KINGDOM OF CAMBODIA

NATION RELIGION KING

ELECTRICITE DU CAMBODGE

TECHNICAL SPECIFICATION

EDC-DTS-MV015

Earthing equipment

August 2019

Version 1.0

ELECTRICITE DU CAMBODGE

Version	Date	Technical Specification Name	Authorized by: (name and signature)
1.0	August, 2019	Earthing Equipment	Dr. PRAING CHULASA

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Draft 1 Final	AD AD/EDC			Sept 2018 Dec 2018
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Content

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ISO/IEC 17025 : General requirements for the competence of testing and calibration laboratories

ISO 9001 : Quality management systems – Requirements

EDF Standards

EDF HN 64-S-55 : Earthings for distribution electrical networks

The supplier may propose alternative standards, provided it is demonstrated that they give an equivalent degree of quality as the referenced standard. Acceptability of any alternative standard is at the discretion of the Employer.

3 Definitions

The definitions of the relevant IEC/ANSI standards apply to this technical specification.

4 Testing and Inspection

4.1 General Notes for Test

Conductors and earthing accessories may be inspected at the manufacturer's factory by EDC's representatives.

The inspection and routine tests shall be carried out in accordance with the provisions of the relevant IEC/ISO recommendations.

The conductors and earthings accessories shall be subjected to tests as specified below.

4.2 Type Tests

All type tests required by the relevant IEC and/or ISO standards shall be carried out.

Type test reports shall be carried out by internationally recognized electrical testing laboratories.

Full copies of type test reports shall be submitted within the bid of the manufacturer/supplier. Type test reports older than 20 years will not be accepted.

If the manufacturer is certified by EDC, it is not necessary to submit type test reports for the considered equipment.

Nevertheless, in case the testing laboratory is not internationally recognized, the testing laboratory shall be mandatorily accredited ISO/IEC 17025 by an international or national accreditation body specialized in testing laboratories accreditation/acceptance. In that case, the testing laboratory shall prove mandatorily its capability/capacity to carry out all type tests mentioned in the type tests reports by supplying: Full description of all tests the laboratory can carry out, list of testing equipment with full characteristics, drawing of testing rooms with location of testing equipment, ...etc., supported by pictures and copy of the ISO/IEC 17025 accreditation certificate.

Acceptability of any accredited testing laboratory is at the discretion of the EDC.

4.3 Routine/Acceptance Tests

The routine tests requested by relevant Standard shall be carried out on all conductors. Routine test reports shall be sent to EDC prior the shipment for EDC acceptance.

Earthing Equipment

1 Scope

This specification covers the design, manufacturing, testing, supply, and delivery and performance requirements of Earthing conductors and earthing accessories to be used on MV and LV networks of Electricité du Cambodge with an expected lifespan of at least 30 years.

2 Standards

IEC: International Electro-technical Commission

IEC 60228	: Conductors of insulated cables
IEC 61238-1	: Compression and mechanical connectors for power cables for rated voltages up to 30 kV (Um = 36 kV) - Part 1: Test methods and requirements
IEC 60364-5-54	: Low-voltage electrical installations - Part 5-54: Selection and erection of electrical equipment - Earthing arrangements and protective conductors
IEC 62561	: Lightning protection system components (LPSC)- All parts.

EN: European Standards

EN 10088-3	: Technical delivery conditions for semi-finished products, bars, rods, wire, sections and bright products of corrosion resisting steels for general purposes

ISO: International Standard Organisation

ISO 4948-1	: Steels - Classification -- Part 1: Classification of steels into unalloyed and alloy steels based on chemical composition
ISO 1460	: Metallic coatings - Hot dip galvanized coatings on ferrous materials Gravimetric determination of the mass per unit area
ISO 10684	: Fasteners — Hot dip galvanized coatings
ISO 7989-2	: Steel wire and wire products - Non-ferrous metallic coatings on steel wire - Part 2: Zinc or zinc-alloy coating
ISO 2408-85	: Steel wire ropes for general purposes - Characteristics
ISO 3108-74	: Steel wire ropes for general purposes - determination of actual breaking load
ISO 3178-88	: Steel wire ropes for general purposes - terms of acceptance
ISO 2063	: Metallic coating-protection of iron and steel against corrosion
ISO 1461	: Hot dip galvanized coatings on fabricated iron and steel articles Specifications and test methods

Nevertheless, the Supplier shall make necessary arrangements for inspection by an Engineer appointed by EDC to carry out in his presence necessary Routine/Acceptance tests of the equipment.

The supplier shall include details of all acceptance/routine tests to be carried out on conductors and the routine test certificate shall be made available to Employer's inspector at the end of inspection.

5 Quality Management

The design, development and production of the conductors and earthing accessories shall be ISO 9001 certified. The ISO 9001 certificates shall be submitted within the bid. If ISO certificates from manufacturer are not submitted within the Bid, the offer shall be rejected.

Nevertheless, in case of locally (Kingdom of Cambodia) designed, developed and or manufactured earthing equipment, if the manufacturer is not ISO 9001 certified, it must prove mandatorily that he has implemented a quality process satisfying to EDC and Cambodian authorities or prove that he is applying for ISO 9001 certification.

6 Operating Conditions

The earthing conductors and earthing accessories shall be suitable to operate in the ambient conditions described here after:

Altitude	Sea level to 1,000 meters
Climate	Tropical
Annual Rainfall	1,300 mm.140 days
Monsoon Period	June to November
Ambient Air Temperatures:	
Average	27.5°C
Minimum	13.3°C
Maximum	40.5°C
Relative Air Humidity	65-100%
Soil Thermal Resistivity:	
Average	1.20 cm/W
Maximum	3.00 cm/W
Solar Emissivity	0.8
Solar absorption	0.8
Wind Velocity:	
Average	37 km/h (10.3 m/s)
Maximum	72 km/h (20 m/s)

7 Generalities

Two kind of earthing conductors are used on EDC network:

- Copper bare conductors: used for indoor MV/LV substations, prefabricated substations (PTT), RMU cabinets and One Pillar Substations as well as for underground MV/LV network.
- Galvanized mild steel conductors on pole mounted substation, reclosers, load break switches, and all kind of earthing when located on poles.

In order to avoid electro-galvanic corrosion, there is no change of kind of conductor all along the earthing circuit (pole/ground, building/ground); the conductor remain of the same type outside and inside the ground.

This explain why for earthing accessories some are specifically used for copper conductors and some used for hot dip galvanized conductors.

Nevertheless, this specification standardizes equipment that can be used for both kind of conductors.

8 Earthing Conductors

8.1 35 mm² Bare Copper Conductor

8.1.1 Description

The bare copper conductors shall consist of concentric-lay stranded conductors made from uncoated hardened round copper wires **class 2 not compacted**.

The bare copper conductor shall be constructed in conventional concentric-lay conductor type. The direction of lay of the outer layer shall be right hand.

No joints of any kind shall be made in the finished copper wires. Joints may be made in the rods or semi-finished wires prior to drawing to final size, provided that the supplier can guarantee that the joint will have at least 90% of the tensile strength of the un-jointed rod.

Welded joints in the copper wires shall be no closer than 15 m to another or to either end of the wire. No more than two such joints shall be present in any reel length of the conductor.

The surface of the wire shall be smooth and free from imperfections not consistent with good manufacturing practice.

