



The Kenya Power & Lighting
Co. Ltd.

TITLE:

**SPECIFICATION FOR
PORTABLE EARTHING
EQUIPMENT FOR 132KV
AND 220KV LINES AND
SUBSTATIONS**

Doc. No.	KPLC1/3CB/TSP/09/012
Issue No.	1
Revision No.	0
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0.1 Circulation List

COPY NO.	COPY HOLDER
1	Research & Development Manager
2	Supplies Manager
3	Stores & Stock Control Manager
4	Transmission Manager
5	Assistant Manager, Technical Audit

0.2 Amendment Record

Rev No.	Date (YYYY-MM-DD)	Description of Change	Prepared by (Name & Signature)	Approved by (Name & Signature)

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FOREWORD

This specification has been prepared by the Research and Development Department in liaison with the Energy Transmission Division both of The Kenya Power and Lighting Company Limited (KPLC) and it lays down requirements for Portable Earthing Equipment (CME) for 132kV and 220kV Lines and Substations. It is intended for use by KPLC in purchasing the equipment.

It shall be the responsibility of the manufacturer to ensure adequacy of the design and good engineering practice in the manufacture of the equipment for KPLC. The manufacturer shall submit information which confirms satisfactory service experience with products which fall within the scope of this specification

1. SCOPE

1.1 This specification gives Electrical and Mechanical requirements for Portable Earthing Equipment used for temporary earthing in high voltage substations and on transmission lines (132kV and 220kV).

1.2 The equipment specified comprises the following components:

- (a) Earth End Clamp.
- (b) Line End Clamp Type 1 for busbars tubes 38 to 76mm diameter.
- (c) Line End Clamp Type 2 for conductor's 6 to 38mm diameter.
- (d) Flexible conductor with terminations.
- (e) Glass Fibre Operating Poles complete with operating socket.

1.3 The equipment shall be purchased as complete kits or individual component when specified.

2. REFERENCES

The following documents were referred to during the preparation of this specification; in case of conflict, the requirements of this specification take precedence.

BSEN 1230: Live working-portable equipment for Earthing and short-circuiting.

BSEN 61138: Cables for portable Earthing and short-circuiting equipment.

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BS7454: Method for calculation of thermally permissible short circuit currents, taking into account non-adiabatic heating effects.

BEBS – S9: Specification for Portable Earthing Equipment for open Type High Voltage Apparatus in Substations.

IEC 60724: Short circuit temperature limits of electric cables with rated voltages of 1kV and 3kV.

3. TERMS AND DEFINITIONS

The definitions given in the reference standards shall apply.

4. REQUIREMENTS

4.1 Service Conditions

The portable Earthing equipment shall be suitable for outdoor use in tropical areas with the following atmospheric conditions.

Altitude: From sea level up to 2200m above sea level.

Humidity: High at the coast, up to 90%, and lower inland, up to 50%.

Temperature: Average ambient of +30°C with a minimum of -1°C and a maximum of +40°C.

Pollution: Heavy saline in coastal lands and generally clean air inland.

4.2 General Requirements

4.2.1 Portable earthing equipment shall permit safe earthing of electrical installations. The aim of earthing of disconnected parts of installations is for induced voltage dissipation and to prevent dangerous voltages and arcs arising from unintentional energising. An electric arc near an operator may cause death or severe burns.

4.2.2 The complete equipment shall withstand the maximum expected short circuit fault current during the selected fault time as detailed below:

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Table 1: Ratings

Category	Rating
Portable Earthing Equipment for Substations	17.5kA, for 2 seconds
Portable Earthing Equipment for Transmission Lines (220kV & 132kV)	14kA, for 1 second

4.2.3 The devices shall be able to withstand all stresses from the specified fault currents without causing electrical, mechanical, chemical or thermal danger to persons.

4.2.4 All the components shall be resistant to the levels of corrosion and physical handling stresses expected in service. The clamps shall be of a robust design to withstand rough handling and drops from heights in operations.

