasoning period and fresh banding shall be applied prior to trimming the poles to final length before treatment. Such bandings shall be effected using either galvanized mild steel wire of galvanized high tensile steel strapping.

b) Material:

The wire used shall be not less than 2.5 mm Dai. And shall be wound tightly around the pole a minimum of five turns and held using galvanized wire stapled at least 40 mm in length and the ends so turned as to avoid any slipping

The high tensile steel strapping at least 20 mm in width and not less than 1 mm thick shall be firmly applied around the pole using an approved strapping machine. Each band shall be stapled on to the pole at three positions, each staple shall be not less than 40 mm long and made of galvanized wire not less than 3.5 mm die. The staples shall be driven in a slant manner across the band so that the two points of the

staples are not driven into the same point of the grain of the timber. If high tensile steel strapping is not available, normal galvanized iron strapping is permissible with the sizes increased to 25 mm in width and 1.5 mm in thickness.

c) Location:

The final bandings shall be positioned not less than 75 mm and not more than 100 mm from the ends of the pole.

11.0 DETERMINATION OF MOISTURE CONTENT OF THE POLES PRIOR TO PRESERVATION TREATMENT:

11.1 General:

Careful records of the weather at the pole storage areas must be maintained. The seasoning practices, in particular the construction of the pole stacks, must be in accordance with sound principles. The records of each stack shall be related to the weather condition over the seasoning periods.

11.2 Type of Measurement:

The use of an electrical resistance moisture is acceptable to carry out rough measurements when the poles are at high moisture contents at the start of the seasoning period.

Such instruments, if used, shall be calibrated against oven drying and weighing of small samples cut to full sapwood depth.

The final checks on moisture content of the poles before treatment must be carried out by the weight loss method or by the Dean Stark method. Tests shall be made on the selected samples, which shall not be taken from the top layer of the stack, but should be from the middle two or three layers of poles in the bottom of each stack.

11.3 Determination of Moisture Content:

The sample plug is taken by a suitable rotary 13 mm cutter. The cutter is to be kept sharp and hand operated to avoid overheating, with consequent unmeasured loss of moisture. As the cutting proceeds to a depth of approximately 40 mm for hardwood transfer all the borings to a tared weighing bottle with ground glass stopper.

When the drilling has been completed to the stipulated depth withdraw the auger from the hole without delay, collect all remaining borings, place them in the bottle with the borings already collected and stopper the bottle immediately.

11.4 Procedure for Oven-Dry Method:

Weigh the closed bottle with its contents and record the total mass. Remove the stopper from the bottle and place the open bottle with its contents in a properly ventilated oven. Heat the oven to a constant temperature of 100 °C to 105 °C, maintaining

this temperature until the mass of the bottle and contents remains constant. Remove the bottle and contents from the oven, replace the stopper on the bottle and place the whole in a desiccator. Allow to cool until a constant room temperature is attained. Weigh the bottle and contents. Record the combined mass.

Calculate the average moisture content of the borings from the formula:

$$\text{Average moisture content, \%} = \{(M_1 - M_2) / (M_2 - C)\} * 100$$

Where M1= Mass of sample and container before drying, in grams.
M2= Mass of sample and container after drying, in grams
C= Mass of container.

11.5 Procedure for Use of Dean and Stark Method:

Apparatus

a) Flask:
A 500 ml Erlenmeyer flask with latest issue BS stander ground glass joint.

b) Extraction apparatus:
A socket extraction apparatus with latest issue IEC & BS stander ground glass cone and socket.

c) Water trap:
A 7.5ml Dean and Stark water trap complying with the requirements for latest issue BS stander. The trap shall be fitted with latest issue IEC & BS stander socket & cone.

d) Condenser:
A condenser complying with the requirements of latest issue IEC & BS stander or equivalent ground glass cone.

e) Wire gauze basket:
A cylindrical 300 mm gauze basket made of stainless steel or brass, approximately 65 mm long and with a diameter of 30 mm.

11.6 Reagents:

a) Water-saturated toluene:
Add a few milliliters of distilled water to chemically pure quality toluene. Shake the mixture well to saturate the toluene with water, and allow the excess water to settle. Decant the supernatant toluene into a clean distillation flask and distil into a clean dry receiver. Discard the first milky portion which distils over and, once the distillate becomes clear, change receivers and collect the distillate for the determination.

b) Cotton wool.

Dry cotton wool in an oven at 105 °C for 1 hour and store in a desiccator.

11.7 Procedure:

Transfer the composite sample to the gauze basket as rapidly as possible to prevent loss of moisture, close the basket with a plug of dried cotton wool and place it in the Soxhlet apparatus.

Assemble the apparatus and pour in sufficient water-saturated toluene to fill the Soxhlet extractor twice. Apply heat and distil the toluene at a rate of 1 drop per second. Continue heating until all moisture is extracted from the drillings and until the volume of water in the trap does not increase by more than 0.1 ml in 15 minutes. Remove the heat source and allow the contents of the trap to cool to room temperature.

If droplets of water adhere to the walls of the condenser or to the sides of the trap, loosen them with a piece of wire twisted into a spiral or with a PTFE rod and wash them down with the aid of a small amount of toluene. Read the volume of water in the trap to 0.1 ml.

11.8 Calculation:

Calculate the moisture content from the formula :

$$\text{Moisture content} = \left[\frac{C}{(a-b)} \right] * 100$$

Where: C = Volume in milliliters of water in trap.

a = Mass in gms of dried timber drilling + basket + cotton wool plug;
and

b = Mass in grams of basket + cotton wool plug.

12.0 PRESERVATION TREATMENT OF POLES:**12.1 General:**

All wood poles and timber products are to be treated by immersion of the timber completely in creosote in a closed cylinder and subjection to a pressure greater than atmospheric.

12.2 Creosote:

The creosote used shall be submitted for analysis and certified. The material shall comply fully with latest issue IEC & BS standard or equivalent.

12.3 Stacking in the Cylinder:

Only timber of the same general species, and if possible similar cross-sectional area, shall be creosoted in the same charge.

The timber shall be stacked in the cylinder so that the creosote shall have free access to all faces. Supporting laths and wedges shall be used to ensure adequate circulation.

12.4 Choice of Process:

Where hardwood timber is processed the treatment should be carried out to the "full" process or bethel process.

In the "full cell" process, the timber in the pressure cylinder is first subject to a vacuum to remove the air from the cells. The cylinder is then filled with creosote at a temperature of about 80 – 90 °C, and pressure is applied to inject the creosote to the cells. The creosote is then emptied from the cylinder and the timber is held under vacuum for a short period, primarily to clean the surface of the timber. The process results in deep penetration with maximum retention.

12.5 Vacuum and General Treatment:

Where the timber is subjected to vacuum by reducing the pressure in the cylinder to less than 0.7 bar (gauge), this shall be achieved in a gradual manner using a vacuum receiver and/or vacuum pump.

In the "full cell" process the vacuum is to be maintained before the introduction of the creosote and the creosote introduced after approximately one hour of vacuum. After the cell has been totally filled with creosote the vacuum is to be released and pressure built up. During the pressure period the temperature of the creosote in the cylinder should not fall below 65 °C nor rise above 100 °C. The pressure will vary between 10 – 14 bar (gauge) depending on the species of timber being creosoted.

12.6 Application and Release of Pressure of Vacuum:

All pressures and vacuum created during the treatment, whether air or creosote, shall be applied and released gradually.

12.7 Retention and Penetration:**Retention:**

Minimum retention shall be 115 kg per m³.