The cross section shall be 35 mm² with a nominal diameter of 7.4 mm. It shall be constituted of 7 wires of 2.5 mm diameter.

8.1.2 Electrical Characteristics

The maximum DC resistance of the earthing copper conductor shall be **0.529 Ω/km** at 20^0C.

8.2 35 mm² Insulated Copper Conductor

8.2.1 Core

The core of 35 mm² insulated conductor shall consist of concentric-lay stranded conductors made from copper wires **class 2**.

The core shall be constructed in conventional concentric-lay conductor type. The direction of lay of the outer layer shall be right hand.

No joints of any kind shall be made in the finished copper wires. Joints may be made in the rods or semi-finished wires prior to drawing to final size, provided that the supplier can guarantee that the joint will have at least 90% of the tensile strength of the un-jointed rod.

Welded joints in the copper wires shall be no closer than 15m to another or to either end of the wire. No more than two such joints shall be present in any reel length of the conductor.

8.2.2 Insulation

The insulation shall be made of black colour XLPE with a nominal thickness of 0.9 mm.

8.2.3 Outer Sheath

The outer sheath shall be made of black coloured UV resistant PVC with a nominal thickness of 1.09 mm.

8.2.4 Electrical Characteristics

Voltage Uo/U (Um)	0.6/ 1 (1.2) kV
Max DC current in air	169 A
Max temperature of core	90°C
Mac core temperature under Short Circuit 5 s	250°C

8.2.5 Flame Propagation

The 35mm² insulated conductor shall be of non-flame propagation type. This shall be proven by supplying the type tests.

8.2.6 Marking

35 mm² insulated copper conductor shall bear the following marking on outer sheath by embossing or printing in white colour:

- Manufacturer
- Standard
- Cross section
- Cu (copper)
- Date of manufacturing

8.3 50 mm² Galvanized Mild Steel Conductor

This conductor shall consist in hot dip galvanized mild steel wires stranded together.

Massive conductor is not accepted and will result in the rejection of the offer.

The base metal shall be steel made by the open-hearth, basic-oxygen or electric-furnace process and of such quality and purity that, when drawn to the size of wire specified and coated with zinc, the finished strand and the individual wires shall be of uniform quality and have the properties and characteristics as specified in this specification.

The wire shall be made of mild steel with a **carbon contain between 0.12% and 2%** with a traction resistance of about 400 MPa.

The conductor shall be constructed in conventional concentric-lay conductor type. The direction of lay of the outer layer shall be right hand.

All wires shall be stranded with uniform tension. Stranding shall be sufficiently close to ensure no appreciable reduction in diameter when stressed.

The wires shall be concentrically twisted with a uniform pitch of not less than 10 nor more than 18 times the specified nominal diameter of the strand.

Joints made in individual conductors shall be accepted provided there is no more than one joint in any 45m section of the completed span. Joints made during stranding shall be protected against corrosion.

The conductor shall be constituted of 7x3 mm or 19 x 1.8 mm wires with a nominal conductor diameter of 9 mm.

8.3.1 Galvanising

Wires shall be cleaned and then hot dip galvanized before stranding.

The zinc used for hot dip galvanising shall be pure (99%).

Wires shall be hot dip galvanised according the requirements of ISO standard. **The minimum zinc thickness shall be of at least 395 gr/m² (55 µm).**

9 Earthing Accessories

9.1 Terminal Lugs

Terminal lugs are used with copper and galvanized steel conductors shall be of tinned forged copper type and shall be used for connection outside the soil.

Tubular lugs are not accepted. Any offer proposing this kind of tubular lugs will be rejected.

The following terminal tinned forged copper lugs shall be used:

- 35 mm² tinned forged copper lug for 35 mm² copper conductor
- 50 mm² tinned forged copper lug for 50 mm² hot dip galvanized mild steel conductor

The tin thickness shall not be less than 25 µm.

The lug palm shall include a hole with a diameter comprised between 12.5 mm and 14.5 mm.

The lugs shall be of regular hexagonal compression with 8 tons press minimum.

9.1.1 Heat Shrinkable Tube

50 mm² tinned forged copper lug for 50 mm² hot dip galvanized mild steel conductor shall be supplied with a heat shrinkable tube inside compounded of 25 cm length.

It shall be able to be shrunk on a 9 mm diameter conductor.

9.1.2 Marking and Delivery

Terminal lugs shall be marked by engraving as follow:

- Manufacturer
- Cross section
- Die hexagonal reference
- Position of hexagonal compressions

Lugs shall be delivered in plastic bag or card-box containing 100 pcs.

Heat shrinkable tubes shall be delivered in bags of 10 pcs.

9.2 Measuring Point Kit for LV Neutral Earthing

This kit comprising 2 tinned forged lugs, one M14 (or M12) x 30 mm stainless steel bolt plus one stainless steel spring washer shall be used on all LV neutral earthing in order to allow earthing disconnection for measuring earthing value as well as electrical coupling with neighbour mass earthings.

It shall include:

- One 35 mm² tinned forged copper lug for 35 mm² copper conductor described above,
- One 50 mm² tinned forged copper lug for 50 mm² hot dip galvanized mild steel conductor described above
- One heat shrinkable tube described above
- One M14 (or M12) x 30 mm stainless steel bolt plus one stainless steel spring washer

9.2.1 Marking and Delivery

Marking shall be the same as requested for the lugs.

The measuring point kit shall be delivered complete inside one plastic bag or card-box.

9.3 C Connectors

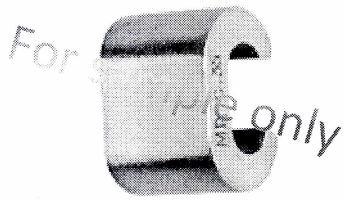
C tinned connectors used with copper and galvanized steel conductors shall be of tinned copper type and shall be used for connection inside and outside the soil.

C connectors shall be obtained from extruded or moulded bars. **C connectors made from flat copper bars buy curving the extremities shall not be accepted and shall result in the rejection of the offer.**

The following C tinned connectors shall be used:

- **2 x 35 mm² for 35 mm² copper conductor**
- **2 x 50 mm² for 50 mm² hot dip galvanized mild steel conductor**

The tin thickness shall not be less than 25 µm.



9.3.1 Marking and Delivery

Tinned C connectors shall be marked by engraving as follow:

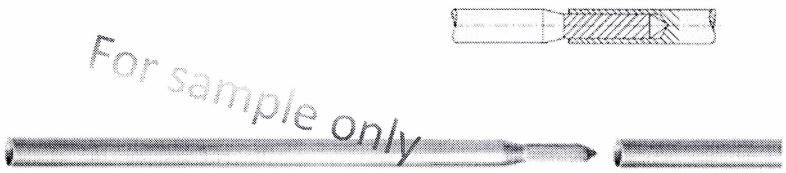
- Manufacturer
- Cross sections
- Die hexagonal reference

C connectors shall be delivered in plastic bag or card-box containing 100 pcs.

9.4 Earthing Rods

Earthing rods shall be of self-extensible type without need of a coupling accessory. One end of the rod shall be fitted with male part and the other end with female end. The pointed part to be sunk into the ground shall be the male end.

Rods shall be united by jamming. Evidently, the male end shall look forward into the ground and the hammering shall be performed on female side. Therefore, hammering shall be never done on edge parts of the female end. So, it is absolutely necessary to use a specifically designed driving head as requested here in after.