4.2.5 The complete kit shall be suitable for three pole earthing by use of single leads.

4.3 Earth End Clamp

4.3.1 The earth end clamp shall comprise:

- (a) A device for making electrical contact with the earth connection point i.e. earth rod assembly or steelwork as appropriate.
- (b) Operating screw for tightening (by hand) the device to the earth connection point.
- (c) A termination separate from the arrangement given in item (b) for attaching the earthing conductor to the device given in item (a).

4.3.2 The clamp shall be of the general shape and material details given in fig 1.

4.3.3 Each clamp shall be provided with a label to warn against its removal. The label shall have a means of being securely fixed to the clamp or earthing conductor and shall bear the words: "SAFETY ELECTRICAL CONNECTION – DO NOT REMOVE", marked legibly and indelibly.

4.4 Line End Clamp

4.4.1 The line end clamp shall comprise:

- (a) A device for making electrical contact with the overhead conductor/busbar.

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- (b) Operating screw for tightening the device on to the conductor/busbar. The operating screw shall be tightened by means of operating socket fitted to the fiberglass operating pole.
- (c) A termination separate from the arrangement given in item (b) for attaching the protective conductor to the device given in item (a).

4.4.2 The clamp shall be suitable for use in any position where it is necessary and appropriate to ensure earth continuity in any part of the electrical installation involving conductors/busbars.

4.4.3 The design of the clamp shall be such that its attachment to the conductor/busbar does not result in the inevitable deformation of the later. It shall slide smoothly onto the overhead conductor/busbar.

4.4.4 The clamps required in two sizes (for overhead conductors and busbars) shall be of the general shape and material details given in fig 2 & 3.

4.5 Flexible Cable with terminations

4.5.1 General

The cable shall be of low weight and flexible over a wide range of temperature.

The insulating covering shall offer protection against mechanical and chemical damage.

To increase the visibility of the Earthing device, the colour of the covering shall be orange.

The earthing cables shall withstand the specified fault currents in 4.2.2..

4.5.2 Construction

The cable shall be manufactured in accordance with IEC 61138.

The conductor shall be of circular cross – section made up of 0.46mm diameter commercially pure Aluminium wires. The covering of the cable shall be based on a compound of thermoplastic polyvinyl chloride suitable for indoor and outdoor use within -5°C to 70°C. The characteristics of the cables shall be as follows:

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Table 2: Characteristics of Earthing Cables

Category	Cable Type	Cross-sectional area (mm ²)	Conductor average outside diameter (mm)	Maximum diameter of wires in conductor (mm)	Average diameter of cable (mm)	Maximum conductor resistance at 20°C (Ω/km)
Portable Earthing Equipment for Substations	Al PVC	150	17.8	0.46	21.4	0.208
Portable Earthing Equipment for Transmission Lines (220kV & 132kV)	Al PVC	95	13.4	0.46	17	0.254

4.5.3 Cable Terminations

Cables shall be supplied complete with terminations ready for connection to line end and earth end clamps by use of single bolts.

Excellent fatigue resistance is required for the connections of cables to clamps. Terminations used shall obviate fraying of conductor strands and wear on protective PVC insulation. The general design of terminations shall be as indicated in fig. 4.

The connections shall ensure that the specified minimum characteristics of the cable are maintained. The cables shall be supplied complete with factory compressed terminals each with its stainless steel spring to protect the conductor ends.

4.5.4 Cable Lengths

The portable earthing equipment shall consist of cables of the following lengths:

- a) Transmission line earthing equipment: 12m, singles

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b) Substation earthing equipment: 6m, singles

4.6 Extensible Operating Poles

4.6.1 General

The Earthing pole and its couplings shall withstand the bending and torsion stresses produced by the load and the tightening forces. The deflection shall be minimised to avoid uncontrollable movements.

The Earthing pole shall be manufactured from glass reinforced epoxy resin and shall be rigid, strong, dimensionally stable, resistant to chemical action and light in weight.

The Earthing pole set shall comprise 1 bottom section, 2 intermediate sections and 1 top section. Each section shall be 1.22m length x 40mm dia.

All sections shall employ copper alloy 'press buttons' to ensure positive jointing. The top section shall incorporate a spigot to accommodate the operating socket. The operating socket shall be of light alloy material and essentially support the line end clamp when being carried at the end of an operating pole and also actuate the operating screw of the line end clamp when being secured in position or being removed.