The net retention is the quantity of creosote remaining in the timber after removal from the cylinder. It shall be calculated from the difference in mass before and after treatment of representative samples mutually agreed upon by the Purchaser and the creosotes.

Penetration

The penetration of the preservative in to the poles shall be except to the 100% depth of the sapwood except in some refractory species where the penetration may be not less than three-quarters of the dept of the sapwood.

12.8 Handling of Timber After Treatment:

To prevent damage to treated poles, hooks shall not be used on the side surfaces of treated material. All handling of poles and bulks etc., with pointed tools shall be confined to the end only.

When pressure-treated materials have been accidentally damaged, or when it has been absolutely necessary to cut or bore into them after treatment in such a way as to expose or nearly expose the unimpregnated wood, such injuries, cuts of holes shall be carefully field-treated by brushing, spraying of dipping with hot creosote so as to minimize the danger of decay or of inspector borer attach.

Holes bored in treated material and not used shall not be left open but shall be poured full of hot creosote and plugged with tight-fitting treated plugs or treated with a pressure bolt-hole treater.

13.0 Schedule “WP-01” Technical Data Wood Poles ,Length 9&11&12Meter (To Be Completed By Manufacturer)

Item	Description		PEC Date	To Be Completed By Manufacturer
1	Country of growth	Unit		
2	Grade			
3	Length	m	9,11,12	
4	Minimum diameter at 1.5 m from butt end	mm		
5	Minimum diameter of top			
6	Species of Timber. Common name			
7	Month and year felled			
8	Age Of The Tree			
9	Full Botanical Name			
10	Altitude of Plantation are			
11	Average Ultimate Extreme Fiber Stress with Details of number of tests in sample	N.mm ²		
12	Modulus of elasticity	N.mm ²		
13	Location & details of Authority			
14	Average moisture: at felling	%		
	After 100 days	%		
	Just prior to treatment	%		
15	Method proposed to determine moisture content prior to treatment			
16	Average radial thickness of sapwood of mature poles	mm		
17	Maximum poles available per year			
18	Alternative species if available, with details of quantities			
19	Details of poles, as offered supplied to user in the middle East area during the last five years.			
	Creosote			
20	National Standard used			
21	Manufacturers Name and Address			
22	Type of creosote guaranteed used in treatment			
	Treatment			

23	Type of plant		
24	Length of pressure cylinder	m	
25	Details of Vacuum/Pressure pimp		
26	Method of heating used		
27	Age of the plant in years		
28	Type of Pressure/Vacuum recording Instruments on the cylinder.		
29	Type of Temperature Recording Instruments on the cylinder		
	Species of timber.		
	<u>Method of preserving.</u>		
	Details of the average diameter of the poles offered from any sample of not less than 5 and not more than 10 poles in a consignment.		

14.0 NON COMPLIANCE SCHEDULE

The Manufacturer 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, operating characteristics and system performance. Each non compliance shall make reference to the relevant specification clause.

[illegible]

Stamp and Signature: _____
Date: _____

PUBLIC ELECTRICITY CORPORATION
SPECIFICATION FOR

11-33 kV SURGE ARRESTERS

Specification No. LA-01

Date: Aug - 2020

1.0 SCOPE:

This specification covers surge protective devices (lightning arrester) used for protecting equipment connected to overhead distribution and transmission lines from over voltage surges.

2.0 STANDARDS:

Unless otherwise specified herein, the performance and tests of arresters shall conform in all respects to the applicable requirements conform in IEC BS 2914 or equivalent.

3.0 SERVICE CONDITIONS:

Arresters covered by this specification will be installed under the following service conditions:

3.1 Arresters rated 36kV will be connected to delta or star source 33kV, 3-wire circuits operating at 50 Hz.

3.2 Arresters rated 12 kV will be connected to delta source 33kV, 3-wire circuits operating at 50 Hz.

3.3 Arresters rated 9kV will be connected to 11kV, 4-wire multiple ground neutral circuits operating at 50 Hz.

3.4 The equipment shall be suitable to ensure satisfactory operation for the following altitude, climatic and atmospheric site conditions:

One Altitude: from sea level up to 2300m will be subjected to lightning strokes.

Two Ambient temperature: -5°C up to 50°C.

Three Wind pressure: (kg/m²) 80 – 130

Four Seismic acceleration: (g) 0.12 - 0.05

Five Isokeraunic level: 10 – 18

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Six Relative humidity: 5 – 100

Seven Solar radiation: 1200W/m²

Eight Atmosphere: Heavy salt and dust laden pollution in coastal areas, moderate sandstorm exposure and dust pollution in low to mid altitude and region and light to heavy dust pollution at high altitudes.

4.0 DETAILLED REQUIREMENTS:

4.1 Arresters shall be outdoor, valve type, employing non-linear resistor of ceramic material suitable for operation up to 2500 meters on 50 Hz systems.

Arresters rated 9 and 12kV shall meet IEC, or BS 2914 requirements for distribution class arresters.

Arresters rated 36 shall meet IEC or BS 2914 requirements for intermediate class arresters.

Arrester Particulars:

☐ Nominal Systems Voltage (kV)	6.9	11	15	33
☐ Maximum System Voltage (kV)	9	12	17.5	36
☐ Number of Phases	1	3	3	3
☐ System Frequency (Hz)	50	50	50	50
☐ Impulse Withstand Voltage of line Insulation (kV)	95	150	150	250
☐ Diverter Rated Voltage (kV)	9	12	17.5	36
☐ Class of Diverter (kA)	10	10	10	10
☐ Type of Earthing	Solid	Solid	Solid	Solid

4.3 Arresters shall have wet process, glazed porcelain or polymeric housings, hermetically sealed, skirted, and of the manufacturer's standard production colour, preferably brown or Grey.

Arresters shall be direct connected type (no external gap). Distribution arresters shall be equipped with a radio noise free disconnector device, which functions to physically and visibly separate and electrically damaged arrester from ground.

4.4 Arrester designed shall have be valve type, consisting of an internal resistance graded gap in series with block valves that incorporate non-linear characteristics to develop low resistance to voltage surges and high resistance to power frequency voltage. Gaps and valves shall be capable of withstanding repeated surges without degradation of protective characteristics.

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Arresters shall be manufactured and designed to maintain a positive moisture-proof seal between the housing and the end cops throughout long arrester life.

4.5 All exposed ferrous parts of arresters shall be hot dip galvanised.

4.6 Accessories to be furnished with arresters.

4.6.1 Solderless bolt type line terminal and ground terminal connectors. Terminal connectors shall be suitable for either aluminium or copper conductor with diameters ranging from 4.0mm to 8.0mm.

4.6.2 Counters.

4.6.3 Top insulating caps (distribution arresters only).

Crossarm mounting bracket, including all plates, bolts, nuts, and washers IEC requirements for mounting on steel crossarms having thickness of 10mm. All mounting bracket parts shall be not dip galvanised.

Nameplate non-corrosive, with the following information:

- 4.6.3.1 Name of manufacturer.
- 4.6.3.2 Arrester rating.
- 4.6.3.3 Arrester type.
- 4.6.3.4 Year of manufacture.

5.0

TESTS:

Test shall be performed to comply with all applicable IEC Standards requirements, or equivalent, at the manufacturer's plant at his expense.

5.1 The manufacturer shall perform 100 percent seal testing of all assembled arresters utilising testing procedures acceptable to the purchaser. Acceptable tests will employ vacuum over fluid or vacuum over insulating environmental influence prior to power frequency voltage spark over tests.

5.2 Failure of any of the test specimens to comply with the requirements of this specification shall constitute grounds for rejection of the lot represented by the specimen.

5.3 Certified copies of test reports in two (2) copies, prepared in accordance with IEC requirements, shall be furnished on each lot of arresters before shipment.

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6.0 INFORMATION TO BE FURNISHED:

The Bidder shall include in his Bid sufficient information to permit a correct evaluation of the Bid in relation to this specification, including at least:

6.1 The promulgating institution (s) of standard specification (s) under which the arresters offered are manufactured and tested.

6.2 Certified laboratory test procedures for 100 percent testing of arresters for seal leakage's.

6.3 Outline drawing including dimensions for arresters and mounting brackets.

7.0 SHIPPING AND MARKING:

7.1 Arresters shall be packaged together with mounting brackets and other accessories, in cartons containing three arresters each. Arresters shall be suitably packed in cartons to prevent and damage during shipping and handling.

7.2 Cartons shall be packed in wooden crates for shipment.

Each carton shall be clearly labelled with name of manufacturer and with description of item.

Each shipping crate shall be durably marked on the outside with the following information in addition to other shipping as may be required:

- 7.2.1 Name of manufacturer.
- 7.2.2 PEC name.
- 7.2.3 Brief description of carton (e.g. Arresters).
- 7.2.4 Gross and net weight.

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8-SCHEDULE (LA-01) TECHNICAL PARTICULARS

(continued)

Ref No.	Description	Unit	Data/Quantity
	SURGE ARRESTERS		
	Manufacture / country of origin		
	Manufacture's type / Model No.		
	Applicable standard		
	Nominal voltage	kV	
	Maximum system voltage	kV	
	No. of phases		
	System frequency	Hz	
	Rated voltage	kV	
	Class of disconnector		
	Maximum permissible line-to-ground voltage (rms)	kV	
	50 Cycle withstand test voltage, 1 min dry (rms)	kV	
	50 Cycle withstand test voltage, 10 sec, wet (rms)	kV	
	Impulse withstand test Voltage, 1.2 x 50 ms Full-Wave, crest (rms)		
	50 Cycle sparkover voltage (rms)	kV	
	Impulse sparkover voltage (rms)	kV	
	Maximum discharge current capacity (rms)	kV	
	Discharge voltage, 8 x 20 current wave: For 5,000 amp(rms) For 10,000 amp(rms) For 20,000 amp(rms)	kV kV kV	
	Creepage distance	mm/kV	

Signature: _____
Date : _____

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9.0

NON COMPLIANCE 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, operating characteristics and system performance. Each non compliance shall make reference to the relevant specification clause.

[illegible]

Signature: _____
Date: _____

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PUBLIC ELECTRICITY CORPORATION
SPECIFICATION FOR
ABC CABLE ACCESSORIES
Specification NO. OA-12
Date: Aug -2020

1.0 SCOPE:

- 1.1 This specification covers manufacture, factory testing and delivery of Aerial bundle cable used in L.V. network.
- 1.2 The types and quantities as given in Schedule of requirements.

2.0 STANDARDS:

- 2.1 Materials and components shall conform to relevant IEC publication, BS Standard or equivalent or supplier to the mentioned standard accepted standard.
- 2.2 All steel structure material shall be galvanised and coated according to BS 729 or equivalent. The minimum thickness of coating 0.610g/mm².

3.0 SERVICE CONDITIONS:

The equipment shall be suitable to ensure satisfactory operation for the following altitude, climatic and atmospheric site conditions:

- a Altitude: from sea level up to 2300m will be subjected to lightning strokes.
- b Ambient temperature: -5°C up to 50°C.
- c Wind pressure: (kg/m²) 80 – 130
- d Seismic acceleration: (g) 0.12 - 0.05
- e Isokeraunic level: 10 – 18
- f Relative humidity: 5 – 100

- g Solar radiation: 1200W/m²
- h Atmosphere: All materials specified here in will be installed out-doors and will be subjected to moisture salt heavy pollution relative humidity up to 100% dust and intense solar radiation.

4.0 DETAILED REQUIREMENTS:

4.1 Connectors and joints: (See Fig 4.1)

4.2.1 General requirements:

The connector must be manufactured and dimensioned so that it is reliable in normal use and does not cause danger to the user or to the surroundings.

Compliance is generally checked by performing all required tests.

4.2.2 Design And Construction:

4.1.2.1 Connectors must be made of corrosion-proof aluminium alloy, the tensile strength of which shall be 300 N/mm². special bolts, tensile strength 800 N/mm², must be used. The M 10 bolts must be hot dip-galvanised and the M 8 bolts elector-plated and passivated. They must also be greased to minimise friction. Also the seams between Al/Cu at the joints must be covered with protective material against corrosion.

4.1.2.2 The joint must be made so that it remains safe and efficient throughout installation and under normal conditions of use.

- 4.1.2.3 The cast parts must be compact and contain no pores or slag. They must be made carefully so as to fit each other perfectly and prevent any possibility of fitting in a wrong position.

It is recommended that the parts of the joint be made of extruded, drawn, forged and/or rolled material.

- 4.1.2.4 The surfaces of the joint shall be smooth and clean, and the edges of the conductor inlets rounded. Contact and pressure surfaces may be toothed, grooved or grip-jawed provided that this does not weaken the joint.

- 4.1.2.5 If the joint is used to connect two conductors of different thicknesses, it must have separate spaces for both, and be designed so that the conductors remain firmly in place.

- 4.1.2.6 Tubular joints into which conductors are inserted at both ends must be designed so that the penetrating of the conductors beyond their meeting point is prevented. In some cases it is enough that the joints has an inspection hole or that the manufacturer provides detailed instructions together with the joint.

- 4.1.2.7 As far as possible the joint should be designed

so that it is not necessary to detach loosable parts during installation.

- 4.1.2.8 The joint must be designed so that the conductors will not loosen up during installation.

- 4.1.2.9 Screw joints and other branch joints should be designed so as to leave room for tightening or compression. Nuts and bolts must have metric threads.

- 4.1.2.10 The aluminium conductor joints should be greased and its surface shall be brushed, greased and protected by suitable packaging.

4.2 Insulation covers (for connectors): (See Fig 4.2)

- 4.2.1 General requirements: Compliance is generally checked by performing all required tests.

4.2.2 Construction of covers and shelters:

- 4.2.2.1 The covers and shelters shall be constructed so that the marked connectors and conductors can be easily installed to them.

- 4.2.2.2 At the inlets, there shall be ready-made holes only for the smallest marked conductors. The inlet holes shall be provided with chokes that are easily removable in accordance with the marked cross sections.

- 4.2.2.3 The bolts and clamps of the covers must endure torque.

4.2.2.4 Covers and other such devices shall be so constructed that the lock is reliable and does not come loose. They shall also endure numerous openings and lockings even in difficult weather conditions.

4.2.2.5 Materials of the covers shall be weather resistant polyethylene with a high resistance to solar radiation.

Suspension devices and clamps: (See Fig 4.3)

4.3.1 General requirements: The suspension devices and clamps shall be designed so that they can be used on different kinds of poles and walls as given in Fig. (4.3.1).

4.3.2 Suspension clamps construction.(See Fig 4.3.2)

4.3.2.1 Suspension clamps for uninsulated messengers. For use with self-supporting overhead cables on straight lines and on angles max. 90°.

4.3.2.2 Markings name, type, if necessary, the nominal dimensions and/or conducting material of the messenger.

4.3.2.3 The clamps must not corrode or damage of the messenger, or the insulation of the conductors, for the plastic cover made of heat resistant special plastic, or include parts liable to get lost during installation.

4.3.2.4 The screw(s) must have a minimum thread of M8 and they must be prevented from working loose by means of spring washers, double nuts or the like. The screws must withstand a minimum torque of

22 Nm (c.2.2 kpm) at tightening.

4.3.2.5 Corrodible parts must be hot dip-galvanised, electroplated, or the like. The protective layer must be at least 25 µm thick.

Dead end Clamps: (See Fig 4.4)

4.4 Dead end clamps used for uninsulated messengers.

4.4.2 Markings: Name, type, the nominal dimensions and/or conducting material of the messenger.

4.4.3 General construction: The body and the conical bushing must be made of corrosion-proof aluminium. The bracket must be made of hot dip-galvanised special steel. The clamp must not have loose parts.

Dead end Tubes:

The ends of the cables shall be covered with suitable PVC protective tubes. (See Fig 4.5)

Fixing nail:

General construction: The plastic part is made of weather resistant black polyethylene, the steel part must be hot dip-galvanised or electroplated (>20 microns). The plastic part is strengthened with an aluminium bank as given in Fig No. 4.6.

Suspension hooks:

It include the following types: ???

The hook must be made of steel with a yield strength corresponding to the permissible forces Fx and Fy. It must be indelibly marked with the manufacture's name or trademark. The hook shall be hot dip-galvanised according to BS-729 standard.

4.7.2 Hook Plate: Fig (4.7/d)

4.7.3 Hook through the pole Fig (4.7/a)

4.7.4 Screw hook for wood wall pole, stone or concrete wall.

Fig (4.7/b)

4.7.5 Heavy duty suspension hooks Fig (4.7/c)

4.7.6 Hook for Mudwall fig (4.7.6)

TESTS:

5.1 Manufacturer's normal production tests shall be performed at the manufacture's plant on a representative quantity of each production run.addition

PUBLIC ELECTRICITY CORPORATION
SPECIFICATION FOR
BARE HARD DRAWN COPPER CONDUCTOR

Specification No. OC-05
Date: Aug - 2020

1.0 SCOPE:

- 1.1 This specification covers bare Hard Drawn, Concentric lay Stranded Copper Conductors for used in over headline transmission and distribution network.
- 1.2 The size and quantities as given in attached requirements schedule.

2.0 STANDARDS:

Unless otherwise specified herein, contraction, performance and testing of all equipment shall comply all respects to requirements contained in BS. 125 or equivalent.

3.0 SERVICE CONDITIONS:

Conductor shall be suitable to ensure satisfactory operation for the following altitude, climatic and atmospheric site conditions:

- | | |
|--|---|
| a) Altitude: | from sea level up to 2300m will be subjected to lightning strokes. |
| b) Ambient temperature: | -5°C up to 50°C. |
| c) Wind pressure: (kg/m ²) | 80 – 130 |
| d) Seismic acceleration: (g) | 0.12 - 0.05 |
| e) Isokeraunic level: | 10 – 18 |
| f) Relative humidity: | 5 - 100 |
| g) Atmosphere: | Heavy salt and dust laden pollution in coastal areas, moderate sandstorm exposure and dust pollution in low to mid altitude and region and light to heavy dust pollution at high altitudes. |

4.0 DETAILED REQUIREMENTS:

- 4.1 The conductor Material and current carrying fittings are to be suitable for continuous operation at 80°C without deterioration. Unless the manufacture can produce evidence in the form of service records, test certificates etc.
- 4.2 Acceptable physical and electrical characteristics of conductor shall be the same as or equivalent to the standard conductors listed on table CO-05 (1-6) attached hereto.
- 4.3 The conductor mechanical characteristics offered should in all cases strictly comply with the limit set by the governing criteria designated on table CO-05 (1-6).
- 4.4 The outermost-layer of all conductors shall be stranded with the right-hand lay.

5.0 TESTS:

- 5.1 All required tests shall be done, in accordance with standards IEC, BS or equivalent, tests shall be performed at the manufacture's plant at his expense:
- 5.2 In addition to the above tests on component wires, the complete conductor shall be tested for its compliance to this specification.
- 5.3 Failure of any of the test specimens to comply with the requirements of this specification shall constitute ground for rejection of the lot as represented by the specimen.
- 5.4 Certified test reports in (2) copies shall be furnished for each lot of conductor before shipment.

6.0 INFORMATION TO BE FURNISHED:

- 6.1 The supplier shall furnish sufficient information to fulfil to this specification, including in attached schedule OC-05 (1-6).
- 6.2 Shipping details, including drawings showing dimensions and construction details of the shipping reels offered.
- 6.3 Complete catalogue information.

7.0 SHIPPING AND MARKING:

- 7.1 Conductor shall be furnished on reels designed for shipment in accordance with requirements presented in the General Instruction for Conductor.
- 7.2 The standard length of each piece of copper conductor to be shipped in each reel shall be as follows:
2500-3000m according the conductor sizes required in schedule.
- 7.3 Each reel shall be durably marked on the outside and tagged on the inside with the following information, in addition to other shipping information as may be required.
- 7.3.1 Manufacturer's name.
- 7.3.2 PEC name.
- 7.3.3 Type of conductor.
- 7.3.4 Size of conductor.
- 7.3.5 Length of conductor.
- 7.3.6 Gross and net weight.
- 7.4 Drums shall be non returnable and shall be made of timber, pressure impregnated against fungal and insect attack, or made of steel suitably protected against corrosion. They shall be lagged with closely fitting battens in accordance with BS1559 or equivalent national standard. The required information shall be clearly shown on the flange.
- 7.5 Protection of conductors:
The drum barrel shall be covered with a layer of waterproof sheet plastic or shall be painted with aluminium flake paint secured immediately under the circumstance battens so that it is not in contact with the conductor.

8.1 SCHEDULE (OC-05/4) TECHNICAL PARTICULARS

Ref. No.	Description	Unit	Data
8.4	Bare Hard drawn Copper Conductor	mm ²	50
1	Manufacturer		
2	Material		
3	Standards for design		
4	Stranding and wire diameter :	No/mm	7/3.00
5	Total area for mechanical purposes	mm ²	
6	Design cross – sectional areas (Total)	mm ²	
7	Over all diameter	mm	
8	Weight per km	kg/km	
9	Calculated breaking load	kN	19.497
10	Long term thermal carrying capacity (for 45°C) ambient temperature, 0.6 m/sec wind velocity under effect of 1200 W/m ² solar radiation For 80C conductor temperature.	A	
11	Resistance / km at 20 °C by D.C.	Ω/km	0.362
12	Coefficient of linear expansion	1/°C	
13	Modulus of elasticity	N/mm ²	
14	Standard delivery length per drum	m	
15	Gross weight per drum including conductor	kg	
16	Standard for drums		

Signature: _____
Date: _____

10.0 TEST CERTIFICATES SCHEDULE

The bidder shall provide a list of the test certificates included with the bid. The list shall include type test certificate, routine test report references. Each certificate listed shall as far as possible refer to the relevant specification clause.

[illegible]

Signature: _____
Date: _____

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PUBLIC ELECTRICITY CORPORATION

SPECIFICATION FOR

LV AERIAL BUNDLE CABLES

Specification No OC-09

Date: Aug - 2020

1.0 SCOPE:

- 1.1 This specification covers minimum requirements for 600/1000V aerial bundle cable self-supported.
- 1.2 The sizes and quantities as given in attached schedule of requirements.

2.0 STANDARDS:

Unless otherwise specified herein, ABC shall meet the requirements contained in the standards specification given below, or equivalent:

- 2.1 Phase conductor to IEC 228.
- 2.2 Neutral conductor 60 IEC 208.
- 2.3 Insulation to IEC 538, IEC 540 & ASTM D 1693-070.

3.0 SERVICE CONDITIONS:

Conductor shall be suitable to ensure satisfactory operation for the following altitude, climatic and atmospheric site conditions:

One) Altitude: from sea level up to 2300m will be subjected to lightning strokes.

Two) Ambient temperature: -5°C up to 50°C.

Three) Wind pressure: (kg/m²) 80 – 130

Four) Seismic acceleration: (g) 0.12 - 0.05

Five) Isokeraunic level: 10 – 18

Six) Relative humidity: 5 - 100

Seven) Atmosphere: Heavy salt and dust laden pollution in coastal areas, moderate sandstorm exposure and dust pollution in low to mid altitude and region and light to heavy dust pollution at high altitudes.

4.0 DETAILED REQUIREMENTS:

4.1

General:

The aerial cables shall be 600/1000V grade cross linked polyethylene and shall be of the types construction stated in the Schedules. All cables shall be manufactured and tested to a nationally approved Standard and all other applicable requirements of this Specification. Cables shall be designed for a maximum continuous conductor temperature of 90% and for operation on a system with a neutral solidly earthed.

4.2

Conductors:

The size of Conductors required as specified within the schedules and shall be of stranded aluminium alloy and shall comply with all the requirements of IEC Recommendation No. 228 Conductor shall conform with table of requirements attached. The mechanical stress should be not less than 90N/mm².

4.3

Insulation:

The materials used in the manufacture shall be black weather-resistant cross-linked polyethylene with a high resistance to Ultra Violet. The insulation shall fit closely on but shall not adhere to the conductor. The cores shall be identified in an approved manner, clearly identified to numbers.

4.4

Design:

The cores of the aluminium stranded conductor cable shall be twisted around an insulated aluminium-alloy or bare aluminium alloy messenger neutral conductor so that the messenger takes all the mechanical stresses or the cores of the cable shall be twisted together to form a neat easy to handle cable.

4.5

Messenger:

This shall be silicon-magnesium aluminium alloy strand composed of 7 wires drawn from continuously cast-fabricated rod. No joints shall be permitted in the messenger except those made in the manufacture of the wire before final drawing. The messenger shall be round compacted. It could also be the neutral conductor. The mechanical stress shall not less than 294 N/mm².

4.6

Cable Identification:

4.6.1

The outer jacket surface of each individual insulated conductor shall be durably marked throughout its length with the manufacturer's name, conductor size, type of insulation voltage, rating and year of manufacture.

4.6.2

Aerial cables which consist more than one insulated conductor shall have the outer surface of individual

insulated conductor cables durably marked throughout the cables length with means of individual phase identification.

5.0

TESTS:

All cables, accessories and materials shall be submitted to and satisfactorily withstand the test requirements specified herein. All materials shall withstand such routine tests as are customary in the manufacture of the cable and accessories included in the contract.

6.0

INFORMATION TO BE FURNISHED:

6.1 The supplier shall furnish sufficient information to fulfil to this specification, including in attached schedule OC-09.

6.2 Shipping details, including drawings showing dimensions and construction details of the shipping reels offered.

6.3 Complete catalogue information.

7.0

SHIPPING AND MARKING :

7.1 Conductor shall be furnished on reels designed for export shipment in accordance with requirements presented in the General Instruction for Cable, and Accessories included in this specification document.

7.2 The standard length of each piece of cables to be shipped in each reel shall be :

7.2.1 1000-500m according the cable sizes required in schedule.

7.2.2 Drums shall be non returnable and shall be made timber, pressure impregnated against fungal and insect attack, or made of steel suitably protected against corrosion. They shall be lagged with closely fitting battens in accordance with BS 1559 or equivalent national standard the required information shall be clearly shown on the flange.

7.3 Each reel shall be durably marked on the outside and tagged on the inside with the following information, in addition to other shipping information as may be required.

7.3.1 Manufacture's name.
7.3.2 PEC name.
7.3.3 Type of conductor.
7.3.4 Size of conductor.

7.3.5
7.3.6

Length of conductor.
Gross and net weight.

7.4 Protection of conductors:

The drum barrel shall be covered with a layer of waterproof sheet plastic or shall be painted with an aluminium flake paint secured immediately under the circumstances battens so that it is not in contact with the conductor.

8.0 SCHEDULE (OC-09/1) TECHNICAL PARTICULARS

Ref. No.	Description	Unit	Data
8.0	LV AERIAL BUNDLE CABLE (600/1000V) 3x50+50mm ²		
1	Manufacturer		
2	Standards		
3	Nominal voltage (U _o /U)	kV	
4	Cross-section of phase conductor.	mm ²	
5	Diameter of phase conductor	mm	
6	Thickness of insulation XLPE	mm	
7	External diameter of individual core	mm	
8	Cross sectional of neutral wire	mm ²	
9	Diameter of neutral wire	mm	
10	Ultimate tensile strength of suspension wire	kN	
11	Thickness of suspension wire covering	mm	
12	Overall diameter of bundle	mm	
13	Total weight of bundle per km	kg/km	
14	Maximum DC resistance / km at 20°C Phase conductors Neutral conductor	Ω /km Ω /km MH/km	
15	Working inductance	mF/km	
16	Working capacitance		
17	1 sec. Thermal short circuit current (max. conductor temperature 130°C, final conductor temperature.	kA	
18	Maximum Continuous current at 35°C ambient temperature 0.6m/sec wind and 90°C conductor temperature		
	Phase conductors Neutral conductor	A A	
19	Zero sequence impedance	Ω/km	
20	Standard unjointed length on drum	m	

Signature: _____
Date: _____

9.0 SCHEDULE (OC-09/2) TECHNICAL PARTICULARS

Ref. No.	Description	Unit	Data
9.0	LV AERIAL BUNDLE CABLE (600/1000V) 3x35+25mm ²		
1	Manufacturer		
2	Standards		
3	Nominal voltage (U _o /U)	kV	
4	Cross-section of phase conductor.	mm ²	
5	Diameter of phase conductor	mm	
6	Thickness of insulation XLPE	mm	1.3
9	External diameter of individual core	mm	
10	Cross sectional of neutral wire	mm ²	
11	Diameter of neutral wire	mm	
12	Ultimate tensile strength of suspension wire	kN	10.3
13	Thickness of suspension wire covering	mm	
14	Overall diameter of bundle	mm	
15	Total weight of bundle per km	kg/km	
16	Maximum DC resistance / km at 20°C Phase conductors Neutral conductor	Ω /km Ω /km MH/km	0.868 0.986
17	Working inductance	mF/km	
18	Working capacitance		
19	1 sec. Thermal short circuit current (maximum conductor temperature 130°C, final conductor temperature.	kA	
20	Maximum continuous current at 35°C ambient temperature 0.6m/sec wind and 90°C conductor temperature.		
	Phase conductors Neutral conductor	A A	
21	Zero sequence impedance	Ω/km	
22	Standard unjointed length on drum	m	

Signature: _____
Date: _____

10.0 NON COMPLIANCE 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, operating characteristics and system performance. Each non compliance shall make reference to the relevant specification clause.

[illegible]

Signature: _____
Date: _____

11.0 TEST CERTIFICATES SCHEDULE

The bidder shall provide a list of the test certificates included with the bid. The list shall include type test certificate, routine test report references. Each certificate listed shall as far as possible refer to the relevant specification clause.

[illegible]

Signature: _____
Date: _____

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PUBLIC ELECTRICITY CORPORATION
SPECIFICATION FOR
FUSED DISCONNECTING SWITCHES (FUSE CUTOUT)
Specification NO. SW-06

Date: Aug - 2020

1.0 SCOPE:

1.1 This specification covers 36kV class power and 15kV class distribution fuse disconnecting switches (fuse cut-outs), open type, crossarm mounted, and fuses for use on overhead distribution lines, complete with spare parts.

1.2 Types and quantities are as given in attached schedule of requirements.

2.0 STANDARDS:

Unless otherwise specified herein, the testing, manufacture, and performance of fuse switches and fuses shall meet all applicable requirements contained in BS 88 Part5, BS 2692, NEMA Standards Publication No. SG2, or equivalent.

3.0 SERVICE CONDITIONS:

3.1 The 36kV class power fuses will be applied as high side fusing on 33-11-6.35kV pole mount substations containing 3-phase transformer sizes up to 1000 KVA solidly grounded system.

3.2 The 15kV class distribution fuses will be applied in line sectionalising and distribution transformer high side fusing on 11kV delta and 11Y/6.35kV delta and solidly grounded distribution systems.

3.3 All systems will operate at 50 Hz.

3.4 Materials shall be suitable to ensure satisfactory operation for the following altitude, climatic and atmospheric site conditions:

One Altitude:	from sea level up to 2300m will be subjected to lightning strokes.
Two	Ambient temperature: -5°C up to 50°C.
Three	Wind pressure: (kg/m ²) 80 – 130

Four	Seismic acceleration: (g)	0.12 - 0.05
Five	Isokeraunic level:	10 - 18
Six	Relative humidity:	5 - 100
Seven	Solar radiation:	1200W/m ²
Eight	Atmosphere:	Heavy salt and dust laden pollution in coastal areas, moderate sandstorm exposure and dust pollution in low to mid altitude and region and light to heavy dust pollution at high altitudes.

4.0 DETAILED REQUIREMENTS:

[illegible]

4.2.2.2	<u>Fuse Units:</u>		
4.2.2.1	Current Ratings in requirement schedule		
	4.2.2.1.1	NEMA Ratings	
		'E'	'T'
4.2.2.2	Interrupting Capacity (rms Symmetrical) (Amps)	3000	5000

Performance:

4.3.1 At rated capacity, the temperature rise of various current carrying parts shall not exceed 30°C with an ambient temperature of 40°C.

4.3.2 The fuse unit shall be designed to quickly interrupt the high fault current specified as well as the lowest fault current required melting the fusible element.

4.3.3 Fuse elements and fuse, links shall conform with NEMA Standard, Publication No. SG 2 and SG 2.1. All time current characteristic curves shall be based on tests starting with the fuse units at an ambient temperature of 30°C and no initial load.

4.3.3.1 Power Fuse Elements:

The characteristic of power fuse elements shall comply with NEMA 'E' standard current ratings (slow speed).

4.3.3.2 **Distribution Fuse Links:**

The characteristics of distribution fuse links shall comply with NEMA "T" standard current ratings. Fuse links rated 5 amp and below shall be designed for high surge withstands performance.

4.3.4 The external and internal insulation characteristics of the fuse shall be so coordinated with each other and with the protected insulation level of the system that there will be no external flashover or puncture of the fuse at the instant of arc interruption, or immediately thereafter.

4.3.5 Fuse holders shall be "drop out" type and swing about 180 degrees to the open position after the fuse has blown. Hook eyes shall be provided on the fuse holder for closing and opening the contacts and removing the fuse holder from the fuse switch with a standard switch stick.

4.4 **Construction:**

4.4.1 **General:**

4.4.1.1 All conducting parts as well as contacts shall be of suitable non-ferrous metal and designed to carry safely the rated current of the fuse and the momentary current equivalent to the interrupting capacity. Contacts shall be silver plated and have a high contact pressure, and shall be rugged enough to withstand shock due to switching.

4.4.1.2 The fuse switches shall be designed and constructed with positive latching that locks the fuse holder closed preventing accidental opening caused by vibration or line transients, yet enables easy and smooth switch stick opening and closing.

4.4.1.3 Fuse switches shall be furnished complete with bolt type terminal connectors. Terminals shall be suitable for either copper or aluminium conductor ranging in diameter from 4.5mm to 14.5mm inclusive.

4.4.1.4 All ferrous metal parts shall be hot dip galvanised in accordance with BS 729, BS 443 or equivalent.

Power Fuse Switch:

4.4.2 Power fuse switch shall consist of two cap and pin insulators mounted on a channel base assembly. The power fuse shall be supplied

complete with base, insulators, live parts, fuse end fittings, terminal connectors and fuse unit, but not to include fuse link.

4.4.2.2

Mounting:

The power fuse switch shall be provided complete with suitable mounting strap and bolts for installing on double crossarms spaced 850mm.

Distribution Fuse Switch:

4.4.3.1 Distribution fuse switch shall consist of one porcelain insulator, a fuse holder, and a standard crossarm-mounting bracket. All metal parts shall be clamped to the porcelain insulator. Distribution fuse switches shall be furnished with hooks facilitating the operation of the switch with portable load break devices.

4.4.3.2 Distribution fuse switches shall be supplied complete with insulator, live parts, fuse holder, hooks, terminals, mounting bracket, but not to include fuse links.

4.5

Fuse Holders:

4.4.2.1 Fuse holders shall accommodate expandable and replaceable fuse links, and shall insure easy, safe, and quick removal and replacement in minimum time.

4.4.2.2 Fuse holder end fittings shall be re-usable so that they may be reattached after replacing a blown fuse link with a new fuse link.

4.4.2.3 Fuse holders shall be capable of sustaining multiple operations under duty of the fuse switch rated interrupting capacity, without substantial physical deterioration.

4.4.2.4 Fuse units shall be suitable for handling with a conventional switch stick.

4.6 **Fuse Links:**

4.6.1 Fuse links shall be of button-head design, having tin or silver fusible elements slow acting type.

Type:

Distribution Fuses:

4.6.2.1.1 High surge

'H' type fuse link of universal button-head design in ratings of 2H, 3H and 5H.

4.6.2.1.2 Slow 'T' type fuse link

having characteristics in accordance with NEMA SG2.1 requirements of equivalent, of universal button-head design in ratings of 6T, 8T, 12T, 15T, 20T, 30T, 50T and 65T.

4.6.2.2

Power Fuses:

Slow 'E' type fuse link having characteristics in accordance with ANSI V37.46 requirements or equivalent, of button-head design, compatible to the power fuse switch offered, in ratings of 6E and 15E.

4.6.3 All fuse links shall be permanently marked with the current rating.

4.7

Nameplates:

All fuse switches shall be furnished with nameplates containing the minimum following information:

- 4.7.1 Name of manufacturer,
- 4.7.2 Purchaser name (PEC),
- 4.7.3 Manufacture's Type or Model Number,
- 4.7.4 Design Voltage,
- 4.7.5 Continuous Current Rating,
- 4.7.6 Interrupting Current Rating,
- 4.7.7 Impulse Withstand Voltage.

5.0 **TESTS:**

- 5.1 Testing of fuse switches and fuse links shall be performed in accordance with NEMA SG 2 and NEMA SG 2.1 requirements respectively, or equivalent.
- 5.2 Certified test reports in two (2) copies shall be submitted on each lot of fuse switches and fuse links before shipment.

6.0 **INFORMATION TO BE FURNISHED:**

- 6.1 The supplier shall include sufficient information in relation to this specification, to fulfil the information required in attached schedule SW-06.
- 6.2 Outline drawings showing principal dimensions, including mounting brackets.
- 6.3 Technical description of performance and construction of the equipment offered.
- 6.4 Time-current characteristics of specified fuse link performance in the fuse holders offered, including total clearing time and minimum-melting time-current characteristic curves.
- 6.5 Test results on previously manufactured similar equipment of short circuit interrupting rating tests.
- 6.6 Complete catalogue information.

7.0 **SHIPPING, PACKING & MARKING:**

The Contractor shall provide such packing of the Goods as is required to prevent either damage or deterioration during transit to their final destination as indicated in the Contract. The packing shall be sufficient to withstand, without limitation, rough handling during transit and exposure to extreme temperatures, salt and precipitation during transit and open storage. Packing case size and weights shall take into consideration, where appropriate, and the remoteness of the Good's final destination and the absence of heavy handling facilities at all point in transit.

The packing marking and documentation within and outside the packages shall comply strictly with such special requirements as shall be provided for in the Contract and, in any subsequent instructions ordered by the Purchaser.

Each reel shall be durably marked on the outside and tagged on the inside with the following information, in addition to other shipping information as may be required.

- 7.1 Manufacture's name.
- 7.2 PEC name.
- 7.3 Number and type of fuse.
- 7.4 Description of contents.
- 7.5 Gross and net weight.

8.0 SPARE PARTS:

The following parts shall be supplied with each order and their price included in the bid price of the fuse switches proper.

- 8.1 For every 25 fuse switches, or fraction thereof, one spare insulator shall be supplied.

- 8.2 For every 25 fuse switches or fraction thereof, one spare fuse holder shall be supplied.

9.0 SCHEDULE 'SW-06' GENERAL PARTICULARS AND GUARANTEES FUSE DISCONNECTING SWITCHES (FUSE CUTOUT):

(To be completed by Tenderer)

	Unit	33 kV	11 kV
1. Standard to which switchgear complies			
2. Type reference of fuse switch and isolator			
3. Number of phases			
4. Service voltage			
5. Frequency	Hz		
6. Normal current	A		
7. Method of closing			
8. Method of tripping			
9. Method of isolation - whether horizontal or vertical drawout			
10. Insulation for busbars - air oil or compound			
11. Making capacity peak current			
12. Breaking capacity:- (One) Symmetrical in amperes	A		
(Two) Asymmetrical in amperes	MVA		
13. * Short time current (1 second and 3 seconds as applicable)	A		
(One) 1 second	kA		
(Two) 3 seconds	kA		

- Short time ratings to be for equipment as assembled for use.

**SCHEDULE 'SW-06' GENERAL PARTICULARS AND
GUARANTEES FUSE DISCONNECTING SWITCHES (FUSE
CUTOUT)**

Continued
(To be completed by Tenderer)

	Unit	33 kV	11 kV
14. Number of series breaks in circuit per phase			
15. Voltage distribution between breaks			
16. Length of each break	mm		
17. Length of stroke	mm		
18. Whether a series break is incorporated in the breaker			
19. Total break time	ms		
20. Time of arc duration	ms		
21. Does magnetic effect of load current increase contact pressure?			
22. Drop across main contacts at normal Current	mV		
23. Type of main contacts			
24. Type of arcing contacts or arc control Device			
25. Weight of equipment complete with oil if any	kg		
26. Weight of whole equipment complete with oil, if any, and all fittings as in service	kg		
27. Quantity and weight of oil in complete three phase oil immersed equipment	kg		
28. Grade of oil in equipment			
29. Head of oil above break	mm		
30. Maximum pressure rise in equipment due to the making or breaking of rated currents.	Pa		

Continued
(To be completed by Tenderer)

	Unit	33 kV	11 kV
31. Routine pressure test on equipment tanks or containers	Pa		
32. Pressure type test on equipment tanks or containers	Pa		
33. Minimum clearance in air:- (One) between phases (Two) live parts to earth	mm mm		
34. Minimum clearance in oil:- (One) between phases (Two) live parts to earth	mm mm		
35. Number of tanks or containers per three phase equipment			
36. Material of tank containers			
37. Thickness of tank or container:- (One) Walls (Two) Bottom	mm mm		
38. Size of tank or container:- (One) Diameter or rectangular Dimensions (Two) Depth	mm mm		
39. Material of top plate			
40. Thickness of top plate	mm		
41. Are separate compartments provided for current transformers?			
42. Are the current transformers compartments air, oil or compound filled?			

**SCHEDULE 'SW-06' GENERAL PARTICULARS AND GUARANTEES FUSE
DISCONNECTING SWITCHES (FUSE CUTOUT)**

Continued

(To be completed by Tenderer)

	Unit	33 kV	11 kV
43. Whether any device is used to limit the rate of rise of restriking voltage			
44. Impulse level 1.2/50 s wave	kv peak		
45. Minimum cable box clearances:			
(One) Between phases	mm		
(Two) Phase to phase	mm		

10.0 NON COMPLIANCE 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, operating characteristics and system performance. Each non compliance shall make reference to the relevant specification clause.

[illegible]

Signature: _____
Date: _____

SPECIFICATION CONTENTS

The bidder shall provide a list of the test certificates included with the bid. The list shall include type test certificate, routine test report references. Each certificate listed shall as far as possible refer to the relevant specification clause.

[illegible]

Signature: _____
Date _____

DESCRIPTION.....	PAGE NO
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PUBLIC ELECTRICITY CORPORATION
SPECIFICATION FOR
11kV AUTOMATIC RECLOSER SWITCH

Specification NO. SW-07

Date: Aug - 2020

1.0 SCOPE:

The Automatic circuit recloser shall be a 3 phase 11kV , 50 Hz out door self-contained pole-mounted unit and shall be capable of operating for long periods with little or no maintenance.

2.0 STANDARDS:

Unless otherwise specified herein the reclosers shall comply in all respect to requirements contained in IEC, BS standards specification, or equivalent.

3.0 SERVICE CONDITIONS:

The equipment shall be suitable to ensure satisfactory operation for the following altitude, climatic and atmospheric site conditions:

One Altitude: from sea level up to 2300m will be subjected to lightning strokes.

Two Ambient temperature: -5°C up to 50°C.

Three Wind pressure: (kg/m²) 80 – 130

Four Seismic acceleration: (g) 0.12 - 0.05

Five Isokeraunic level: 10 – 18

Six Relative humidity: 5 – 100

Seven Solar radiation: 1200W/m²

Eight Atmosphere: Heavy salt and dust laden pollution in coastal areas, moderate sandstorm exposure and dust pollution in low to mid altitude and region and light to heavy dust pollution at high altitudes.

4.0 DETAILED REQUIREMENTS:

4.1

Mountings:

These recloser shall be suitable for mounting on wood pole structure. A drawing of the method of mounting shall be submitted with the tender document. All necessary steelwork etc., for mounting the equipment shall be provided.

Provision shall be made for ease of on-site maintenance and removal of the recloser without the use of special tools. Lifting lugs shall be provided on the top of the unit.

4.2

Design and Operation:

The recloser shall be capable of making and breaking repeatedly the loads stated in clause under the specified conditions.

No auxiliary supply shall be provided and the recloser shall derive the energy required to operate from the H.V. circuit .

A suitable means of manually operating the recloser from ground level while the HV circuit is energized shall be provided.

A position indicator shall be provided which shall show clearly from ground level whether the recloser is open or closed.

Indicators on stored-energy operating systems shall have the legends CHARGED and DISCHARGED.

Where series-trip coil systems are specified in clause the coil shall be provided with suitable means of diverting over-voltage surges (such as those due to lightning strikes on the overhead line) without damage to the coil.

4.3

Operation and protection:

The circuit breaker shall be fitted with over-current and earth fault protection utilizing series trip coils and / or current transformers. The circuit breaker shall be fitted with a separately mounted electronic control unit whereby up to 4 instantaneous or time delayed operations can be obtained and giving automatic lockout after one reclosure on to permanent fault. The continuous current rating of the coil is 400 A.

4.4

Particular Requirements:

4.4.1

Rating:

1	Nominal System Voltage (kV)	11
2	Rated Max. Voltage (kV)	15
3	Rated Continuous Current (A)	400

4	No. of phases	3
5	Rated short circuit breaking Current (kA)	12
6	Rated making current (peak) (kA)	31.9
7	Power frequency with stand Voltage:	
	- Dry (kV)	50
	- Wet (kV)	45
8	Rated impulse withstand Voltage dry (kV)	110
9	Short time current rating For 3 Sec. (kA)	12.5

Closing Device : Solenoid, energised at system Voltage.
Indicators: (Visible from the ground)
 On/Off
 Operations Counter.

(One)
 (Two)

Current Transf. Ratio:

Protection	
Over current	Current range 50% - 200% Time delay normal inverse
Earth Fault	Current range 10% - 40% Time delay normal inverse

Insulating and acting Medium Oil/SF6 gas pressure ,or Vacuum

4.4.2

Vacuum Interrupters:

If offered , vacuum interrupters shall Be capable of interrupting the maximum fault current.

a.

b. Be provided with splutter shields inside the vacuum bottles.

c. Be provided with an indicator to show the amount of contact wear, which shall be easily accessible without dismantling the recloser.

4.4.3

Fault Sensing:

Fault sensing shall be either by means of bushing current transformers or by series coil mounted inside the recloser tank.

4.4.4

Control:

An elector-mechanical control system shall be provided using a hydraulic fluid with constant viscosity to determine the delayed characteristic curves. The control system shall be capable of fast and retarded tripping operation, the tripping speed for each tripping operation being selected

by an external mounted device. The number of tripping operations to lock-out shall be adjustable.

5.0

POWER SOURCES:

In all cases the recloser shall be self – contained so that it operates without the provision of auxiliary supplies. The closing energy may be derived from spring charged from shunt coils using source sideline power or from a transformer driving a 50 Hz motor. Similar power source may be used to operate a solenoid closing and tripping mechanism.

Batteries shall not be used to power control relays, or trip, or close mechanism or for any other purpose.

6.0

PANTING AND FINISHING:

Shall consist of a primer on intermediate coat that dries to form a moisture – salt and abrasion resisting coating and a final coat of grey color shade No.63 to BS 381C high voltage bushing shall be glazed porcelain cover mounted. The unit shall be complete with all fitting and channel section supporting steelwork complete with necessary bolts.

7.0

TESTS:

Design and production testing shall be performed in accordance with the requirements of IEC 56.

Certified test reports in two copies shall be submitted on each lot of reclosers before shipment.

8.0

SPARE PARTES:

As specified here may be required to provide any or all of the following materials and notifications pertaining to spare parts manufactured or distributed by the Contractor:

One) Consumable spare parts such as contacts, gaskets, plugs, washers, etc the Purchaser may elect to purchase from the Contractor, providing that this election shall not relieve the Contractor of any warranty obligations under the Contract; and

b) In the event of termination of production of the spare parts:

- advance notification to the Purchaser of the pending termination, in sufficient time to permit the Purchaser to procure needed requirements; and
- following such termination, furnishing at no cost the Purchaser, the blueprints, drawings and

specifications of the spare parts, if and when requested.

9.0 INFORMATION TO BE FURNISHED:

9.1 The supplier shall furnish with his tender documents sufficient information in relation to this specification to fulfill the information required in attached schedule SW-07.

9.2 Out line drawings showing principal dimensions, including those of mounting brackets.

9.3 Time – current characteristic curves for reclosers.

9.4 Complete catalog information.

10.0 DRAWING & INFORMATION TO BE SUPPLIED BEFORE THE DELIVERY OF THE RECLOSERS:

10.1 Three sets of finally corrected certified drawings of all equipment's including of outline, arrangement and construction should be submitted.

10.2 Three sets of installation, operation and maintenance booklets.

10.3 Three sets of replacement part catalogs.

10.4 Three sets of time current characteristic curves of the recloser.

11.0 SHIPPING AND MARKING:

11.1 Reclosers shall be individually packed in wood boxes or crates for export packing shall be that all projecting parts are protected from damage during shipment and that all parts subject to salt corrosion are wrapped or otherwise protected.

11.2 Mounting brackets, metering kits, and spare parts may be separately crated for export.

11.3 Shipping crates shall be durably marked on the outside with the following information in addition to other shipping information as may be required:

- Name of manufacturer.
- PEC name.
- Brief description of content (e.g. recloser parts)
- Gross and net weight.

12.0 SCHEDULE SW-07 TECHNICAL PARTICULARS

Ref No.	Description	Unit	Data/Quantity
	11KV Automatic Recloser Switch		
1	Manufacturer and country of manufacture		
2	Manufacturer's Type/Model No.		
3	Applicable Standards		
4	Rated system voltage/highest system voltage	kV	
5	Number of phases / Normal current	/A	
6	Rated Frequency	Hz	
7	Method of closing		
8	Method of tripping		
9	Normal voltage for operation of closing mech.	kV	
10	Normal voltage for operation of tripping mech.	kV	
11	Normal current required for closing solenoids	kA	
12	Rated making capacity	kA	
13	Rated breaking capacity: Symmetrical Asymmetrical Rated short time current Rated duration of short circuit	kA kA kA Sec	
14	Voltage limit within tripping/ closing device will operate	kV	

Signature: _____
Date: _____

SCHEDULE SW-07 TECHNICAL PARTICULARS
(Continued)

Ref No.	Description	Unit	Data/Quantity
	11KV Automatic Recloser Switch		
15	Total opening time	ms	
16	Make time	ms	
17	Auto-reclosing operation Dead time Reclosing time	ms ms	
18	No of current interrupting breaks in series/ph.	Hz	
19	Method of controlling voltage distribut./breaks		
20	Length of each break	mm	
21	Type of main contacts		
22	Type of arcing contacts		
23	Type of arc control device		
	VOLTAGE TRANSFORMER DATA		
1	System voltage	kV	
2	Type of transformer		
3	Type of connection		
4	Rated Voltage Primary/ Secondary	kV	
5	Class IEC recommendation		
6	Rated burden		
7	Electrical charac. of terminal bushing		
8	Weight of complete transformer	kg	

Signature: _____
Date: _____

PEC Technical Specification
11kV Auto-Re-closer
Switch

13.0 NON COMPLIANCE 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, operating characteristics and system performance. Each non compliance shall make reference to the relevant specification clause.

[illegible]

Signature: _____
Date: _____