9.4.1 Copper Clad Rod

The copper clad earthing rods will have a minimum real diameter of 14.2 mm or 14.3 mm and a length of 1.5 meter.

The copper thickness shall not be less than 250 µm. Any copper thickness less than required will result by rejection of the offer.

If at delivery, it is proven by EDC testing that the copper minimum thickness is less than required, the earthing rods will be unpaid by EDC and made available for the supplier.

9.4.2 Copper Clad Rod Connector

The connector to be used for connecting 35 mm² bare copper earthing conductor onto the diameter 14.3 mm copper clad rod shall be made of bronze. The bolt shall be made of copper alloy.

9.4.3 Hot Dip Galvanized Rod

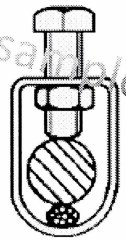
The hot dip galvanized earthing rods will have a real diameter of 16 mm and a length of 1.5 meter.

The zinc thickness shall not be less than 610 g/m² (85 µm). Any zinc thickness less than required will result by rejection of the offer.

If at delivery, it is proven by EDC testing that the zinc minimum thickness is less than required, the earthing rods will be unpaid by EDC and made available for the supplier.

9.4.4 Galvanized Steel Rod Connector

The connector to be used for connecting 50 mm² bare hot dip galvanized steel earthing conductor onto the diameter 16 hot dip galvanized earthing rod shall be made of galvanised steel. The bolt and nut shall be protected against corrosion and preferably made of galvanized steel.

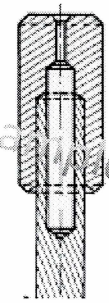


9.4.5 Earthing Rods Driving Head

Driving head shall be used for sinking earthing rods into the ground.

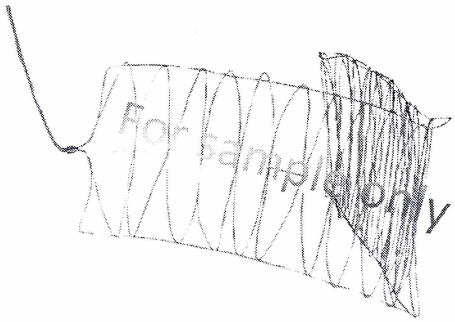
This driving head shall be constituted by a small hard steel pin to be inserted in the female part of the earthing rod and a steel part that cover this pin and the female part of the rod in order to avoid damaging the female part edges.

This driving head shall be compatible with diameter 14.2 mm and 16 mm earthing rods both and be made in two (2) or one (1) part.



9.5 Earthing Grid (net)

Prefabricated earthing grids will advantageously replace rods for getting good earthing values and efficient flowing of atmospheric currents in the ground.



9.5.1 Copper Grid

This grid shall be entirely made of hard draw copper wires. No welding of wires will be tolerated. In that case the offer will be rejected. It is the same for metal expanded grids or mats.

The grid shall be constituted of a 0.4 x 2 m grid and a conductor of 2-meter length.

The cross section of the conductor shall be approximately 35 mm² and this conductor shall be done with all wires constituting the grid.

9.5.2 Hot Dip Galvanized Grid

This grid shall be entirely made of hot dip galvanized mild steel wires. No welding of wires will be tolerated. In that case the offer will be rejected. It is the same for metal expanded grids or mats.

The grid shall be constituted of a 0.4 x 2 m grid and a conductor of 2-meter length.

The cross section of the conductor shall be approximately 50 mm² and this conductor shall be done with all wires constituting the grid.

9.5.3 Galvanizing

Wires shall be cleaned and then hot dip galvanized before making the grid.

The zinc used for hot dip galvanising shall be pure (99%).

Wires shall be hot dip galvanised according the requirements of ISO standard. The minimum zinc thickness shall be of at least **395 gr/m² (50 µm).**

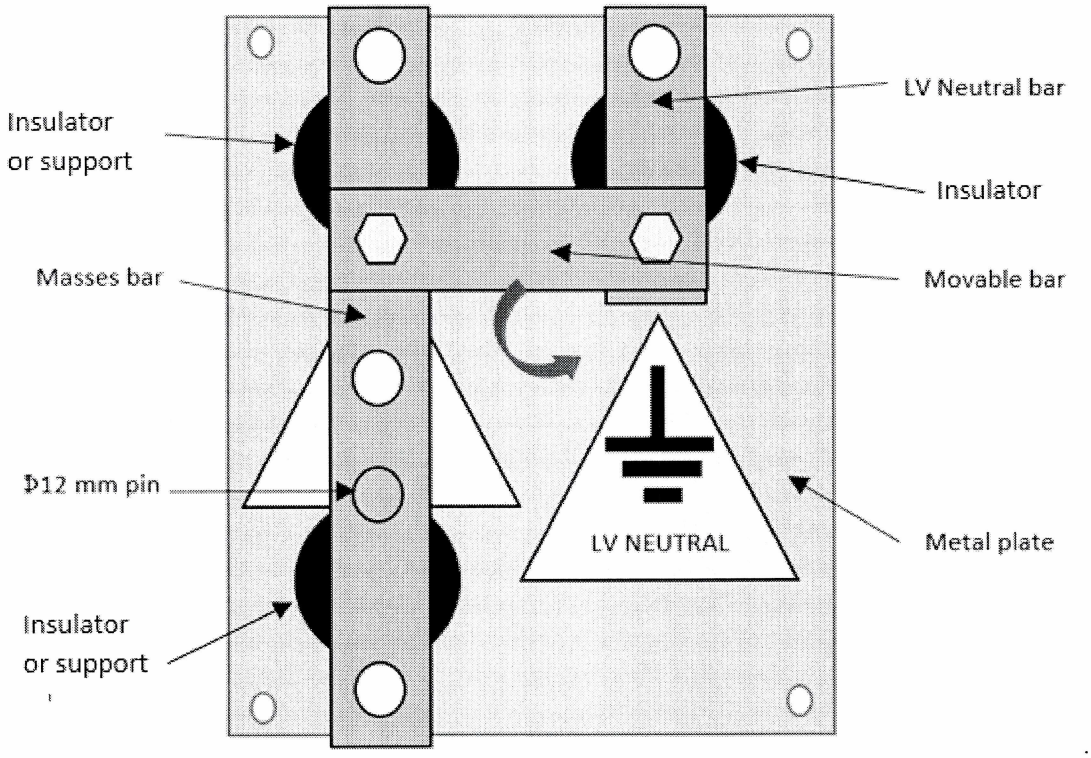
9.6 Earthing Board for Built or Compact Substation

This board shall be installed in all built substations, prefabricated substations, Ring main unit cabinets and One Pillar Substation for collecting mass earthing circuit (equipotential link, equipotential loop around the substation, cabinet, OPS and grounding circuit) and the LV neutral earthing link from the Low Voltage Distribution Board (in case of substation and OPS). It shall also allow an easy earthing ohmic measurement.

It shall be fixed again the walls thanks a metallic plate.

It comports:

- One mass copper collecting copper bar (25 x 3 mm) including 3 holes of 13 mm diameter plus one Diameter 12 mm and 40 mm length pin for connection of measurement apparatus,
- One LV neutral earthing link copper bar (25 x 3 mm) including 1 hole of 13 mm diameter,
- One movable copper bar link (20 x 4 mm) between mass and neutral bar
- 2 isolators or metallic bars supporting the Mass copper bar
- 1 isolator supporting the neutral bar
- Supporting plate
- Symbol of mass earthing and symbol LV neutral earthing
- 4 M12 x 30 mm stainless steel bolts with 3 stainless steel spring washers
- 2 M6 or M8 x 20 mm stainless steel bolts



9.6.1 Marking and Delivery

The earthing board shall be marked with the manufacturer name or logo.