The bottom section shall be supplied complete with rain shield as shown in fig 5

5. TESTS AND INSPECTION

5.1 The complete Earthing kit shall be inspected and tested in accordance with BS EN 61230. It shall be the responsibility of the manufacturer to perform or to have performed the tests specified.

5.2 The Earthing and short circuiting cables shall be inspected and tested in accordance with BS EN 61138. It shall be the responsibility of the manufacturer to perform or to have performed the tests specified.

5.3 Certified true copies of previous test reports by the relevant International or National Testing/Standards Authority of the country of manufacture (or ISO/IEC 17025 accredited laboratory) shall be submitted with the offer for evaluation (all in English Language). A copy of the accreditation certificate for the laboratory shall also be submitted.

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5.4 Routine test reports for the equipment to be supplied shall be submitted to KPLC for approval before shipment/delivery of the goods.

6. MARKING AND LABELLING

6.1. Markings shall be clearly legible, durable and consist of letters at least 3mm high. All markings shall be in the English Language.

6.2. Devices shall be marked with the following information:

- Manufacturer's name or trade mark.
- Model or type reference for the device.
- Cross-section in mm^2 , material and a double triangle symbol at 1m intervals on each cable.
- Year of manufacture.
- Rated current I_r (kA r.m.s) for rated time t_r (s) of the device (example 17.5kA/2s).

6.3. Manufacturer's instructions for use shall be submitted with the Tender. The instructions shall be in English language and be in accordance with BS EN 61230.

6.4. Portable Earthing Equipment for Transmission Lines shall be supplied complete with reinforced PVC carrying bag to provide protection of the equipment during transit as well as easing transportation in the field. Substation Earthing Equipment shall be supplied complete with a storage case.

FIGURES

- Figure 1 - Earth End Clamp.
- Figure 2 - Line End Clamp for 38-76mm diameter busbar tubes.
- Figure 3 - Line End Clamp for 6-38mm diameter conductor.
- Figure 4 - Cable termination.
- Figure 5 - Operating Poles.

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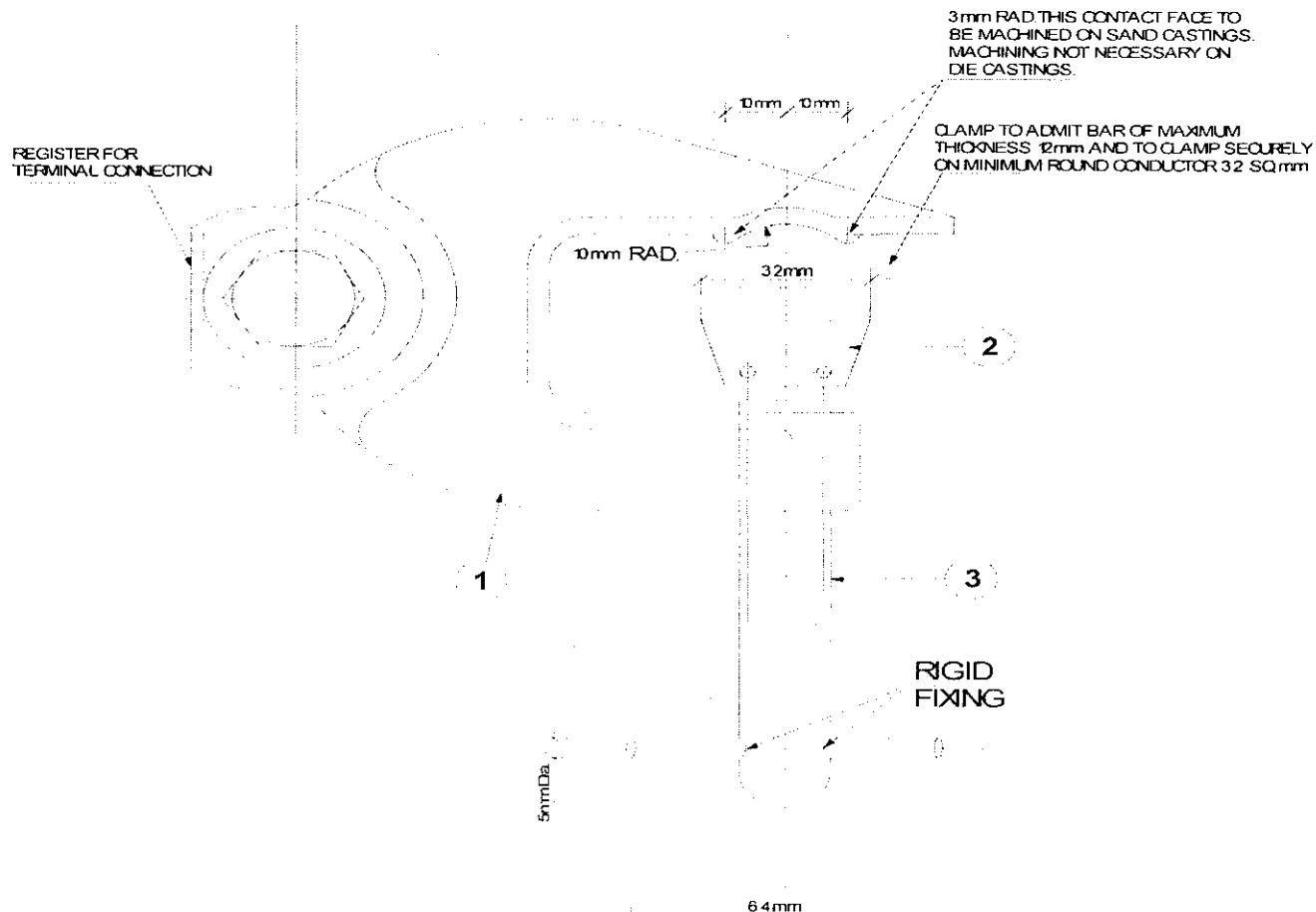
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Item	Description	Material
1	Clamp body	Aluminium alloy t o BS 1490
2	Rocker body	Aluminium alloy t o BS 1476
3	Operating screw 12mm	Stainless steel t o BS 970
-	Pin, bolt, nuts & washers	Stainless steel t o BS 970

Fig 1: Earth End Clamp - General Layout