Each earthing plate shall be delivered complete and assembled inside a plastic bag or a card-box.

9.7 Insulation Piercing Connector for LV ABC (LV neutral earthing on poles)

This IPC shall be used for connecting copper earthing conductor on Low Voltage Neutral ABC. That IPC shall be conformed to the requirement of EDC-DTS-LV002 with a cross section range as follow:

- **Main ABC: 50 mm² to 70 mm²**
- **Tap cable: 35 mm² insulated**

Any proposed IPC that is not in the accordance with the requirement of EDC-DTS-LV002 will result in the rejection of the offer.

9.8 Insulation Piercing Connector for Underground Cable (LV neutral earthing in cabinets)

This IPC shall be used for connecting copper earthing conductor on Low Voltage Neutral of underground cables inside connecting cabinets. That IPC shall be conformed to the requirement of EDC-DTS-LV002 with a cross section range as follow:

- **Main: 50 mm² to 120 mm²**
- **Tap cable: 35 mm² bare copper insulated with heat shrinkable tube**

Any proposed IPC that is not in the accordance with the requirement of EDC-DTS-LV002 will result in the rejection of the offer.

9.9 Heat Shrinkable Tube for 35 mm² Bare Copper Conductor

This heat shrinkable tube shall be used on 35 mm² bare copper earthing conductor when this one is located inside a cabinet for connection on neutral.

9.10 Stainless-steel Strap for Fixing Earthing Conductor Against Poles

Stainless steel shall be used for fixing brackets and other equipment on poles.

The dimensions shall be:

- Width = 20 mm
- Thickness = 0.4 mm

Strap shall be of 18/8 mat or brilliant stainless steel with a breaking strength comprised between 600 and 950 N/mm². The breaking strength of the strap shall be proved by a type test carried out by the manufacturer. The maximal elongation shall be 40%.

The four edges of the stainless-steel strap shall be mandatorily deburred in order to avoid cable or personal cutting. Not deburred strap shall be rejected.

Buckle shall be designed for tightening steel strap on pole by « looping ». Buckle shall be made of stainless steel.

9.11 Electrical/Mechanical Protection for Earthing Conductor

This electrical/ mechanical protection shall be used on lower part of poles in order to protect earthings conductors against mechanical aggression from about 30 cm under ground level up to 2 m above ground level at a minimum.

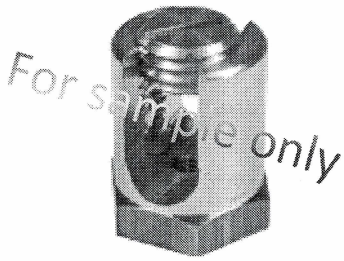
The earthing conductor mechanical protection shall be made of PVC of grey colour with an L shape (30 mm x 30 mm) and shall be attached on pole by using stainless steel strap.

The cable mechanical protection shall be designed for protection of a cable with a maximum diameter of 10 mm.

9.12 Wall Mounted Brass Support for Earthing Conductor

This equipment shall be used in indoor substations, prefabricated substations, OPS, RMU cabinet and all indoor locations for fixing a bare earthing conductor against walls in order to avoid conductor movement and connection destruction during flowing of short circuit current.

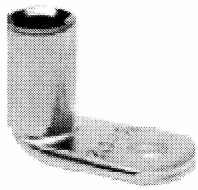
It shall be made of brass and capable to receive 1x35 mm² copper conductor. In addition, depending the case, the support shall be delivered with 1 specific wood screw fitting for fixing the support against masonry wall using plug (supplied) or one corrosion protected metric bold with washer and nut for fixing the support against metallic sheets.

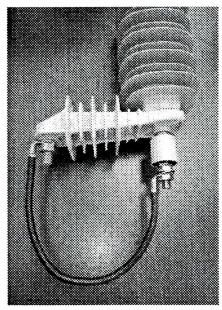


9.13 Flexible Indicator Leads for Surge Arrester

This equipment shall be constituted of extra flexible black UV protected PVC insulation (1000 V) copper conductor of 35 cm length fitted with 2 tinned copper 90° tubular lugs.

The cross section of the copper insulated extra flexible conductor will be 25 mm² and holes of lugs palm shall be between 12.5 mm and 12.8 mm.





The two (2) lugs shall be hexagonally compressed onto the extra flexible insulated conductor. This shall be done at factory

It shall be connected between surge arrester disconnector and the surge arrester insulated bracket fixing bolt located on the supporting cross arm. In case of arrester failure (end of life) the arrester disconnector will operate and eject on end of the lead. This will efficiently disconnect the faulty arrester from the line and clearly visible from the ground to an operator signalling that this arrester is faulty and to be replaced.

10 Technical Data Sheets

10.1 35 mm² Bare Copper Conductor

No.	Description	Unit	Requirements	Supplier's Offer
1	Country		to be specified	
2	Manufacturer		to be specified	
3	Manufacturer's Reference		to be specified	
4	Applicable Standards		To be specified	
5	Type tests reports		To be provided	
6	Made of		Class 2, non-compacted pure copper	
7	Cross section	mm²	35	
7.a	Actual cross section		to be specified	
7.b	Approximate conductor diameter	mm	7.4	
8	Number of wires		7	
8.a	Diameter of wires	mm	2.5	
8.b	Direction of outer layer		right	
9	maximum DC resistance	Ω/km	0.530	
8	weight	Kg/km	To be specified	

Supplier's offer column must be properly filled with the right figures. "Compliant, Yes, ", V , etc..." **are not accepted**.

Deviation from the technical specification:

The bidder shall list point after point and explain here in after all deviation from the requested technical specification.

1/

2/

Full technical information shall be supplied within the bid. If not, the offer shall not be considered

Bidder signature:

10.2 35 mm² Insulated Copper Conductor

No.	Description	Unit	Requirements	Supplier's Offer
1	Country		to be specified	
2	Manufacturer		to be specified	
3	Manufacturer's Reference		to be specified	
4	Applicable Standards		To be specified	
5	Type tests reports		To be provided	
6	Core made of		Class 2, non-compacted pure copper	
7	Cross section	mm²	35	
7.a	Actual cross section		to be specified	
7.b	Approximate conductor diameter	mm	7.4	
8	Number of wires		To be specified	
8.a	Diameter of wires	mm	To be specified	
8.b	Direction of outer layer		right	
9	maximum DC resistance	Ω/km	To be specified	
10	Insulation		black colour XLPE	
10.a	Nominal insulation thickness	mm	0.9	
11	Outer sheath		black coloured UV resistant PVC	
11.a	Outer sheath nominal thickness	mm	1.09	
12	Uo/U (Um)	kV	0.6/ 1 (1.2)	
13	Max DC current in air	A	169	
14	Max temperature of core	°C	90	
15	Mac core temperature under 5 s Short Circuit	°C	250	
16	Non-flame propagation type		Mandatory	
16.a	Type tests.		Supplied at tender stage	

17	marking on outer sheath by **embossing or printing in white colour:** • Manufacturer • Standard • Cross section • Cu (copper) • Date of manufacturing		Yes Yes Yes Yes Yes Yes	
18	weight	Kg/km	To be specified	
Supplier's offer column must be properly filled with the right figures. "Compliant, Yes, ", V , etc..." **are not accepted**.				