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Drawn by: J. M. Kahare
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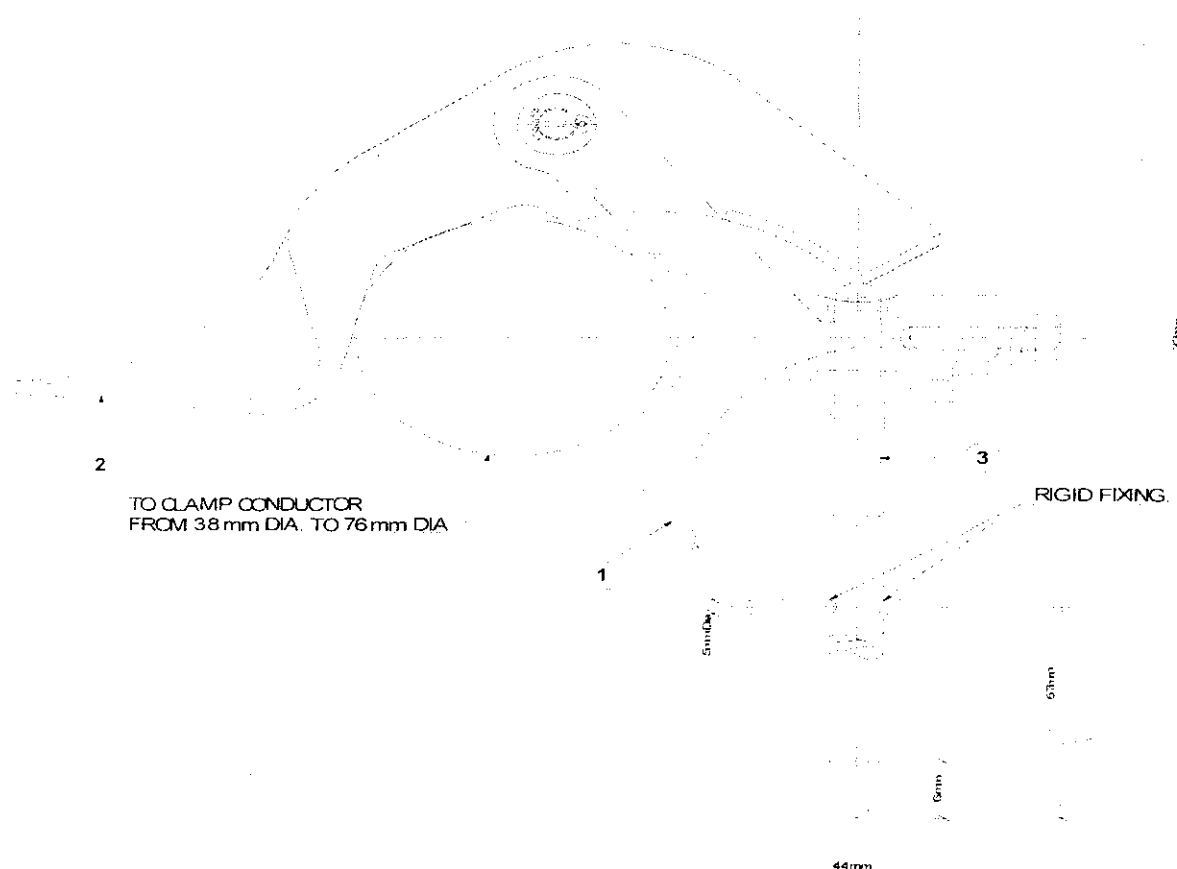
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Item	Description	Material
1	Clamp body	Aluminium alloy to BS 1490
2	Trigger	Aluminium alloy to BS 1476
3	Operating screw	Stainless steel to BS 970
-	Spindle, washers, split Pin & bolt	Stainless steel to BS 970

Fig. 2 :Line End Clamp 38 - 76 mm Dia. Conductor - General Layout

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Reviewed by: J. M. Kahane
Date: 2008-03-26

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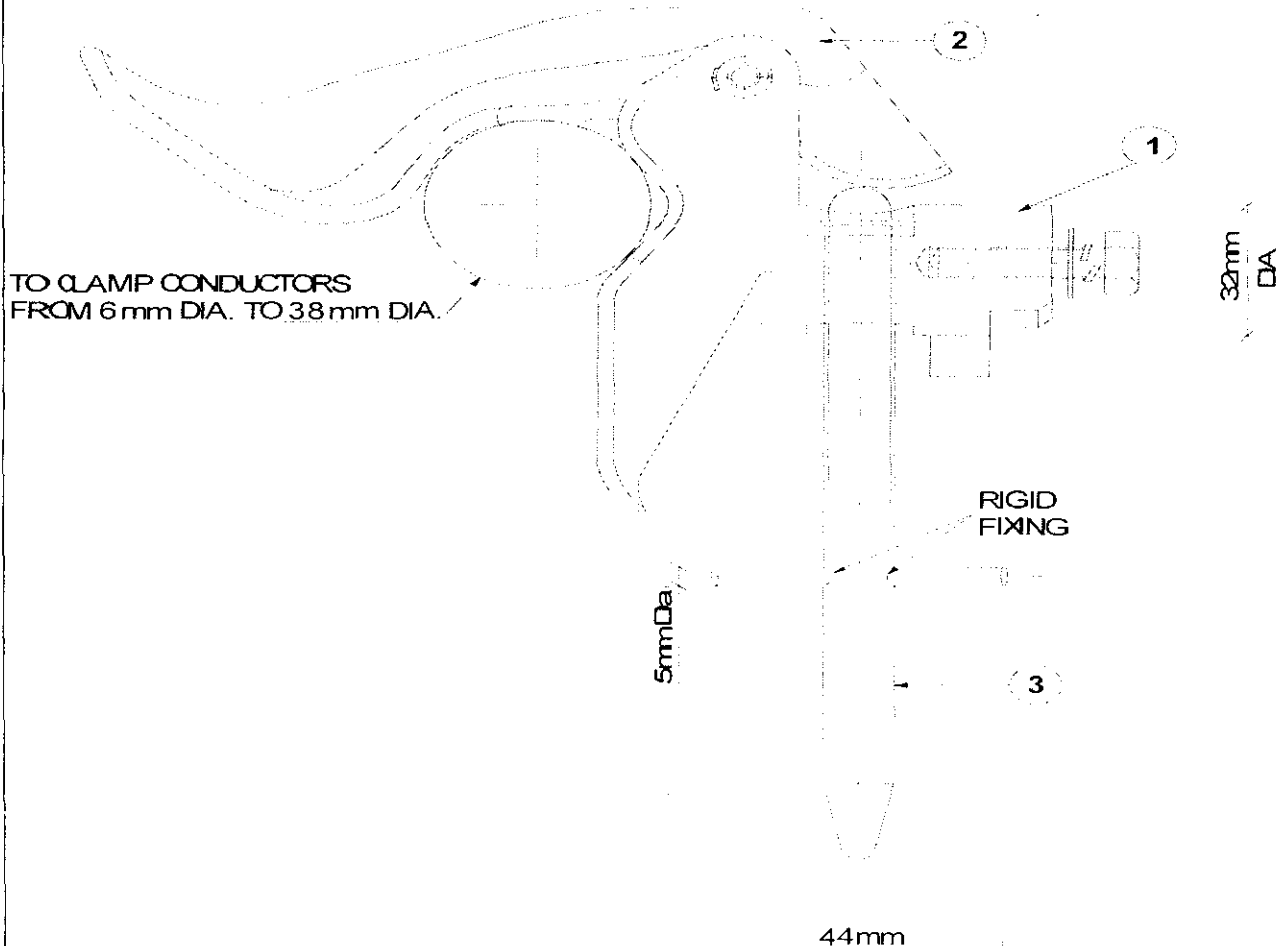
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Item	Description	Material
1	Clamp body	Aluminium alloy to BS 1490
2	Trigger	Aluminium alloy to BS 1476
3	Operating screw	Stainless steel to BS 970
—	Spindle, washers, split Pin, & bolt	Stainless steel to BS 970

Fig. 3 :Line End Clamp 6 - 38 mm Dia. Conductor - General Layout

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Drawn by: J.M. Kahare
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3 COMPRESSIONS (50 Ton Press or Equivalent)