Deviation from the technical specification:

The bidder shall list point after point and explain here in after all deviation from the requested technical specification.

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Full technical information shall be supplied within the bid. If not, the offer shall not be considered

Bidder signature:

10.3 50 mm² Galvanized Mild Steel Conductor

No.	Description	Unit	Requirements	Supplier's Offer
1	Country		to be specified	
2	Manufacturer		to be specified	
3	Manufacturer's Reference		to be specified	
4	Applicable Standards		To be specified	
5	Type tests reports		To be provided	
6	Made of		mild steel	
6.a	Steel carbon contain between 0.12% and 2%		To be specified	
7	Cross section	mm²	50	
7.a	Actual cross section		to be specified	
7.b	Approximate conductor diameter	mm	9	
8	Number of wires		7 or 19	
8.a	Diameter of wires	mm	3 or 1.8	
8.b	Direction of outer layer		Right	
9	Wires cleaned before hot dip galvanizing before stranding		Mandatory	
10	Wires hot dip galvanized before stranding		Mandatory	
11	The zinc used for hot dip galvanising is pure (99%).		Yes	
12	Wires are hot dip galvanised according the requirements of ISO standard		Mandatory	
13	Minimum zinc thickness	gr/m²	395 (55 µm).	
14	weight	Kg/km	To be specified	

Supplier's offer column must be properly filled with the right figures. "Compliant, Yes, ", V , etc..." **are not accepted**.

Deviation from the technical specification:

The bidder shall list point after point and explain here in after all deviation from the requested technical specification.

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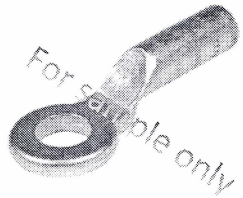
Bidder signature:

10.4 Lugs for 35 mm² Copper Conductor (Barre or Insulated)

No.	Description	Unit	Requirements	Supplier's Offer
1	Country		to be specified	
2	Manufacturer		to be specified	
3	Manufacturer's Reference		to be specified	
4	Applicable Standards		To be specified	
5	Made of		Tinned Forged copper	
6	Tin thickness	µm	≥ 25	
7	Cross section	mm^2	35	
8	Tube internal diameter	mm	To be specified	
9	Palm hole diameter	mm	12.5 or 14.5	
10	Regular hexagonal compression type		Yes	
11	Regular hexagonal Die reference		To be specified	
12	Marking • Manufacturer • Cross section • Position of compressions • Die reference		Yes Yes Yes Yes	
13	Delivery		Bag or card-box of 10 pcs 	

Supplier's offer column must be properly filled with the right figures. "Compliant, Yes, ", V , etc..." **are not accepted**.

Deviation from the technical specification:

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Bidder signature:

10.5 Lugs for 50 mm² Mild Steel Hot Dip Galvanised Conductor

No.	Description	Unit	Requirements	Supplier's Offer
1	Country		to be specified	
2	Manufacturer		to be specified	
3	Manufacturer's Reference		to be specified	
4	Applicable Standards		To be specified	
5	Made of		Tinned Forged copper	
6	Tin thickness	µm	≥ 25	
7	Cross section	mm²	50	
8	Tube internal diameter	mm	To be specified	
9	Palm hole diameter	mm	12.5 or 14.5	
10	Regular hexagonal compression type		Yes	
11	Regular hexagonal Die reference		To be specified	
12	Heat shrinkable tube inside compounded of 25 cm length.		Supplied	
13	Able to be shrunk on a 9 mm diameter conductor.		Yes	
14	Marking • Manufacturer • Cross section • Position of compressions • Die reference		 Yes Yes Yes Yes	
15	Delivery		Bag or card-box of 10 lugs and 10 length of shrinkable tube	

Supplier's offer column must be properly filled with the right figures. "Compliant, Yes, ", V , etc..." **are not accepted**.

Deviation from the technical specification:

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Bidder signature:

10.6 Measuring Point Kit for LV Neutral Earthing

No.	Description	Unit	Requirements	Supplier's Offer
1	Country		to be specified	
2	Manufacturer		to be specified	
3	Manufacturer's Reference		to be specified	
4	Applicable Standards		To be specified	
A/ Lug for 35 copper insulated cable				
1	Made of		Tinned Forged copper	
2	Tin thickness	µm	≥ 25	
3	Cross section	mm^2	35	
4	Tube internal diameter	mm	To be specified	
5	Palm hole diameter	mm	12.5 or 14.5	
6	Regular hexagonal compression type		Yes	
7	Regular hexagonal Die reference		To be specified	
8	Marking • Manufacturer • Cross section • Position of compressions • Die reference		Yes Yes Yes Yes	
B/ Lugs for 50 mm^2 mild steel hot dip galvanised conductor				
1	Made of		Tinned Forged copper	
2	Tin thickness	µm	≥ 25	
3	Cross section	mm^2	50	
4	Tube internal diameter	mm	To be specified	
5	Palm hole diameter	mm	12.5 or 14.5	
6	Regular hexagonal compression type		Yes	
7	Regular hexagonal Die reference		To be specified	

8	Heat shrinkable tube inside compounded of 25 cm length.		Supplied	
9	Able to be shrunk on a 9 mm diameter conductor.		Yes	
10	Marking • Manufacturer • Cross section • Position of compressions • Die reference		Yes Yes Yes Yes	
C/ Stainless steel bolt				
1	Made of stainless steel		Yes	
2	Diameter		M12 or M14	
3	Length		To be specified	
4	One nut and one spring washer		Yes	
5	Delivery		One kit (2 lugs + heat shrinkable tube + bolt) in one plastic bag	
Supplier's offer column must be properly filled with the right figures. "Compliant, Yes, ", V , etc..." **are not accepted**.				

Deviation from the technical specification:

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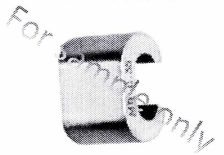
Bidder signature:

10.7 C connector

No.	Description	Unit	Requirements	Supplier's Offer
1	Country		to be specified	
2	Manufacturer		to be specified	
3	Manufacturer's Reference		to be specified	
4	Applicable Standards		To be specified	
5	Type tests		To be supplied at tender stage	
6	Made of		Tinned copper	
7	Tin thickness	µm	≥ 25	
8	Obtained from extruded or molded bars		Mandatory	
9	Cross section	mm^2	□ 2 x 35 □ 2 x 50	
10	Regular hexagonal Die reference		2 x 35 C connector 2 x 50 C connector	
11	Marking • Manufacturer • Cross section • Die reference		Yes	
12	Delivery		Bag or card-box of 100 C connectors 	

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Deviation from the technical specification:

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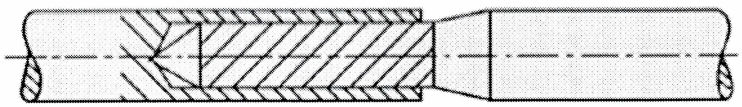
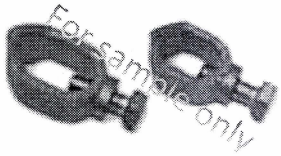
Bidder signature:

10.8 Copper Clad Earthing Rod and Connector

No.	Description	Unit	Requirements	Supplier's Offer
Rod				
1	Country		to be specified	
2	Manufacturer		to be specified	
3	Manufacturer's Reference		to be specified	
4	Applicable Standards		To be specified	
5	Made of		Copper clad steel	
6	Real diameter	mm	14.2 or 14.3	
7	Length	m	1.5	
8	Minimum Copper thickness	µm	250	
9	Coupling type		self-extensible type without need of a coupling accessory	
9.a	One end of the rod shall be fitted with male part and the other end with female end		Mandatory	
9.b	Rods are extended (united) by self-jamming		Mandatory	
10	Delivery		Package of 10 rods attached together and female part protected by plastic cap	
	COUPLING 			
Connector				
11	Made of Bronze		Yes	
12	For 14.3 copper clad earthing rods		Yes	
13	Copper conductor cross section	mm^2	35	
14	Bolt made of copper alloy		Yes	
15	Delivery		Per bag or box of 50 pcs	

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Deviation from the technical specification:

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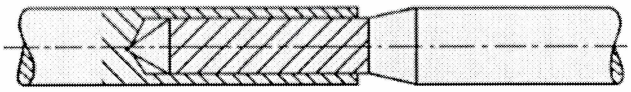
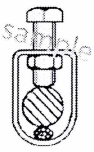
Bidder signature:

10.9 Hot Dip Galvanized Mild Steel Earthing Rod and Connector

No.	Description	Unit	Requirements	Supplier's Offer
Rod				
1	Country		to be specified	
2	Manufacturer		to be specified	
3	Manufacturer's Reference		to be specified	
4	Applicable Standards		To be specified	
5	Made of		Hot dip galvanised mild steel	
6	Real diameter	mm	16	
7	Length	m	1.5	
8	Minimum Zinc thickness	µm	85	
9	Coupling type		self-extensible type without need of a coupling accessory	
9.a	One end of the rod shall be fitted with male part and the other end with female end		Mandatory	
9.b	Rods are extended (united) by self-jamming		Mandatory	
10	Delivery		Package of 10 rods attached together and female part protected by plastic cap	
	COUPLING 			
Connector				
11	Made of:		Galvanized steel	
12	For 16 mm diameter hot dip galvanised earthing rods		Yes	
13	Hot dip galvanised mild steel conductor cross section	mm^2	50	
14	Bolt made of:		Galvanised steel or stainless steel	
15	Delivery		Per bag or box of 50 pcs	

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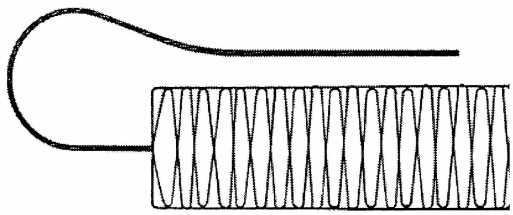
Bidder signature:

10.10 Copper Earthing Grid (net)

No.	Description	Unit	Requirements	Supplier's Offer
1	Country		to be specified	
2	Manufacturer		to be specified	
3	Manufacturer's Reference		to be specified	
4	Applicable Standards		To be specified	
5	Made of		Hard drawn Copper wires	
6	Dimension of grid	m	0.4 x 2	
7	Length of conductor	m	2	
8	Cross section of conductor	mm^2	35	
9	Conductor made with all wire constituting the grid		Mandatory	
10	Wire welding		No (mandatory)	
11	Delivery		Package of 10 attached together	
				

Supplier's offer column must be properly filled with the right figures. "Compliant, Yes, ", V , etc..." **are not accepted**.

Deviation from the technical specification:

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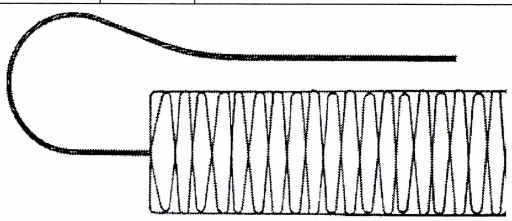
Bidder signature:

10.11 Hot Dip Galvanized Earthing Grid (net)

No.	Description	Unit	Requirements	Supplier's Offer
1	Country		to be specified	
2	Manufacturer		to be specified	
3	Manufacturer's Reference		to be specified	
4	Applicable Standards		To be specified	
5	Made of		Hot dip galvanized mild steel wires	
6	Dimension of grid	m	0.4 x 2	
7	Length of conductor	m	2	
8	Cross section of conductor	mm^2	50	
9	Conductor made with all wire constituting the grid		Mandatory	
10	Wire welding		No (mandatory)	
11	Delivery		Package of 10 attached together	
				

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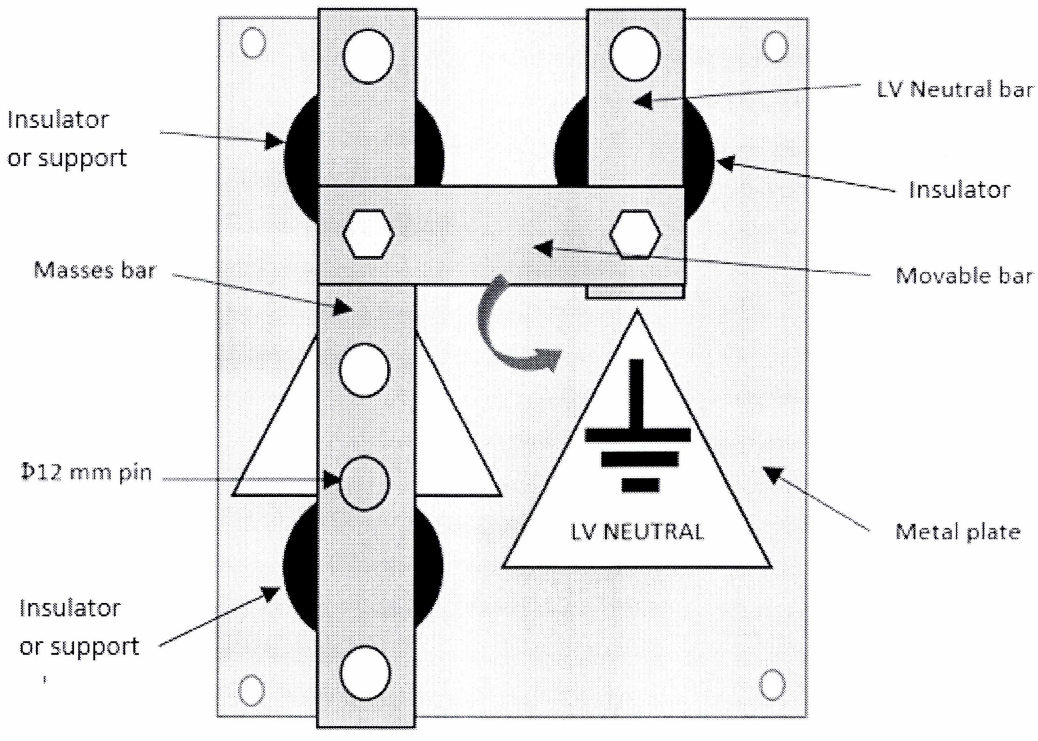
Bidder signature:

10.12 Main Earthing Board for Indoor/Prefabricated Substation

No.	Description	Unit	Requirements	Supplier's Offer
1	Country		to be specified	
2	Manufacturer		to be specified	
3	Manufacturer's Reference		to be specified	
4	Applicable Standards		To be specified	
5	Designed to be install in all indoor substations, prefabricated substations, Ring main unit cabinets and One Pillar substation		Yes	
6	Designed for collecting mass earthing circuit (equipotential link, equipotential loop around the substation, cabinet, OPS and grounding circuit) and the LV neutral earthing link from the Low Voltage Distribution Board (in case of substation and OPS)		Yes	
7	Allow an easy earthing ohmic measurement		Yes	
8	To be fixed again the walls thanks a metallic plate		Yes	
9	Plate dimensions	mm	To be specified	
10	Plate fixing holes diameter	mm	To be specified	
11	Copper bars cross section	mm	20 x 3	
12	Connection hole diameters	mm	≥ 12.5	
13	Includes • one masses copper collecting bar including 3 holes for connection of massive forged lugs • one Diameter 12 mm and 40 mm length pin for connection of measurement apparatus, • One LV neutral earthing link copper bar including		Yes Yes Yes	

	1 hole for connection of massive forged copper lug • One movable (openable) copper bar link (20 x 3 mm) between mass and neutral bar • 2 isolators or metallic bars supporting the Mass copper bar • 1 mandatory isolator supporting the neutral bar • 4 M12 x 30 mm stainless steel bolts with 4 stainless steel spring washers • Symbol of mass earthing and symbol LV neutral earthing		Yes Yes Yes Yes Yes	
14	Delivery		One piece in a plastic bag or card-box.	



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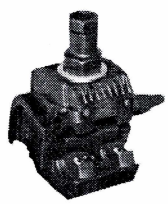
Bidder signature:

10.13 IPC for Connection of 35 mm² Insulated Copper Cable onto LV ABC Neutral for LV Neutral Earthing

No.	Description	Unit	Requirements	Supplier's Offer
1	Country		to be specified	
2	Manufacturer		to be specified	
3	Manufacturer's Reference		to be specified	
4	Applicable Standards		NF C 33-020, EN 50483 and EDC DTS-LV-002	
5	Type tests reports		To be provided	
6	Minimum IPC life expectancy	Year	30	
7	Suitable for LV ABC conform to		NFC 33-209 and EDC-DTS-LV001	
8	Suitable for connect		Aluminium and copper cable	
9	Fully insulated and suitable for LV live line works		Yes	
10	Insulation piercing type on main and tee-off		Yes	
11	Simultaneous piercing of main and tap		Yes	
12	No energized part of the connectors accessible during installation and all along lifespan by design and type tests		Yes (Mandatory)	
13	No detachable parts to prevent them from missing during transportations or fall apart during installation and /or while in service		Yes (Mandatory)	
14	housing entirely made of mechanical, weather, UV and age resistant plastic insulation material		Yes (Mandatory)	
15	Housing fire retardant / Self extinguishable		Yes	

16	no metallic parts outside the housing except for the tightening system or bolt(s)		Yes (Mandatory)	
17	UV protected and weather resistant		Yes	
18	Ambient temperature	°C	40.5	
19	Relative humidity	%	95	
Teeth				
20	Made of non-magnetic metal		aluminium alloy or tin-plated copper alloy	
20.a	Insulation piercing thickness (NFC 33-209 and EDC-DTS-LV001ABC) min/max	mm	1.2/3	
Water tightness				
21	Ensured by appropriate elastomer materials and must not be based on the usage of grease, gel paste etc. only		Yes (Mandatory)	
21.a	the interior surfaces of the connectors could be filled with oxide inhibiting compound of silicon-based grease		To be specified	
21.b	IPC voltage withstands during 1 minute when immersed under 30 cm of water	kV	6	
Bolts and tightening torque				
22	The bolt(s) and washer(s) (if any) made of non-corrosive material		Yes	
22.a	Bolts maintain the pressure of the connector on the cable throughout the service life of the connector		Yes	
22.b	Number of bolts		1	
22.c	The bolt(s) incorporate an over-torque shear off head		Yes	
22.d	Material of shear off head		Metal or	

			UV and age resistant plastic	
22.e	Size of the shear off head:		10mm, 13mm or 17mm	
22.f	Size and shape of the second head after breaking of shear off head		shall not have the same size or shape than shear off head	
23	Type of IPC (EDC-DTS-LV002)		CDRS/CT 70-70	
24	Cross section main conductor	mm^2	70	
25	Cross section tap conductor	mm^2	35 to 50	
26	System Voltage at 50Hz	V	230/400	
27	Rated Voltage	kV	0.6/1	
28	Dielectric withstand	kV	6	
29	Minimum current transit (30°C)	A	250	
30	Marking in accordance with the requirement of:		NFC 33-020	
31	Standard marking -Manufacturer logo or trade mark -Min and max cross sections -Batch number or serial number		 Yes Yes Yes	
32	Marking		indelible	
33	Packing by bag or card box of:	pcs	10	
	For sample only			
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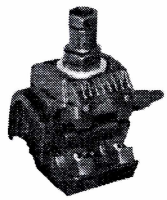
Bidder signature:

10.14 Insulation Piercing Connector for Underground Cable (LV neutral earthing in cabinets)

No.	Description	Unit	Requirements	Supplier's Offer
1	Country		to be specified	
2	Manufacturer		to be specified	
3	Manufacturer's Reference		to be specified	
4	Applicable Standards		NF C 33-020, EN 50483 and EDC DTS-LV-002	
5	Type tests reports		To be provided	
6	Minimum IPC life expectancy	Year	30	
7	Suitable for LV ABC conform to		NFC 33-209 and EDC-DTS-LV001	
8	Suitable for connect		Aluminium and copper cable	
9	Fully insulated and suitable for LV live line works		Yes	
10	Insulation piercing type on main and tee-off		Yes	
11	Simultaneous piercing of main and tap		Yes	
12	No energized part of the connectors accessible during installation and all along lifespan by design and type tests		Yes (Mandatory)	
13	No detachable parts to prevent them from missing during transportations or fall apart during installation and /or while in service		Yes (Mandatory)	
14	housing entirely made of mechanical, weather, UV and age resistant plastic insulation material		Yes (Mandatory)	
15	Housing fire retardant / Self extinguishable		Yes	
16	no metallic parts outside the housing except for the tightening system or bolt(s)		Yes (Mandatory)	

17	UV protected and weather resistant		Yes	
18	Ambient temperature	°C	40.5	
19	Relative humidity	%	95	
Teeth				
20	Made of non-magnetic metal		aluminium alloy or tin-plated copper alloy	
20.a	Insulation piercing thickness (NFC 33-209 and EDC-DTS-LV001ABC) min/max	mm	1.2/3	
Water tightness				
21	Ensured by appropriate elastomer materials and must not be based on the usage of grease, gel paste etc. only		Yes (Mandatory)	
21.a	the interior surfaces of the connectors could be filled with oxide inhibiting compound of silicon-based grease		To be specified	
21.b	IPC voltage withstands during 1 minute when immersed under 30 cm of water	kV	6	
Bolts and tightening torque				
22	The bolt(s) and washer(s) (if any) made of non-corrosive material		Yes	
22.a	Bolts maintain the pressure of the connector on the cable throughout the service life of the connector		Yes	
22.b	Number of bolts		1	
22.c	The bolt(s) incorporate an over-torque shear off head		Yes	
22.d	Material of shear off head		Metal or UV and age resistant plastic	
22.e	Size of the shear off head:		10mm, 13mm or 17mm	