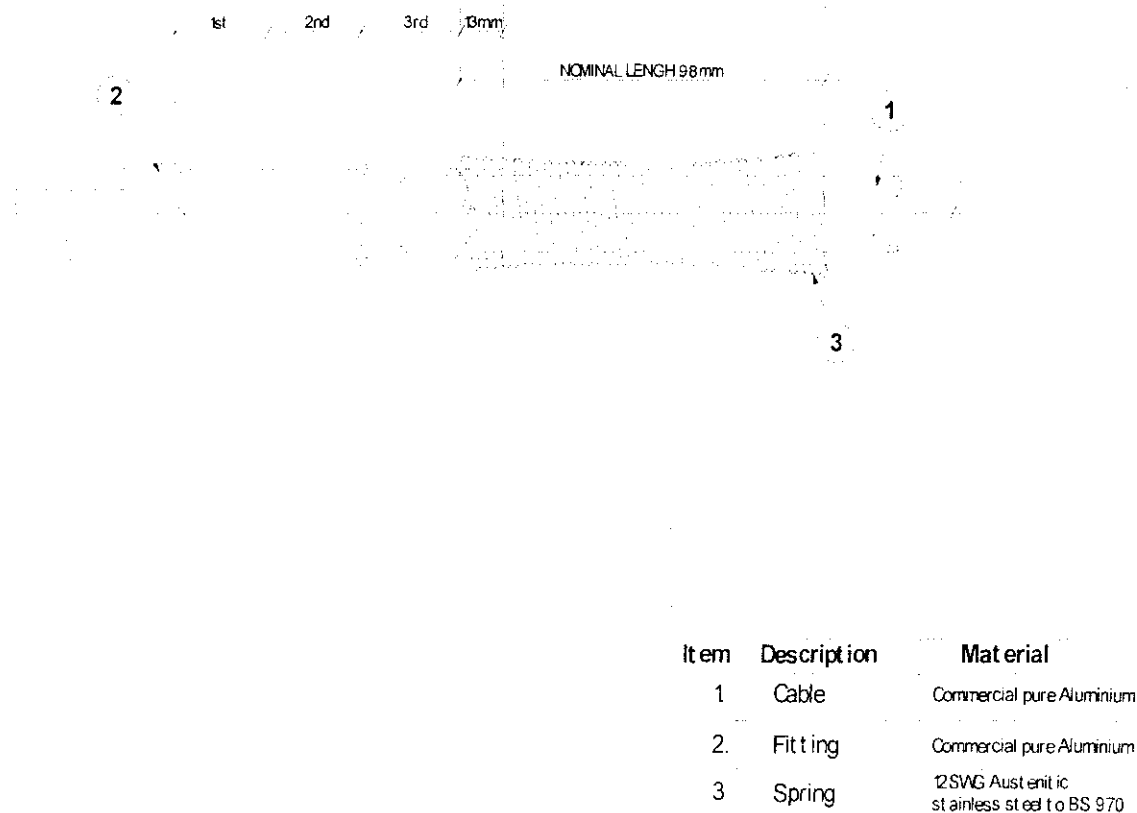


Fig. 4 :Cable Termination - General Configuration

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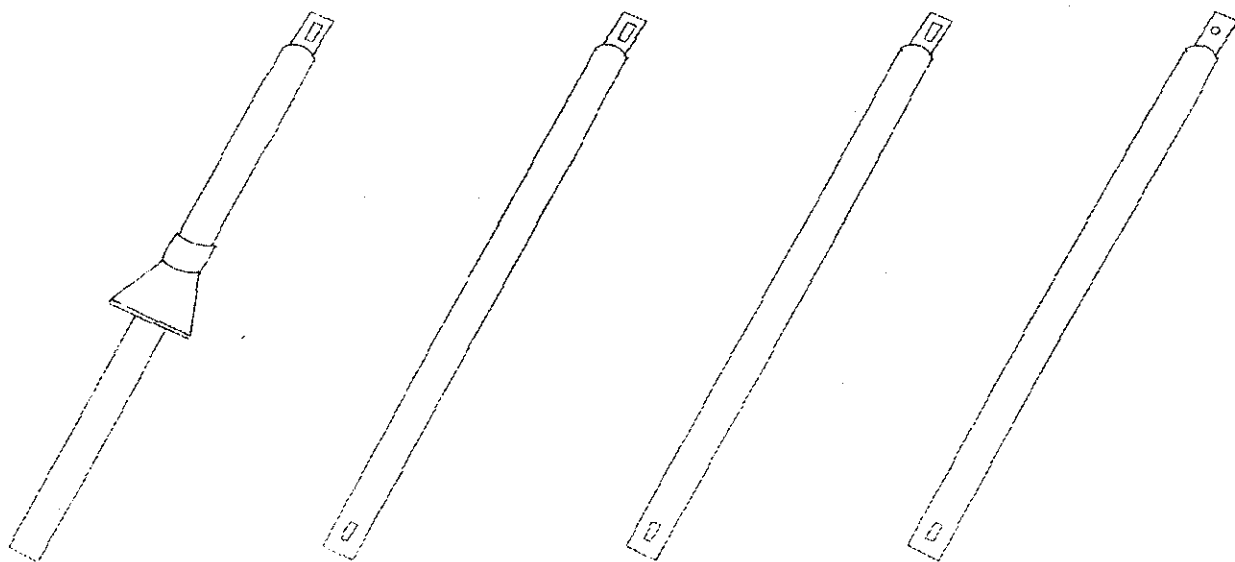
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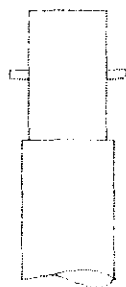
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TOP SECTION
TERMINATIONS



Spring clip

POLE HEADS



Earth clamp
operating head

Fig. 5 :Operating Poles & Pole Head - General Layout

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Drawn by: J.M.Kahare

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