22.f	Size and shape of the second head after breaking of shear off head		shall not have the same size or shape than shear off head	
23	Type of IPC (EDC-DTS-LV002)		CDRS/CT	
24	Cross section main conductor	mm^2	50 to 120	
25	Cross section tap conductor	mm^2	35 to 50	
26	System Voltage at 50Hz	V	230/400	
27	Rated Voltage	kV	0.6/1	
28	Dielectric withstand	kV	6	
29	Marking in accordance with the requirement of:		NFC 33-020	
30	Standard marking -Manufacturer logo or trade mark -Min and max cross sections -Batch number or serial number		Yes Yes Yes Yes	
31	Marking		indelible	
32	Packing by bag or card box of:	pcs	10	
	For sample only			

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Bidder signature:

10.15 Heat Shrinkable Tube for 35mm² Bare Copper Conductor

No.	Description	Unit	Requirements	Supplier's Offer
1	Country		to be specified	
2	Manufacturer		to be specified	
3	Manufacturer's Reference		to be specified	
4	Applicable Standard		To be specified	
6	Tube thickness		To be specified	
7	Internal diameter before shrinkage		To be specified	
8	Minimum internal diameter after shrinkage		To be specified	
9	Insulation Level	V	1000	
10	Suitable for bare copper 35 mm²		Yes	
11	Delivery		Rolls of 10 meter	

Supplier's offer column must be properly filled with the right figures. "Compliant, Yes, ", V , etc..." **are not accepted**.

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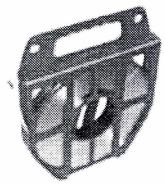
Bidder signature:

10.16 Stainless-steel Strap

No.	Description	Unit	Requirements	Supplier's Offer
1	Country		to be specified	
2	Manufacturer		to be specified	
3	Manufacturer's Reference		to be specified	
4	Applicable Standard		To be specified	
6	Used for attaching cables or conductors onto poles.		Yes	
7	Made of 18 / 8 mat or brilliant stainless steel		Yes	
8	Width	mm	20	
9	Thickness	mm	0.4	
10	Breaking strength comprised between:	N/mm^2	600 and 950	
11	The breaking strength proved by a type test carried out by the manufacturer.		Yes To be provided	
12	The four edges of the stainless-steel strap are deburred in order to avoid cable or personal cutting		Certified and guarantied	
13	Delivered inside a plastic dispenser container by length of:	m	50	
FOR SAMPLE ONLY				

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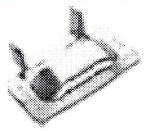
Full technical information shall be supplied within the bid. If not, the offer shall not be considered

Bidder signature:

10.17 Buckle

No.	Description	Unit	Requirements	Supplier's Offer
1	Country		to be specified	
2	Manufacturer		to be specified	
3	Manufacturer's Reference		to be specified	
4	Applicable Standard		To be specified	
5	Buckle designed for tightening steel strap on pole by "looping"		Yes	
6	Buckle made of stainless steel		Yes	
7	Delivered in plastic bag or card box containing	pcs	100	
FOR SAMPLE ONLY				

Supplier's offer column must be properly filled with the right figures. "Compliant, Yes, ", V , etc..." **are not accepted**.

Deviation from the technical specification:

The bidder shall list point after point and explain here in after all deviation from the requested technical specification.

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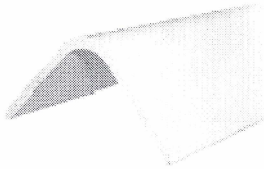
Bidder signature:

10.18 Electrical/Mechanical Protection for Earthing Conductor

No.	Description	Unit	Requirements	Supplier's Offer
1	Country		to be specified	
2	Manufacturer		to be specified	
3	Manufacturer's Reference		to be specified	
4	Applicable Standard		To be specified	
5	To be used for earthing conductor protection at ground level along poles		Yes	
6	For cable protection against mechanical aggression from about 30 cm under ground level up to 2 m above ground level at a minimum.		Yes	
7	Made of PVC of grey colour		Yes	
8	Shape		L	
8	Minimum length	cm	230	
10	Attached on pole by using stainless steel strap or fixed against walls by screw and plugs.		Yes	
11	Maximum conductor diameter	mm	10	
12	Delivery		10 pcs attached together	
FOR SAMPLE ONLY				

Supplier's offer column must be properly filled with the right figures. "Compliant, Yes, ", V , etc..." are not accepted.

Deviation from the technical specification:

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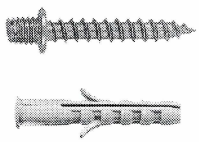
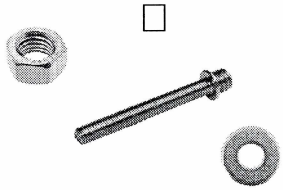
Bidder signature:

10.19 Wall Mounted Brass Support for Earthing Conductor

No.	Description	Unit	Requirements	Supplier's Offer
1	Country		to be specified	
2	Manufacturer		to be specified	
3	Manufacturer's Reference		to be specified	
4	Applicable Standard		To be specified	
5	Used in indoor substations, prefabricated substations, OPS, RMU cabinet and all indoor locations for fixing a bare earthing conductor.		Yes	
6	Avoid conductor movement and connection destruction during flowing of short circuit current		Yes	
7	Made of		Brass	
8	For bare copper conductors		Yes	
9	Conductor cross section	mm^2	≥ 35	
10	**Option 1:** delivered with 1 specific wood screw fitting for fixing the support against masonry wall using plug (supplied)		☐ 	
11	**Option 2:** one corrosion protected Metric bold of 25 mm length minimum with washer and nut for fixing the support against metallic sheets.		☐ 	
12	Delivery		Bag or cardbox with 50 pcs	
FOR SAMPLE ONLY				
Supplier's offer column must be properly filled with the right figures. "Compliant, Yes, ", V , etc..." are not accepted.				

Deviation from the technical specification:

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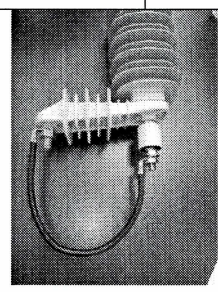
Bidder signature:

10.20 Flexible Indicator Leads for Surge Arrester

No.	Description	Unit	Requirements	Supplier's Offer
1	Country		to be specified	
2	Manufacturer		to be specified	
3	Manufacturer's Reference		to be specified	
4	Applicable Standard		To be specified	
5	Constituted of a length of conductor fitted with 2 x 90° tubular lugs		Yes	
6	Class of copper conductor		5	
7	black UV protected PVC insulation of 1000 V		Yes	
8	Copper insulated extra flexible conductor cross section	mm^2	25	
9	Length of conductor	cm	35	
10	Tinned copper tubular lugs		Yes	
11	Holes of lugs palm diameter	mm	≥12.5 ≤12.8	
12	90° lugs 		Mandatory	
13	Lugs hexagonally compressed onto the extra flexible insulated conductor. This shall be done at factory		Yes	
FOR SAMPLE ONLY				
Supplier's offer column must be properly filled with the right figures. "Compliant, Yes, ", V , etc..." are not accepted.				

Deviation from the technical specification:

The bidder shall list point after point and explain here in after all deviation from the requested technical specification.

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Full technical information shall be supplied within the bid. If not the offer shall not be considered

Bidder signature: