CHAPTER 24 - AERIAL BUNDLED CONDUCTOR - POLICY AND DESIGNS

1. FOREWORD AND SCOPE

This chapter provides for policy, design and erection requirements, to plan LV ABC Networks. The Construction Procedures and Modules needed in building LV ABC Networks are covered in CP430 Part 1.

2. POLICY

2.1 General

Aerial Bundled Conductor shall be used for new LV Overhead lines and is the preferred method for all LV Overhead refurbishment work.

2.2 The aims of the Policy

To ensure that once a section of network has been converted to ABC no capital expenditure will be required for at least 10 years, and the maintenance expenditure will be reduced to minor works only (e.g. safety checks, inspections). The risk of specified events, and loss of supply will therefore be considerably reduced.

These aims will be achieved by the following:

(a) Replacement of the open wire conductor system with a completely insulated system constructed to a very high standard.

(b) Upgrading of all services to the concentric or ABC type.

(c) Replacement of all 'defective' poles, ensuring that those remaining are fit for purpose.

2.3 To achieve least lifetime costs and increased safety standards for ABC networks the following shall be carried out

(a) Change all open wire services to the concentric type for normal spans or ABC type for long spans. See Drg HQ.A4.51.09-386 and 387.

(b) Check all poles for signs of decay. Replace 'defective' poles where necessary.

(c) Replace all metal pole boxes with heat shrink terminations. See Drg HQ.A4.51.09-456.

2.4 Extensions and Diversions of open wire systems - not due for refurbishment

The long term aim is to convert the LV network eventually to ABC therefore all extensions and diversions will be carried out using ABC. However minor diversions to mains and services with the exception of the final service span, may be carried out using the existing conductor provided the following criteria are met. Work on the final service span shall always include replacement by an insulated service cable.

(a) The diversion requires one pole only and the conductors do not need to be lengthened.

(b) The required tree clearances can be achieved and maintained.

(c) The poles of the diversion are in good condition.

(d) The conductors to be diverted are in good condition and the complete section involved can be correctly regulated.

(e) Local planning permission cannot be obtained for replacing the bare open wire lines to ABC.

2.5 Targeting the parts of the LV network

The following criteria shall be used in prioritising parts of the LV network in need of refurbishment.

(a) Non-PVC conductors close to, or crossing buildings where the clearance is less than 3 metres.

(b) Damaged conductors, or copper spans that are badly regulated.

(c) Spans fitted with spacers or spans that clash.

(d) Where clearance over roads or tracks is less than 5.8 metres, or where high electrical loads have caused conductor clashing.

(e) Where tree clearance to the conductors is less than that stated in Chapter 15.

(f) Where more than 50% of the network contains poles which are 40 years old.

Note: The period stated above is for guidance purposes only, a full survey of the condition of the poles is necessary not just at ground level but throughout the full length of the poles prior to construction.

(g) Where the existing overhead line is close to high risk areas, i.e. schools, recreational sites etc.

Information collated on the Master Asset Management System (MAMS) Database during the Condition Data Capture (CDC) patrol shall be used to identify and grade the quality of the network and to plan the refurbishment programme.

2.6 Restrictions of use

An ABC network is an insulated system and therefore safer with respect to the general public than an open wire system. It is not considered to be an <u>all</u> <u>insulated</u> (i.e. double insulated) system and therefore its use as a Mural Wiring system is limited to situations in which the ABC bundle can be placed out of reach of a person who is 'ordinarily accessible' using scaffolding or ladders or any other construction.

In view of the above the use of ABC as a Mural Wiring system is problematic. Therefore its use is limited strictly to LV overhead distribution networks.

3. CONDITIONS OF USE

3.1 General

ABC is suitable for use in association with PME systems (4-wire) or conventional separate neutral earth systems (5-wire). However, with the fifth wire being a 25mm^2 aluminium conductor this reduced section fifth wire might not provide a low enough loop impedance for maintaining a separate earth in an SNE system.

3.2 Attachment of ABC to Poles

ABC attached to poles shall be generally in accordance with the arrangements illustrated in CP430 Part 1. All fittings supporting the ABC system shall provide an insulating barrier rated at 1000V between the core insulation and the mechanical attachment. The ABC shall be attached in such a manner that it does not make direct or inadvertent contact with any metalwork or stays. ABC shall not be attached to steel or steel reinforced concrete poles.

Line deviations of up to 90° are permitted using section poles. Intermediate suspension supports are limited to a maximum angle of 30° light angle, and 60° using heavy angle suspension supports. See Table 1.

This Code of Practice covers the requirements for single circuit lines, but this does not preclude the running of an additional circuit on the same poles. If designs of this nature are ever needed, the designer shall take due regard for the extra loadings involved when designing this type of double circuit line.

Table 1 - Angles of Deviations LV ABC

STAYED POLES
(unstayed poles - REFER TO TABLE 5)

Type of Construction	MAX Angle of Deviations (°)
Suspension Intermediate Pole HQ.A4.51.09-379 and HQ.A4.51.09-380	30
Suspension Intermediate pole HQ.A4.51.09-381	30 - 60
Section angle (Single eyebolts and Nuts) HQ.A4.51.09-382	0 - 20
Section angle (Two eyebolts and Nuts) HQ.A4.51 .09-383	20 - 90

4. BASIC DESIGN DATA FOR ABC

4.1 Mechanical Loading Details

This Standard is based on the following assumptions:

(a) The nominal tensile strength of the aluminium conductor is $170N/mm^2$.

(b) The average elastic limit of extension for the conductor material is 60% of the nominal tensile strength.

This Code of Practice uses a maximum design stress of 50 per cent of the elastic stress limit for service lines and 40 per cent in the case of four-core main lines. In both service and main lines, compliance with these stress levels occurs with the smallest ABC, for service lines this is the 2 core $35mm^2$. These conditions also permit reasonable access to the cores for the application of connections.

Common erection sag/span data is adopted for service lines and similarly for main lines, based on the criteria given above for maximum stress levels which are treated in the same manner. Where common tables are used, the worst case condition for $95mm^2$ x 4 core is detailed.

The tension of each size of ABC under design loading conditions is used for all stay and pole selection data. These figures having been derived using common mass/tension ratios at 10°C.

4.1.1 Individual Conductor Characteristics

Table 2

1	Nominal cross-sectional area of conductors (mm^2)	35	35	50	95
2	Number of cores	2	4	4	4
3	Ultimate tensile strength of conductor based on $170N/mm^2$ (calculated) (kN) As Main As Service	2.85 3.55	5.7 7.1	8.1 10.2	15.5 19.4
4	Ultimate tensile strength of bundle (calculated) (kN)	11.3	22.4	30.4	61.2
5	Modulus of Elasticity of conductor (hbar)	5900	5900	5900	5900
6	Coefficient of linear expansion (°C)	23×10^6	23×10^6	23×10^6	23×10^6
7	Minimum bending radius of bundle (mm)	175	207	236	312
8	Minimum bending radius of single core (mm)	86	86	98	129

4.2 Electrical Loading Details

4.2.1 Individual Conductor Characteristics

Table 3

1	Nominal cross-sectional area (mm^2)	35	35	50	95
2	Number of cores	2	4	4	4
3	Maximum dc resistance of conductor in bundle at 20°C (n/m)	868	868	641	320
4	Maximum ac resistance of conductor at 75°C (n/m)	1060	1060	783	392
5	Star resistance of bundle at 50Hz (n/m)	86	86	83	80
6	Zero sequence impedance of bundle 50 Hz and 75°C (n/m)	2120 +j86	4240 +j372	3130 +j365	1570 +j348
7	Maximum continuous current-carrying capacity per phase at 75°C (25°C ambient) Design Parameter (A)	113*	117	143	228
7a	at (20°C Ambient) Summer (A)	118*	123	150	239
7b	at (9°C Ambient) Spring/Autumn (A)	129*	134	164	262
7c	at (2°C Ambient) Winter (A)	136*	141	172	275
8	Maximum continuous conductor temperature (°C)	75	75	75	75

* These values are related to a maximum conductor temperature of 50°C.

4.2.2 Application of the Loading Details

(a) Refurbishment of Existing Lines

The following sizes of ABC will be used to replace existing conductors

MAIN FEEDERS

0.05sq in	}	}	}
0.06sq in	}	}	}
0.075sq in	} copper	}	}
0.lsq in	}	}3 or 4 wire	}replace with }95mm^{2}x 4 core
50mm^2	}	}	}
100mm^2	} Aluminium	}	}

SPURS FROM MAIN FEEDERS TO 7 OR MORE CUSTOMERS
Replace with 95mm^{2}x 4 core

POLE TO POLE SERVICES
Replace with 35mm^2 x 4 core or 2 core

These guidelines will depend very much on the local network loadings, and the economics of taking an additional drum to site to reconductor a small number of spans.

(b) New Work

MAIN FEEDERS - and SPURS	95mm^2 x 4 core

Note: Spurs off 5 wire systems must be 5 wire spurs.

4.3 Design of individual schemes

4.3.1 General

Before attempting to design the individual components of any ABC scheme it is essential that a preliminary investigation of the existing network is carried out, in order that the following points can be clarified.

4.3.1.1 Check the conditions of the supports and stays in accordance with approved procedures.

4.3.1.2 Check the clearances listed in section 7. These two checks will enable the structure of the new network to be decided upon. Bear in mind during this preliminary planning that you are not replacing the old network but constructing a new one based on the highest possible standards. Therefore if parts of the existing system are patently in the wrong position, do not hesitate to use a different route even if this means applying for a new Section 37 consent.

Other considerations which can now be incorporated into the plan.

4.4 Conductors

Not only the conductors at transposition poles are to be considered but also any tee off lines on the proposed ABC route. It may not be advantageous to refurbish the whole tee off with ABC but it is desirable at least to change the first span so that the integrity of the insulated system is maintained at the tee off pole.

4.5 Sectioning Points

The designer shall take due regard for Electricity North West Limited(Electricity North West) operational working policy for Dead working and therefore Link Boxes or Fuses shall be installed in positions so that in the event of making sections of ABC Dead the least number customers are effected by the loss of supply.

4.6 Tier Type or Inverted Pole Boxes (4 Core PLSTS Cable)

These boxes will be replaced by a new pole length tail of Waveform cable and a heat shrink termination. This will provide an insulated pole top arrangement in every instance. The Waveform cable to ABC termination is covered in the appropriate Module.

4.7 Tier Type Poles (CONSAC)

These boxes will be replaced by a heat shrink termination.

4.8 Calculations

4.8.1 Calculations of Pole Heights

4.8.1.1 Ground Clearances

Minimum ground clearance = 5.2m
Road clearance = 5.8m

4.8.1.2 Clearances to buildings and structures

When clearances to buildings and structures are considered reference shall be made to section 7 of this document and Chapter 15.

Chapter 15 gives the existing clearances required where insulated conductors are in situ. It shall be noted that where non-PVC conductors exist the insulation shall be in good condition to be considered as insulated. If the braided jute has deteriorated to a frayed condition exposing the paper insulation the conductor shall be considered as bare. If existing bare or non-PVC conductors are to be left in situ there clearances to buildings shall comply to Chapter 15 or ABC shall be installed.

Drg No HQ.A4.51.09-337 shows the clearances required for ABC as set out in section 7.

How to calculate the clearances

(a) Measure or calculate the distance from the ABC route (normally this will be the existing open wire route).

(b) Select from Drg HQ.A4.51.09-407 the maximum sag for the span in question. (Note: If building or structure is not in mid span the maximum sag can be decreased nearer the pole as calculated from below):

DISTANCE FROM OBSTRUCTION TO POLE	PERCENTAGE OF DESIGN SAG(Z)
MID SPAN	100
0.25 x MID SPAN-POLE	94
0.50 x MID SPAN-POLE	75
0.75 x MID SPAN-POLE	44
POLE	NIL

(c) Decide if deflection of the bundle is a factor to be considered.

(d) Measure from the bundle under maximum sag and deflection if appropriate to the nearest point of the building or structure.

A simple way to obtain the above data on site would be to run a polypropylene rope or similar from the proposed fixing points at each end of the span. Sag as Drg HQ.A4.51.09-407. Deflect if necessary and measure clearance.

4.8.1.3 Clearances to Other Lines

When clearances to other lines are considered reference shall be made to section 7 of this document and Chapter 15.

The only lines were crossing are permitted with the ABC in the upper position are LV and BT. To carry out the crossing calculation bear in mind that the design parameters are that the upper HV line is at maximum sag (i.e. 50 or 75°C) and the ABC is unenergised and therefore could be at minimum sag (-6°C).

Data regarding the position of the HV conductors at maximum sag can be obtained from the relevant HV line profile.

Consideration shall be given to undergrounding the overhead line section at all HV crossing points.

4.9 Calculations of the Diameters

4.9.1 Unstayed Poles

The maximum angle of deviation that can be taken by any pole is given in Drg HQ.A4.51.09-430.

4.9.2 Stayed Poles

The value of the angle the stay makes with the pole (angle ∅) has a tremendous effect on the diameter and class of pole to be used. The smaller the stay base, the smaller angle ∅ becomes and greater is the strut loading imposed on the pole resulting in large diameter poles being required.

Under no circumstances will stayed poles have stay bases that produce an angle ∅ of less than 20° and this shall be regarded as the absolute minimum stay angle. It is preferable that this angle be as large as possible but not more than 45°.

Table 6 gives the value of angle ∅ for various stay bases and pole heights.

A typical calculation for calculating a stay pole would be as follows:

10.5m pole; Stay base 3.5m; Terminal pole.

From Table 6 stay angle ∅ between 20° and 25°; Terminal equal to 60° line deviation; and from Drg HQ.A4.51.09-464.

= 2 No stays
Pole diameter - STOUT.

RELATIONSHIP BETWEEN STAY BASE AND ANGLE ∅ LV ABC LINES

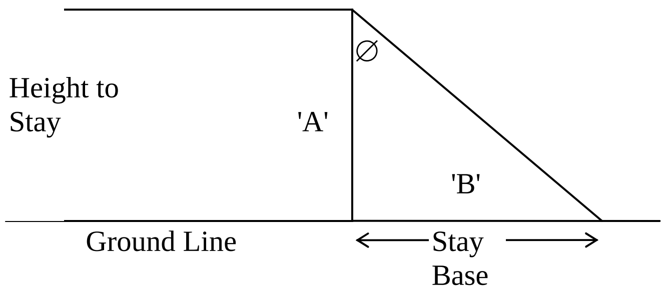


Table 6 - New Metric Poles

Pole Length	Distance (m)		Angle	Pole Length	Distance (m)		Angle
(m)	A	B	∅	(m)	A	B	∅
8.5	7.0	2.55	20	11.0	9.5	3.46	20
	7.0	3.27	25		9.5	4.43	25
	7.0	4.04	30		9.5	5.48	30
	7.0	4.90	35		9.5	6.65	35
9.0	7.5	2.73	20	11.5	9.7	3.53	20
	7.5	3.50	25		9.7	4.52	25
	7.5	4.33	30		9.7	5.60	30
	7.5	5.25	35		9.7	6.79	35
9.5	8.0	2.91	20	12.0	10.2	3.71	20
	8.0	3.70	25		10.2	4.76	25
	8.0	4.62	30		10.2	5.89	30
	8.0	5.60	35		10.2	7.14	35
10.0	8.5	3.09	20	13.0	11.2	4.08	20
	8.5	3.96	25		11.2	5.22	25
	8.5	4.91	30		11.2	6.47	30
	8.5	5.95	35		11.2	7.84	35
10.5	9.0	3.28	20	14.0	12.2	4.44	20
	9.0	4.20	25		12.2	5.69	25
	9.0	5.20	30		12.2	7.04	30
	9.0	6.30	35		12.2	8.54	35

Table 6 - Existing Imperial Poles

Pole Length (ft)	Distance (m) A	Distance (m) B	Angle ∅	Pole Length (ft)	Distance (m) A	Distance (m) B	Angle ∅
28	6.19	2.55	20	38	8.94	3.28	20
	6.19	2.89	25		8.94	4.17	25
	6.19	3.57	30		8.94	5.16	30
	6.19	4.33	35		8.94	6.26	35
30	6.8	2.47	20	40	9.55	3.48	20
	6.8	3.17	25		9.55	4.45	25
	6.8	3.93	30		9.55	5.51	30
	6.8	4.76	35		9.55	6.69	35
32	7.41	2.70	20	42	10.15	3.69	20
	7.41	3.45	25		10.15	4.73	25
	7.41	4.28	30		10.15	5.86	30
	7.41	5.19	35		10.15	7.11	35
34	8.01	2.92	20	45	11.07	4.03	20
	8.01	3.74	25		11.07	5.16	25
	8.01	4.62	30		11.07	6.39	30
	8.01	5.66	35		11.07	7.75	35
36	8.62	3.14	20	48	11.98	4.36	20
	8.62	4.02	25		11.98	5.59	25
	8.62	4.98	30		11.98	6.92	30
	8.62	6.04	35		11.98	8.39	35

Notes:

1. Metric poles assume point of attachment at 150mm below pole head.
2. Imperial pole assume point of attachment at existing neutral (850mm below pole head).

5. CONSTRUCTION OF THE BUNDLE

5.1 Conductors

The conductors are compacted, circular, stranded aluminium and the individual wires used in the construction are to Material 1350 in the H9 condition as specified in BS 2627. Successive layers of wires have opposite directions of lay, the outermost layer being right-handed.

5.2 Insulation

The conductors are insulated with extruded cross-linked polyethylene.

The insulation is coloured black and has a carbon black content not less than 2 per cent by weight.

5.3 Identification of Cores

The individual phase cores are identified as indicated in Drg No HQ.A4.51.09-440 by 1, 2 or 3 longitudinally continuous raised ribs.

The raised ribs have a nominal base width of 1mm and a nominal separating distance of 1mm. The minimum rib height is 0.5mm.

The surface of the neutral is lightly ribbed continuously along its length with a minimum of 16 ribs spaced evenly around the circumference of the core. The nominal height of these ribs is 0.25mm and the actual number of width of the ribs is left to the discretion of individual manufacturers.

The cross sectional area of the earth wire of a 5 wire bundle is 25mm^2. The surface of this earth wire is completely smooth and is easily identified from the other conductors with respect to its size.

5.4 ABC Markings

The identification of the Manufacturer is shown by a colour identification thread, applied beneath the insulation of at least one conductor. Alternatively a name tape is applied between the insulation and the strand of at least one conductor.

5.5 Sealing and Drumming

After the test at Works, both ends of every length of the bundled conductors are sealed to prevent the ingress of moisture. This shall be achieved by the use of mastic-lined heat-shrink end caps fitted over the ends of individual cores or by other approved means.

In addition, both ends of every length of the assembled bundle is temporarily bound in such a manner to prevent the cores from separating.

The ends of the 4-core/5-core bundle are identified by a red tape to indicate that end where the sequence of core identification is 1, 2, 3 in a clockwise direction and with a green tape to indicate the end where the sequence is anti-clockwise. See Drg HQ.A4.51.09-440.

The minimum dimensions and maximum weights of all drums are as follows to ensure fitment and road clearances when mounted in the ABC drum trailers. It shall be noted that 500 metres of 4 x 95mm^2 + 1 x 25mm^2 weighs approximately 1100kg and therefore it shall only be installed using the Two tonne trailer.

One Tonne Trailer

Max. weight of any drum shall not exceed 1000kg. Max. drum dimensions 1.8m high x 1.02m wide

Two Tonne Trailer

Max. weight of any drum shall not exceed 2000kg. Max. drum dimensions 2.2m high x 1.22m wide

Drum lengths will only be purchased in 500 metre lengths to avoid overloading of the One tonne trailer. However if longer lengths of ABC are needed the manufacturer shall be consulted to verify the weight of the drum being purchased. In any event no drum shall be purchased weighing over the limit of the Two tonne trailer.

Cable drums shall be suitable to take a round spindle and shall be lagged to protect the cable from damage. The end of the bundle projecting from the drum shall also be protected.

Each drum shall bear a distinguishing number either branded or chiselled on the outside of the one flange. Particulars of the bundle, ABC, i.e. number and size of conductors, voltage, length, gross and net weights shall be clearly shown on one flange of the drum, together with the direction of rolling.

The drum shall be generally be in accordance with Electricity North West Limited's (Electricity North West) Electricity Specification 400C7: Specification for Returnable Cable Drums for Mains Cables.

5.6 Individual Conductor Details

Table 8

1	Nominal cross-sectional area of conductors (mm^2)	35	35	50	95
2	Number of cores	2	4	4	4
3	Number of conductors	compacted circular stranded			
4	Nominal number of wires in conductor	7	7	19*	19*
5	Diameter of conductor: Minimum (mm) Maximum (mm)	 6.6 7.5	 6.6 7.5	 7.7 8.5	 11.0 12.0
6	Minimum average thickness of insulation (mm)	1.3	1.3	1.5	1.7
7	Maximum diameter of core (excluding ribs) (mm)	10.7	10.7	12.2	16.1
8	Calculated maximum diameter of circumscribing circle of assembled bundle (mm)	21.9	26.2	29.5	39.0

* - subject to a tolerance of + one wire

4 x 95mm^2 + 1 x 25mm^2 (5 wire ABC) details the same as 4 x 95mm^2 ABC.

6. SPANS AND SAGS

6.1 Basic and Maximum Spans

Basic spans used for determining sags and tensions as follows:

Main lines	50m
Service line	70m pole to pole
	50m pole to house

Maximum spans are as follows:

Main lines	90m
Service line	70m pole to pole
	50m pole to house

Note: For service lines the basic and maximum spans are the same to allow the use of single spans of maximum length without infringing the design criteria.

6.2 Erection Data

Main and service lines shall be erected in accordance with Table 8 using the dynamometer and temperature gauge as set out in the tensioning and terminating procedures.

6.3 Design Sag Data

Design sag data for determining main line and service line clearances, are given in Tables 9b, 9c and 9e.

6.4 Tension Release Devices (TRD) and Weak links

When sections of the line pass through mature trees and there is a possibility that branches will fall onto the bundle, a tension release device will be fitted behind the anchor clamp as shown on Drg No HQ.A4.51.09-384

The criteria for fitting the device will be as follows:

1. Up to 3 spans - A TRD fitted at one end of section.

2. Over 3 spans - A TRD fitted at each end of section.

Note: A running section can be introduced to facilitate the extra TRD if required.

If very heavily wooded areas are encountered and there is a definite possibility of trees falling on the ABC line, weaklings are available and can be fitted to intermediate poles at the discretion of the designer.

The following tables 9A to 9E contain Temperature/Tension data LV ABC.

Table 9A - ABC Erection Data

Temp (°C)	* 35mm² ABC (2 CORE)	35mm² ABC (4 CORE)	50mm² ABC (4 CORE)	95mm² ABC (4 CORE)
	Tension (kgf)	**Tension (kgf)**	**Tension (kgf)**	**Tension (kgf)**
-6	66.1	132.2	349.9	650.8
0	64.8	129.5	312.6	581.0
5	63.7	127.4	287.9	534.9
10	62.7	125.3	267.6	497.0
15	61.7	123.3	250.6	465.3
20	60.8	121.5	236.2	438.5
25	59.9	119.7	223.8	415.4
30	59.0	118.0	213.0	395.4

Table 9B - Design Sag Data 50 & 95mm² x 4 Core ABC (Full Tension)

Spans (m)	40	45	50	55	60	65	70	75	80	85	90
Hot 75°C	0.88	1.11	1.37	1.65	1.97	2.31	2.68	3.08	3.5	3.95	4.43
Cold -6°C	0.36	0.45	0.55	0.67	0.8	0.94	1.09	1.25	1.42	1.6	1.8

Table 9C - Design Sag Data 35mm² x 4 Core ABC and 35mm² x 2 Core (Full Tension)

Spans (m)	20	25	30	35	40	45	50	55	60	65	70
Hot 75°C	0.25	0.39	0.56	0.76	0.99	1.25	1.54	1.87	2.22	2.61	3.02
Cold -6°C	0.20	0.31	0.44	0.60	0.79	1.00	1.23	1.49	1.77	2.08	2.41
***Hot 50°C**	0.23	0.36	0.52	0.71	0.93	1.18	1.45	1.76	2.09	2.46	2.85

* For 2 Core 35mm² ABC service cable between poles ONLY. For pole to house erection and design data refer to tables 9D and 9E respectively.

Table 9D - 2 Core 35mm^2 ABC Erection Data (Reduced Tension)

Temp	* 35mm^2 ABC (2 Core)
(°C)	Tension (kgf)
- 6	23.5
0	23.2
5	22.9
10	22.6
15	22.4
20	22.1
25	21.9
30	21.6

Table 9E - Design Sag Data 35mm^2 x 2 Core ABC (Reduced Tension)

Spans (m)		30		35		40		45		50	
* Hot 75°C		1.41		1.91		2.50		3.16		3.91	
* Cold -6°C		1.24		1.69		2.21		2.80		3.46	

* For 2 core 35mm^2 ABC service cable between pole and house ONLY. For pole-to-pole erection and design data refer to tables 9A and 9C.

7. CLEARANCES

7.1 General

The clearances given in this Clause shall be regarded as minimum values and consideration shall be given to the local circumstances which may require that increased clearance is provided. For the purpose of evaluating clearances, the sags at the maximum operating temperature of 75°C will be used. (See Tables 9B and 9C, Section 6). For ABC services the maximum operating temperature will be 50°C. (See Table 9E, Section 6).

To aid the designer and linesman to evaluate clearance problems associated with LV lines refer to Drg HQ.A4.51.09-470.

7.2 Ground Clearances

The following minimum ground clearances shall apply.

Table 10A

Location	(m)
High Load Routes	6.9
Motorway Crossings *	8.2
Other Roads	5.8
Farm Tractor Roads +	5.8
Operational Railways (See Chapter 15)	7.3
Parks and Recreational Areas	5.8
Other Locations not involving vehicle access	5.2

* Refer to overhead lines engineer before carrying out work.

\+ Roads and tracks regularly used by agricultural machinery.

7.3 Clearances to Building and Structures

When determining clearances the following conditions shall be considered appropriate, sags at the maximum working temperature of 75°C and angular deflection of 30°. Deflected conditions need not be considered if the span is effectively shielded from wind by a building or structure.

The minimum clearances in Table 10B below shall apply:

Table 10B

Location **(see Drg. No. HQ.A4.51.09-337 for clarification)**	**Clearance (m)**
The minimum vertical clearance of ABC to any surface or structure which is accessible without access equipment.	3.0
The minimum horizontal distance of ABC to any surface or a building or structure which is not accessible without access equipment.	1.0
The minimum clearance to parts of a building or structure not normally accessible.	0.5
The minimum clearance between ABC and free-standing apparatus such as street lighting columns, traffic signs, British Telecom poles or columns.	0.3
The minimum clearance between ABC and any scaffold and access equipment. Structure Work Platform Clearance to ABC attached to pole.	 0.5 3.0 4.3

7.4 Clearances to Other Lines

The following minimum clearances shall apply under the maximum and minimum sags given in Table 9B, 9C and 9E in section 6.

Table 10C

Type of Line Crossing	**Minimum Clearance(m)**	**Type of Line Crossing**	**Minimum Clearance(m)**
LV Open Wire	1.0 +	132kV	2.7
11kV	1.8	275kV	3.7
33kV	2.0	400kV	4.4

+ Increases to 1.25 if ABC is the upper line.

HV Lines shall always be crossed with the LV ABC span lowermost. Under no circumstances will ABC cross over HV or EHV lines as tension limiting devices fitted to the ABC will allow the bundle to drop below the design clearance.

Consideration shall be given to undergrounding the ABC at all HV crossing points.

7.5 Trees

Where an ABC system is erected through trees four main points shall be considered, these are:

(a) Risks of the ABC abrading on trees.

(b) Sag variations and windage.

(c) The effect of wind and snow loading on trees or branches bearing onto the ABC.

(d) The danger of trees providing unauthorised climbing access to the ABC.

Drawing No. HQ.A4.51.09-385 gives guidance on the above aspects which shall be considered and shows how to measure the clearance windows. In order to give guidance to linesmen the following 'rule of thumb' shall be applied. No mature branch or tree trunk allowed inside the window. A mature branch is one whose diameter at likely point of contact is greater than 20mm (a little finger). Any branches of fir or similar trees outside of window but under snow weight could come into contact with the ABC will be removed.

Where unauthorised access is a potential problem such as areas where fruit trees, sweet or horse chestnuts exist, or any trees close to the ABC route in Parks and Recreational areas, the following additional precautions shall be taken.

1. Ensure branches below the ABC which would allow the conductor to be touched are cut, or

2. Remove branches from ground level that could aid climbing.

8. SUPPORTS

8.1 General

8.1.1 All main line pole diameters will be designed for 95mm^2 x 4 core + 1 x 25mm^2 core with factor of safety of 2.5. Service line (pole to pole) supports shall be at least medium class.

8.1.2 All strut poles, all unstayed angle poles which do not equate to a medium pole, poles with outrigger brackets and angle/terminal poles with stay outrigger brackets, will be changed where possible or resited using single poles.

8.1.3 All poles (whether dated or not) will be excavated at ground line and checked for external and internal decay. If the pole is sound at ground line it will be checked for rot up to the pole top.

8.1.4 Any poles that have evidence of rot but have sufficient residual strength to remain in service shall be treated with boron rods at rot level. (See Drg. HQ.A4.51.09-468.) Details of when the pole has been boron rod treated shall be entered into MAMS.

8.1.5 Where a pole is covered by 8.1.1 to 8.1.4 and could be removed completely but services are attached, consideration shall be given to re-routing services or using a service distribution pole fed by a span of 35mm^2 ABC from the nearest convenient mains pole.

8.1.6 All existing poles which are to be re-used in-situ will be checked for 'plumb' and re-aligned where necessary.

8.1.7 All redundant holes left by the removal of the old fittings shall be 'plugged' using creosoted plugs.

8.2 Unstayed Angle Poles

Existing poles that conform to 8.1 or new poles may be considered for use as unstayed angles with or without services.

Drg. No. HQ.A4.51.09-430 indicates the maximum angle of deviation that can be adopted on a single pole with a kicking block. Table 11 details the calculation of line angles using the triangulation method.

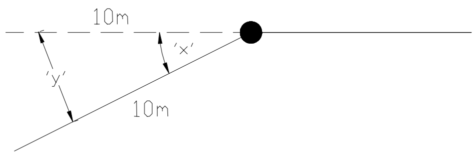
8.3 Safety Signs

All poles shall be fitted with 2 no. safety signs. The signs shall be positioned approximately three metres above ground line in the most prominent position.

METHODS OF DETERMINING ANGLES OF LINE DEVIATION

Table 11

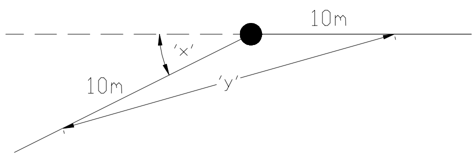
Method A



METHOD A

1. Measure 10m along route of line, place sighting rod.
2. Measure 10m along projected route, if no deviation place sighting rod.
3. Measure between rods, check chart to determine angle of deviation.

Method B



METHOD B

1. Measure 10m in both directions from pole along direction of the line.
2. Place sighting rods at 10m.
3. Measure in a straight line between rods. Refer to chart to determine angle.

Method A Length 'y' (m)	**'x' (deg)**	**Method B Length 'y' (m)**	**Method A Length 'y' (m)**	**'x' (deg)**	**Method B Length 'y' (m)**
0.87	5	19.98	8.45	50	18.13
1.74	10	19.92	9.23	55	17.74
2.6	15	19.83	10	60	17.32
3.47	20	19.7	10.75	65	16.87
4.33	25	19.53	11.47	70	16.38
5.18	30	19.32	12.18	75	15.87
6.0	35	19.07	12.86	80	15.32
6.84	40	18.79	13.51	85	14.75
7.65	45	18.48	14.14	90	14.14

9. STAYS

9.1 General

Approval has now been granted to install the following Stay Systems :-

1. Augered stay rod system. (Preferred method)
2. Duckbill stay anchoring system. (LV only)
3. Excavated stay rod with wooden or concrete holding blocks
4. Rock Anchors.

Installation of the above Stay systems is covered in CP430 Part 1. General requirements for the installation of ABC stays are given in the appropriate Module.

9.2 Stays Requiring No Excavation

Duckbill Anchors, Screw Anchors and Rock Anchors require no excavation therefore it is essential that these Stay Systems are used in preference to the Wooden and Concrete Blocks to reduce land damage and therefore claims from landowners and tenants.

9.3 Stay Bases

In most cases ground conditions will be suitable for Duckbill, Screw Anchor or Rock Anchor systems, however if holding capacity cannot be obtained, Wooden or Concrete Blocks will have to be used. In all cases stay bases shall be designed for the requirements of 95mm^2 x 4 core + 1 x 25mm^2 core and in no circumstances will the stay angle ∅ be less than 20°.

Stays will generally installed in accordance with the following table.

Table 12

Number of Stays	Angle ∅	Maximum Angle of Deviation
One	20°	34°
One	30°	55°
One	35°	67°
One	45°	90°
Two	20°	65°
Two	25°	86°
Type of Stay	7/4.00mm^2 Grade 1150 Stay Wire with stay systems 1, 2 or 3 of section 9.1	

Notes:

1. An easy site measurement of Angle ∅ is shown in Table 6.

2. Terminal poles are equivalent to 60° angle of deviation.

9.4 Existing Stays

Any stay rods showing signs of corrosion shall be replaced.

9.5 Stay Insulators

All stays shall be fitted with an approved insulator in accordance with the recommendation given in CP430 Part 1.

9.6 Out of Balance Stays

At transposition poles it may be necessary to plant an additional stay to counter act the outer balanced loads.

10. SAFETY

10.1 General

An ABC network is an insulated system and therefore safer in respect of the general public than in open wire system. It is not considered to be an all insulated (i.e. double insulated) system and therefore ABC shall not be accessible to the general public, or attached to buildings. Drg No HQ.A4.51.09-337 and HQ.A4.51.09-336 shows the minimum clearance parameters for buildings and street furniture and will be used at all times.

When selecting sites for ABC systems it shall be borne in mind that to the general public the ABC system is not readily identified as an electricity overhead line. Therefore, the chance of accidental damage to the ABC bundle and fittings maybe greater than with an open wire system.

Great care shall be exercised when running the ABC bundle through trees to limit the danger of the trees providing unauthorised climbing access to the ABC. Installing ABC through trees without observing the tree clearance is obviously a potential danger therefore it is essential that trees are cut back to the values shown on Drg HQ.A4.51.09-385

Furthermore all LV poles shall have 2 x Danger of Death signs installed in the most prominent locations as a warning against the potential dangers of an overhead line.

All ACDs if needed, shall be in good condition and be of the correct type to prevent unauthorised climbing.

10.2 Building Work in Proximity to ABC

The same rules for building work being carried out in proximity to open wire LV lines applies to ABC as the system is not fully insulated, except the clearances can be reduced as set out in section 7, Table 10B.

Proximity protection shall be used in all locations where building work infringes on the safety clearances given in section 7.

10.3 Live Work at the Pole Top

10.3.1 When the existing open wire mains are still Live and the ABC is Dead.

(a) Where the ABC can be worked on safely outside of a 'touching zone' to open wire conductors, the work will be considered as Dead Line Working.

(b) Where the ABC cannot be worked on safely in proximity to the open wire conductors, the following equipment shall be used and the requirements of CP423 shall be adhered too.

1. Rubber gloves

2. Pole rescue equipment

3. Shrouds to cover the open wire within the 'touching zone'.

10.3.2 General Requirements for all Live Work at the Pole Top

Rubber gloves shall always be worn when working on the bundle in any circumstances.

On no account shall linesmen rely on the insulating properties of the bundle when carrying out checks and inspections. Rubber gloves shall always be worn.

11. SERVICES

11.1 Concentric Neutral Services

Single phase services will be 35mm^2 Aluminium or 25mm^2 Copper CNE or SCNE cables with a maximum aerial flight of 30 metres. Three phase services will be 25mm^2 Aluminium 3 phase CNE or SCNE cable with a maximum aerial flight of 20 metres.

Street Lighting services will be 4mm^2 CNE or SCNE cable with maximum span of 15m.

Services erected pole to pole will be ABC if the span lengths exceed the above maximum flights. In this case, the maximum span lengths will be restricted to 70m.
(See Drg HQ.A4.51.09-387).

The erection sag/tension data for the pole to pole service span lengths for 2 core 35mm^2 ABC is included in Table 9A, Section 6. The erection sag/tension data for CNE and SCNE are covered in Table TBA.

11.2 Aerial Bundled Conductor (ABC) Services

11.2.1 General

In those instances where a maximum aerial flight would exceed 30 metres for single phase services and where the consumer has refused permission for erection of a service pole on their property, two core ABC 35mm^2 service may be considered. The ABC service will be terminated at both the pole and the consumers' property using light duty anchor clamp and service screw hook (See Drg HQ.A4.51.09-387). The plan angle that the ABC service makes with the screw hook shall not exceed 45° either at the pole or on consumers' property. The sag/tension regime of this cable is such that restriction of span length will normally be due to ground clearance, the maximum aerial span length therefore being limited to 50 metres.

Details of the erection sag/tension data is included in Table 9D. It will be noted from Table 9E which gives the design sag/tension data that with a maximum span length of 50 metres, the maximum design sag is almost 4 metres. Due to this excessive sag, it will not be possible in most cases to use the 50 metres maximum span length unless a tall pole is used for the aerial flight.

For pole to pole service spans, the 4 core anchor clamp can be used. In this case, the cores will be fitted to the ports adjacent to the clamp side plates (i.e. not diagonally). Although not shown on drawing HQ.A4.51.09-398 a suspension clamp for 35mm^2 4 core cable can be used for 2 core cable if two short 'dummy' lengths of 35mm^2 conductor are additionally installed in the clamp.

As ABC is not an effectively insulated system, it is not permissible to use the ABC as a lead-in to the meter position.

In view of this restriction, the concentric neutral cable will continue to be used for mural cabling and lead-ins to the consumer's meter. A Heat shrink Breakout kit will be used to connect the ABC service flight to the concentric neutral cable. This joint will be suspended beneath and as close to, the consumers 2 core ABC service anchor clamp as is reasonably practicable. (See Drg HQ.A4.51.09-389)

11.2.2 Service Stays

Dependent on the strength of the pole or soil will determine the maximum number of unstayed services permitted.

Where the service pole strength or soil types is unsuitable for use as an unstayed structure, one 7/4.00mm^2 stay will be suitable for the out-of-balance tension in the direction of the long, pole to pole service span.

11.3 Connections

A maximum of 2 No Single phase or 1 No 3 phase Service connections are permitted at any one pole. The connections shall be equally spaced and fitted either side of the pole this is to limit the number of neutral connections.

Typical service arrangements can be seen in Drgs HQ.A4.51.09-399, HQ.A4.51.09-400 and HQ.A4.51.09-401 etc.

When services are initially installed from ABC, it shall be established if there is a reasonable possibility that more than four connections (i.e. two single phase services or one three phase service) will be needed in the future. If this is the case, a Distribution Box shall be fitted initially (see Drg HQ.A4.51.09-408 and HQ.A4.51.09-417).

The phase to which a service is connected will be identified by a coloured tag fitted over the phase core. Details of the connections to the bundle are given in the appropriate Modules.

Where two services are required in adjacent properties (i.e. semi-detached houses), one service can be provided directly (as Drg HQ.A4.51.09-386) whilst the other service concentric neutral cable can be jointed using the 3M 'Under Eaves Connection Box' joint. (See Chapter 23.)

Only one such teed service can be so connected, where electrical loading permits.

11.4 Distribution Box

This is a plastic weatherproof box for mounting on poles using coach or wood screws and washers. It provides the facility for connecting (and disconnecting) up to six phase and neutral conductors. (9 No. for the G.E.C. Henley Box.) The connectors in the box will be supplied by a short length of 95mm^2 or 50mm^2 ABC which will enter the bottom of the box through the small holes provided. These tails can be fitted in at ground level.

Single phase services will enter the box via the bottom. All services will be made off in the box and a 'putty seal' shall be applied to all service cables. All bare wires of CNE and SCNE cables shall be shrouded using Black Sleeving before connection to the terminal block.

The box will contain a label warning that once energised, the phase connector block covers shall only be removed one at a time, other than for testing only, due to the close proximity of an adjacent phase.

The standard position for the distribution box is 500mm below the bundle.

11.5 Distribution Poles

Where several cross road services exist or where service route obstructions exist, it may be found convenient to install a Service Distribution Pole supplied by 50mm^2 x 4 core ABC. In some cases, back stays may be required.

11.6 Concentric Cable Crutch Seals

All concentric cables at the pole top will have a heat shrink crutch seal applied (except in Distribution Boxes). Refer to the appropriate procedure for applying the crutch seals.

11.7 4mm^2 Concentric Cables

Street furniture service cables will be sealed with the same components and using the same method described in 11.6.

11.8 Service Disconnection/Reconnection

Services connected via a Distribution Box are easily disconnected/reconnected in the normal way.

For both concentric and ABC 35mm^2 services connected directly to the ABC, the method of disconnection is to cut the phase core(s) 150mm from the connector this will normally be on the service side of the cable tie, if not an additional cable tie shall be fitted. A waterproof 'push on' seal shall be fitted over both ends of all cut cables. Reconnection is achieved by connecting the phase core to the 'live' stub using a compression splice.

12. CONNECTIONS TO THE BUNDLE

The main method of making a branch connection to ABC is by Insulation Piercing Connectors (IPC). These fittings are all insulated, contact is made by tightening down the clamping bolt(s) until the shear head caps break(s). It is essential that only an approved torque wrench is used for this procedure.

It is important to note that when using twin bolt connectors, both bolts shall be tightened gradually in turn to keep the two halves of the fitting parallel. Only two connectors on the neutral and earth conductors per pole are permitted. IPCs shall be arranged equally each side of suspension clamp.

12.1 Mains Connections

One Twin Bolt IPC shall be used for connecting mains branch phase connections All neutral connections will be carried out using two Twin Bolt IPCs.

12.2 Service Connections

All service cables will be converted to ABC before connections are made to the bundle. This can be done either by ordering specific lengths of 'tailed out' connectors or by making up tailed out lengths on site to suit individual needs.

The conductor for making up these tailed out lengths will be completely smooth (i.e. no ribs) this is to avoid the use of the wrong ribbed conductor being used on the wrong phase or neutral.

Phase connections will be made using single bolt IPCs ensuring where possible that a phase balance is maintained on the main. Phase colour identification tags or tapes are to be fitted to the service to help in this and for future reference. The tail shall be fitted right through the connector to a distance of 50mm, this will provide an additional test position by removal of the push on end cap.

The neutral on a 3 phase service will <u>always</u> be connected using <u>two</u> single bolt IPCs.

As soon as a service is connected, a polarity check shall be made at the cut-out. In addition to a polarity check being made at every service, a random amount of Impedance checks shall also be carried out and a note of the readings obtain shall be handed over to the Engineer in charge of the works. Impedance values are given in the appropriate Module. If for any reason the readings obtained are higher than the values given in the Module, action shall be taken to reduce the value of earth impedance and further readings shall be taken.

12.3 Securing Service Conductors to the Bundle when IPCs are used

In order to ensure that the unsupported conductors are not subject to wind vibration and subsequent strand fracture the branch conductor shall be secured to the bundle using wrap lock ties.

12.4 Shrouding of ABC Service Cable

As ABC is not an effectively insulated cable, shrouding shall be applied to the bundle whenever a consumer requires to work within 3m of the bundle.

13. CONNECTION OF EQUIPMENT

Note: The designer shall bear in mind Electricity North West's policy for working Dead, Code of Practice 606, System Operations, when choosing equipment to be installed to control/protect the ABC network for the operation of that network.

13.1 Link Box

A Link Box (or Bonar Long fuses) may be fitted at normal open points, Main Tee Off positions, Service Distribution Boxes and at sections where frequent disconnection is anticipated. The principle of the box is shown on Drg HQ.A4.51.09-410, 411 and 412. The Main neutral will always bypass the box, the neutral connection for the Link Box will be via 2 No. double bolt IPCs.

A minimum 16mm^2 insulated earth wire shall be run down the pole from the ABC bundle to the base of the pole and connect to an earth electrode. A test position shall be provided at approximately 3 metres in this earth wire. If 5 core ABC is to be used it is essential that an electrode is fitted to all poles having Link Boxes or fuses to provide an earthing facility for the 5th core of the ABC (i.e. earth wire).

Link Boxes are best fitted approximately 1.0 metre below the bundle attachment but above 4.3 metres but no higher than 7 metres.

The link box is fitted with a lid which can be set to indicate the following:

(a) Lid showing black only - box is running closed with links or fuses inserted.

(b) Lid showing black with green band - box is running open and links are not making contact (i.e. links not fitted).

(c) Black lid fitted with orange tag on one side. Box is earthed on the side indicated by the tag showing the network on this side is shutdown for dead work under the safety rules. A Caution Notice will be fitted under the earth bar and will also be an indication that work is taking place. A Danger Notice will be fitted to indicate that Live connections are present on the pole and to show the limits of the work.

13.2 Pole Boxes

All underground cables terminated on a ABC system will be concentric, consac or waveform. The arrangement of the termination will be as follows:

13.2.1 Concentric

Single and three Phase Cables will be terminated as described in section 14.2.3.

13.2.2 Consac

(a) Terminated in metal tier type pole box - Remove and dispose of metal tier box and run new Waveform Cable and install a link box for disconnection purposes.

(b) Existing heat shrink termination. Install a link box or fuses for disconnection purposes.

Waveform

Only 95mm^2 and 185mm^2 cables will be terminated on poles. A typical termination using a link box or fuses is shown on Drg HQ.A4.51.09-413 and Drg HQ.A4.51.09-414.

The following ABC Tails will be used:

(a) When the bundle is feeding the cable
95mm^2 Waveform - 95mm^2 ABC Tails
185mm^2 Waveform - 95mm^2 ABC Tails

(b) When the Waveform is feeding the bundle only 95mm^2 ABC Tails to be used.

13.2.3 Conventional PLSTS Cables

These cables to be cut at base of the pole and a new length of Waveform Cable with a standard termination jointed in. Install a link box or fuses for disconnection purposes.

13.3 Transformer Poles

When ABC is erected at a transformer pole, it will be connected directly into the pole mounted fuses. ABC will also be used from the LV fuses to the PMT LV connections. The neutral core of the ABC main will be removed from the bundle just above the fuses and taken straight to the neutral stem of the PMT. In addition a separate neutral will be installed from the neutral stem of the transformer to a test/earth position installed in accordance with Drg. number HQ.A4.51.09-416.

If a Link Box is to be used instead of Bonar Long type fuses the neutral connection is directly to be installed from the transformer to the Link Box.

When it is felt necessary due to the considerable congestion of the pole above the LV fuse a length of plastic cable guard can be fitted to protect the ABC from constant abrasion by ladders.

Where 100kVA and 200kVA transformer poles have multiple feeds of both ABC and cables consideration shall be given to splitting the fusing arrangement by addition of a further set of fuses. When this is done the individual feeds shall be connected to the fuse contacts by a maximum of two lugs. The leads from the transformer to the fuses will be of the following sizes:

All other sizes	-	95mm^2 ABC
100kVA Three Phase	-	1 x 95mm^2 ABC
200kVA Three Phase	-	2 x 95mm^2 ABC or 120mm^2 PVC/PVC copper conductor.

When 2 sets of LV Fuses are installed they shall be positioned one set on one side of one limb and the other set on the other side of the same limb and both labelled with circuit information.

13.4 Balancers

Before reconnection the Engineer in charge of the work shall confirm the balancer is still required.

Before attempting a reconnection, check that the neutral fuse is of the correct size and is not blown. If no fuse fitted check with Engineer that this is correct.

The phase and neutral connections shall be made off to the Balancer bushings using compression lugs.

A minimum 16mm^2 PME Earth Electrode shall be run at all Balancer positions.

13.5 Regulators

Connection of regulators to a ABC system is covered in the appropriate Module.

A minimum 16mm^2 PME Earth Electrode shall be run at all Regulator positions

14. EARTHING

14.1 General

No fusible cut-out, circuit breaker or switch is to be included in the supply neutral conductor.

In view of the importance of avoiding the possibility of an open circuit in the supply neutral conductor, it is essential to pay particular attention to its integrity through the design, construction, maintenance and operation of the ABC distribution system.

Compression joints, duplicate connectors or other suitable connectors (e.g. for Aerial Bundled Conductors) shall be used on overhead lines at all points of connection between copper neutral conductors, e.g. at section poles and at service connections. Where the supply neutral conductor is aluminium, compression joints only shall be used except on Aerial Bundled Conductor where connectors satisfying ENA Technical Specification 43-14 shall be permitted. Connections made to the ABC bundle are covered in the appropriate Modules.

14.2 Conversion of earthing systems considerations

When converting 3 phase 4 wire systems to PME, all overhead sections of associated main and any other main likely to be used as an alternative supply, between the supply substation and the connection to the customer being offered PME, shall be brought to PME standards.

Additional neutral earth electrodes may be required at intervals along the line in order to maintain the neutral to earth impedance below the required 20 ohms. It is found that neutral earth electrodes installed at intervals not greater than 8 spans will generally achieve this figure. (See Drg HQ.A4.51.09-459.)

On poles supporting cable terminations, the sheaths and metallic termination boxes shall be bonded to the neutral conductor.

The undergrounding of sections of 3 phase 4 wire overhead systems by CNE cable or the replacement by 4 wire Aerial Bundled Conductors presents no additional hazards and the network can retain or be modified to PME.

On overhead networks containing continuous earth wires (CEW) when the 5 wire sections are replaced by CNE cable, or 4 wire ABC, it is preferable for all existing SNE customers to be converted to PME provided their earthbonding is brought up to PME standard. However, existing SNE customers connected to each CNE or 4-wire ABC insert may retain their SNE earth provided there are additional earth connections to the neutral downstream of the last SNE customer by means of earth electrodes and/or sufficient length of SNE cable which shall give an overall impedance of 10 ohms or less in line with CP332. Existing customers beyond the CNE or ABC insert may retain their SNE earth provided the earth is connected to a sufficient length of SNE cable so as to give an impedance of 10 ohms or less. An additional requirement is that at the junction of the 5 wire system and the CNE or ABC section, the neutral of the CNE or ABC shall be bonded to the neutral and earth of the 5 wire system and an earth electrode installed. (See Drg HQ.A4.51.09-460.)

Where none of these solutions can be applied a 4 core metallic sheathed cable or separate earth conductor shall be installed. The sheath or earth conductors shall be connected to the CEW earth conductor at each end with the neutral and earth remaining separate.

It may be desirable to use 4 x 95mm^2 + 1 x 25mm^2 (5 wire ABC) due to the cost of PME bonding of the consumers installation. If this method of distribution is adopted the above rules apply and earthing of both the neutral and earth shall be carried out in accordance with Drg. HQ.A4.51.09-460. Also, with the reduced cross-section fifth wire calculations shall be carried out to ensure that there is a low enough loop impedance for maintaining a separate earth in an SNE system.

14.3 Neutral Earths

When an existing neutral earth is located at the transformer pole the connection to the neutral of the bundle will be made as described in the appropriate Module. The neutral conductors will be left unbroken.

Before any existing neutral earth is reconnected, the resistance value will be measured and if found to be an excessive value remedial work shall be carried out to bring the resistance of the neutral earth to a level of other neutral earths on the system.

14.4 PME Electrodes

When an existing open wire network is converted to ABC many of the existing electrodes will become redundant. The position of most of the new electrodes will be predetermined by the policy to fit electrodes at the following positions:

(a) All mains cable terminations.

(b) Link Box and Fuse positions.

(c) Balancers.

(d) Regulators.

(e) Transformers.

(f) Source Electrodes.

(g) End Electrodes.

(h) Existing Neutral Earths

14.5 Safety Earthing

As ABC is an insulated system it is important that provision is made to earth down the bundle at strategic points. The position of these earth points will be as follows:

(a) At Mains cable terminations.

(b) Transformer LV fuses.

(c) At a Link Box.

In addition to the above an earth position can be installed anywhere along the length of the ABC by means of a special earthing IPC and portable earthing kit connected to all conductors of the ABC.

This kit contains a portable earth lead which to enables the bundle to be earthed down at these points. Details of how the earthing IPC is fitted is covered in the appropriate Module.

15. OPERATING AN ABC NETWORK

15.1 Feeder Arrangements

It is not intended that the ABC Networks shall be run differently from existing open wire systems. The following best practices will be adopted.

15.1.1 Linked Systems (more than 1 transformer) 3 Phase.

(a) Fuses only at Transformer feeding continuously to open point at Link Box.

(b) Supplies at both sides of the link box shall be in-phase.

15.1.2 Linked System (more than 1 transformer) 2 x 2 wire (Two Phase)

(a) Fuses only at transformer feeding continuously to open point at Link Box.

Note: A 4 core bundle can be used with a two phase transformer (split phase). The phase connections of the transformer shall be connected to the Red phase (1 rib) and Blue phase (3 ribs). The Yellow phase (2 ribs) will not be connected and will remain unenergised. Compression End caps shall be installed to each end of the yellow phase conductor. This provision shall be indicated on the records showing only two phases are energised, with the other phase conductor remaining Dead and not connected to any live conductor. If for any reason it is felt that 2 x 2 core bundles are needed which are to be used instead of the 4 core bundle, both neutral/earth conductors of the 2 core bundles shall be connected directly to the neutral/earth on the transformer. (See Drg. HQ.A4.51.09-471.)

(b) Supplies at both sides of the link box shall be in phase.

15.1.3 Feeding a single Phase spur from the Bundle.

The spur will be refurbished with either 2 x 35mm^2, 2 x 50mm^2, 2 x 95mm^2 or 4 x 95mm^2 + 1 x 25mm^2 ABC.

15.2 Linking Adjacent Systems

When the condition set out in sections 15.1.1 and 15.1.2 have been met the Link Box or Fuses can be used to back feed an adjacent network providing the continuous current per phase does not exceed 200A.

16. PRE-INSULATED WATERPROOF ABC FITTINGS

16.1 General

A range of waterproof fittings has been developed which provide greater protection from the elements, simplicity of installation and obviates the necessity of re-insulation operations at the pole.

Although full tension fittings are available it is not good practice to install full tension mid span joints on new construction work. **<u>The use of mid span joints shall be limited to fault repair only.</u>**

16.2 Fittings available

The new fittings, currently purchased, include the following:

(a) Pro-insulated, non-tension transition connectors which can be used at all section positions where disconnection is not required.

(b) Pre-insulated copper and aluminium palmed lug suitable for 12mm and 20mm studs. These fittings can be used for terminating ABC at LV fuse positions and transformer bushing interfaces.

(c) Pre-insulated end seal for capping ends of ABC cores.

(d) Pre-insulated full tension connector which can be used for joining ABC mid span positions, fault repairs or removal/replacement of ABC sections and for all non-tension applications where there is no size transition. (See 16.1 above.)

(e) Non-tension connector ABC/bare copper or aluminium conductor, available as a compression splice at both ends or with a bare pre installed tail. These fittings can be used where ABC is provided to interface with an existing copper or aluminium open wire LV line.

(f) A range of fittings suitable for extending service cables which ensures final connections to the bundle is ABC to ABC.

16.3 Compression Tooling

All the above fittings are installed using approved hand operated compression tool with hexagonal dies.

In the event of tool malfunction, the tool supplier shall be informed and the tool returned to them. An annual inspection/adjustment of all tools shall be undertaken to ensure the tool is crimping effectively. This inspection shall include all 'dies'; if any die shows signs of wear they shall be disposed of and a new set obtained.

16.4 Installation Procedure

It is essential that the procedures laid down in the Modules are adhered to, to ensure that the integrity of the ABC waterproof insulation is maintained.

17. ASSOCIATED DRAWINGS

I-420-1.15-005-11-1	Clearance from LV conductors to lighting standards. Source ENA TS 43-8.
I-420-1.15-006-11-1	Minimum clearance of ABC systems to buildings and structure. Source ENA TS Drg No. 431221.
HQ.A4.51.09-379	ABC intermediate support up to 30° line deviation.
HQ.A4.51.09-380	ABC intermediate support inside angle support up to 30° line deviation.
HQ.A4.51.09-381	ABC intermediate support up to 60° line deviation.
HQ.A4.51.09-382	ABC section support angles 0° - 20° line deviation.
HQ.A4.51.09-383	ABC section support angles 20° - 90° line deviation.
HQ.A4.51.09-384	ABC terminal support.
HQ.A4.51.09-385	The clearance window for ABC.
HQ.A4.51.09-386	CNE services.
HQ.A4.51.09-387	ABC service spans.
HQ.A4.51.09-389	ABC attachments to buildings.
HQ.A4.51.09-398	ABC service connection (single phase).
HQ.A4.51.09-399	ABC service connection (three phase).
HQ.A4.51.09-400	CNE service connection (single phase).
HQ.A4.51.09-401	CNE service connection (three phase).
HQ.A4.51.09-402	SCNE service connection (single phase).
HQ.A4.51.09-403	SCNE service connection (three phase).
HQ.A4.51.09-404	Open wired service connections (single phase).
HQ.A4.51.09-405	Open wired service connections (three phase).
HQ.A4.51.09-406	Street lighting service connection.
HQ.A4.51.09-407	Pole height selection chart.
HQ.A4.51.09-408	Distribution box.
HQ.A4.51.09-410	ABC to open wire connection with link box.
HQ.A4.51.09-411	ABC link box on section pole.
HQ.A4.51.09-412	ABC link box fuses and links.
HQ.A4.51.09-413	ABC pole box with link box.
HQ.A4.51.09-414	ABC pole box with LV fuses.
HQ.A4.51.09-416	PME electrodes.
HQ.A4.51.09-417	ABC distribution box service connections.
HQ.A4.51.09-430	Unstayed angle poles permitted angles.
HQ.A4.51.09-440	Cutting and capping ABC.
HQ.A4.51.09-443	Connecting ABC conductors to section poles.
HQ.A4.51.09-453	Inspection and testing of wood poles.
HQ.A4.51.09-456	3 core waveform pole top termination.
HQ.A4.51.09-459	PME earth requirements for 4-core waveform to 4-core ABC.
HQ.A4.51.09-460	PME earth requirements when 5-wire sections are replaced by 4-core ABC.
HQ.A4.51.09-464	Stayed angle pole selection chart (95 ABC FOS 2.5).

HQ.A4.51.09-468	Installing boron rods.
HQ.A4.51.09-470	ABC clearances.
HQ.A4.51.09-471	ABC connection to a 2 - phase transformer.

18. DOCUMENTS REFERENCED

18.1 Electricity North West's Distribution Safety Rules.

18.2 CP332: LV Service Connections & Application of PME.

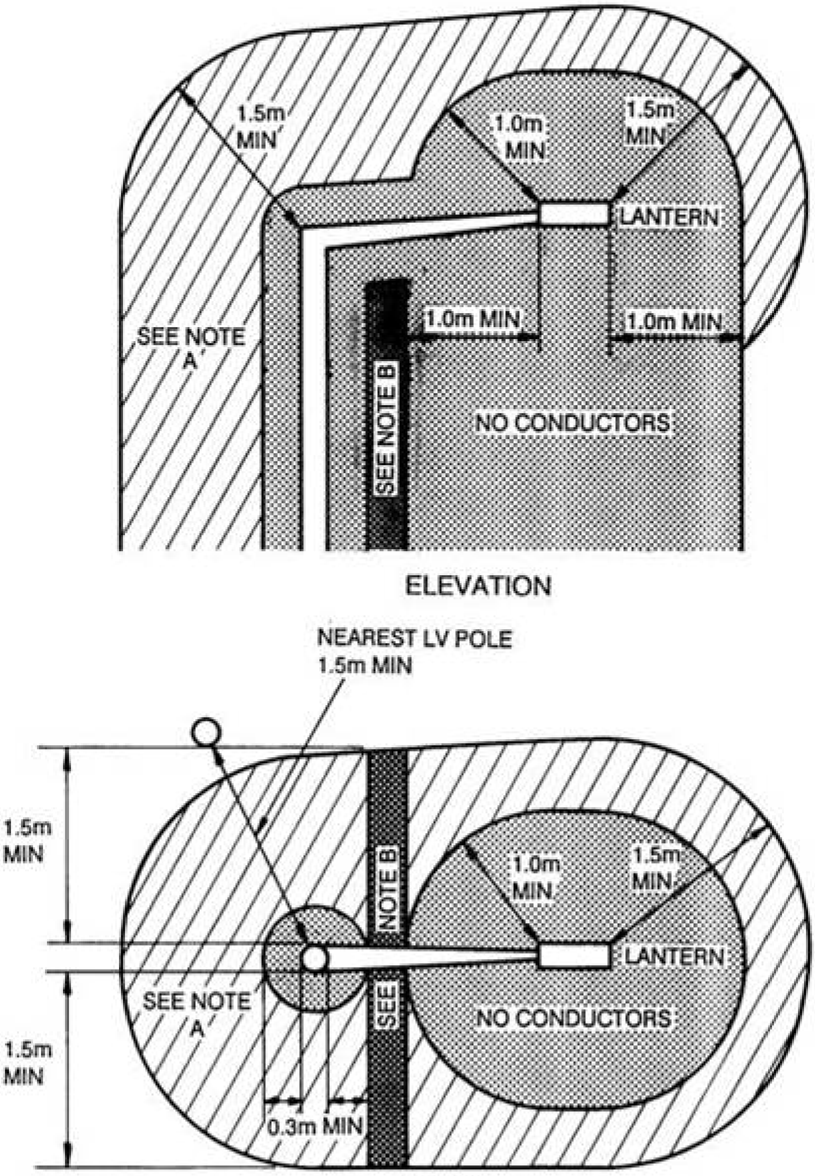
18.3 CP423 Overhead Line - Linesman's Manual, Live Line Working.

18.4 CP430 Part 1 Overhead Line - Linesmen’s Manual, Wood Pole.

18.5 ES400C7: Specification for Returnable Cable Drums for Mains Cables.

19. KEYWORDS

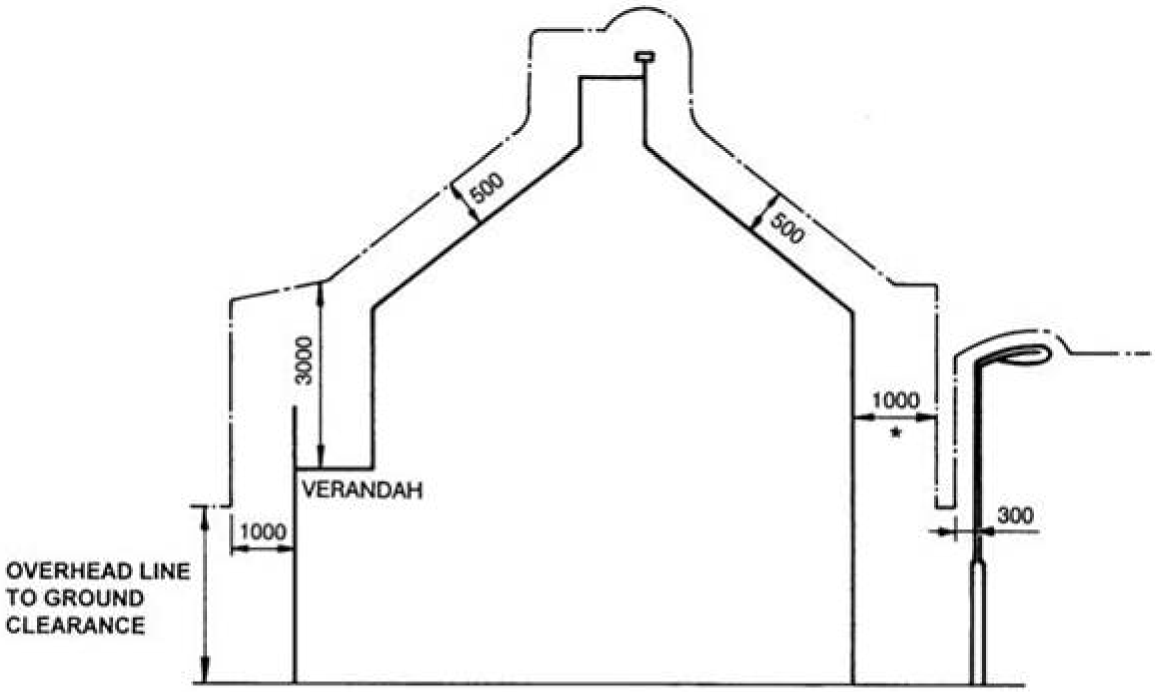
ABC



A — ALL PHASE NEUTRAL AND SWITCHWIRE CONDUCTORS IN THIS AREA SHALL BE INSULATED FOR 1.5m FROM THE COLUMN OR LANTERN.

B — ALL PHASE NEUTRAL AND SWITCHWIRE CONDUCTORS BENEATH THE OVERHANGING ARM OF THE COLUMN SHALL BE INSULATED THROUGHOUT THE SPAN OR INSULATED AS IN 'A' ABOVE BUT WITH SUITABLE CONDUCTOR SPACERS.

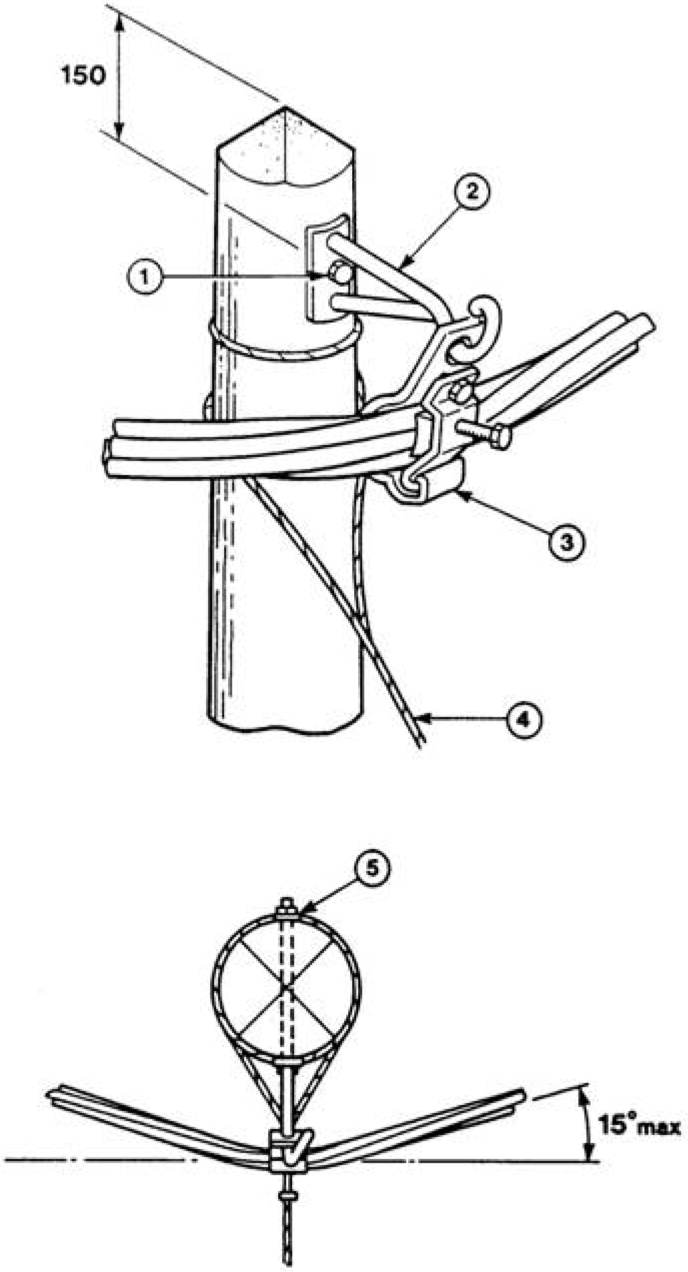
scale nts	CLEARANCE FROM LV CONDUCTORS TO LIGHTING STANDARDS SOURCE ENATS 43-8	drawn JS approved DPH 20.9.04	drawing number I-420-1.15-005-11-1



DIMENSIONS IN mm

—·—·— NO ABC WITHIN THIS LINE
* THIS CLEARANCE MAY BE REDUCED TO 500 IN THE CASE OF BLANK WALLS

scale nts	MINIMUM CLEARANCES OF ABC SYSTEMS TO BUILDINGS AND STRUCTURE SOURCE ENATS 43-8	drawn JS approved DPH 20.9.04
		drawing number I-420-1.15-006-11-1



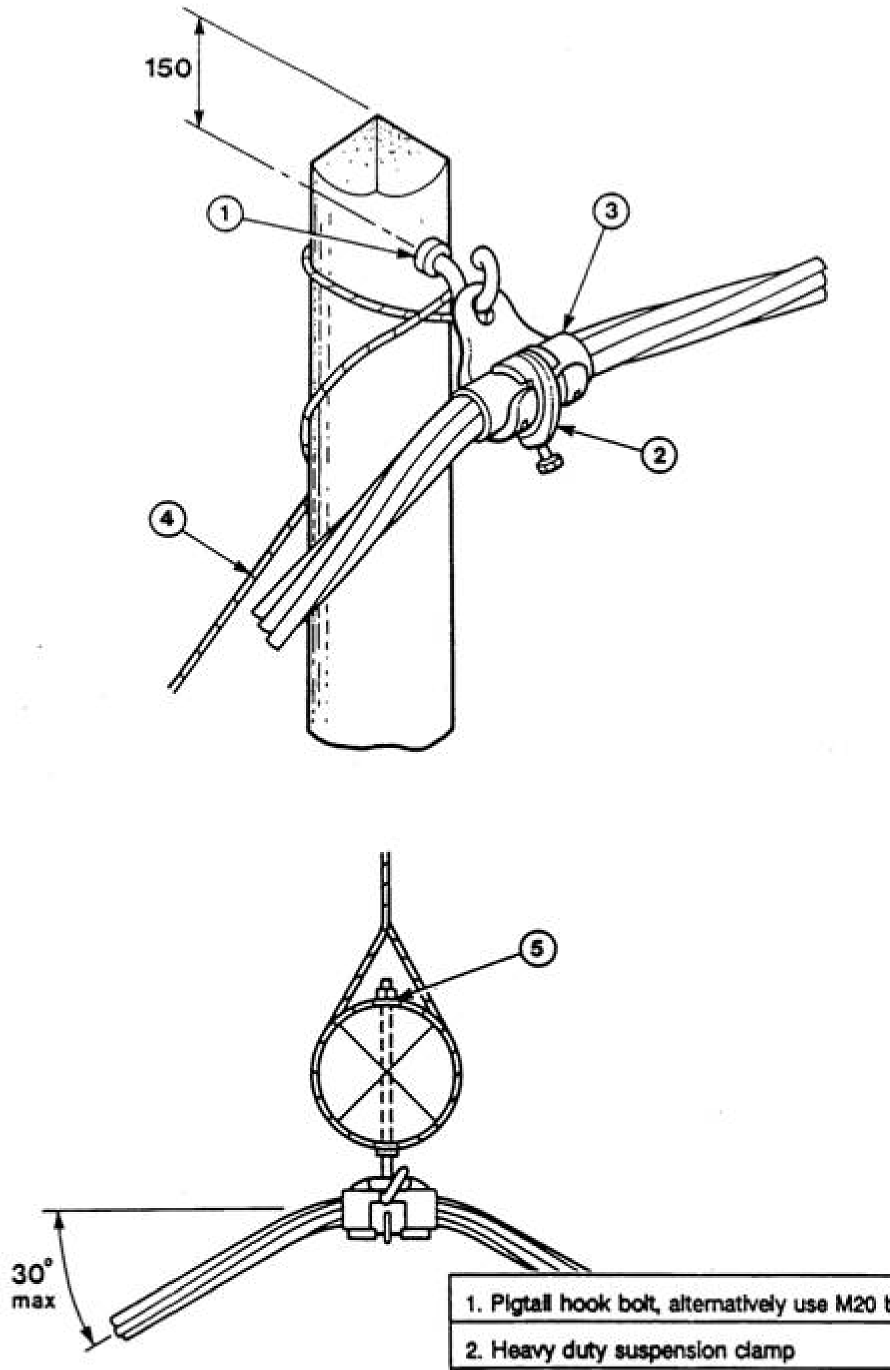
1. M20 Bolt length to suit pole diameter
2. Outrigger pole hook
3. Suspension clamp
4. Stay assembly to ESI 43-91
5. Curved square washer

.sions

scale

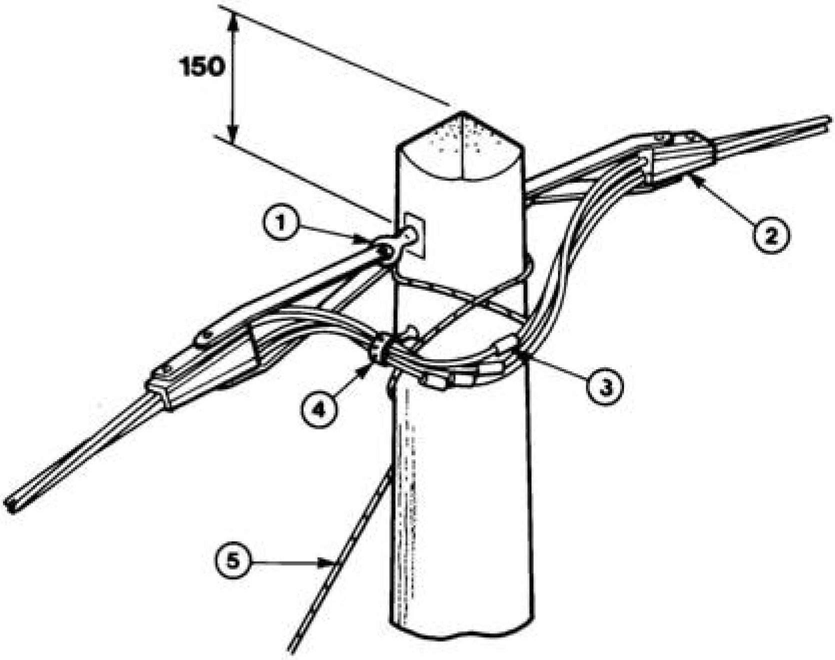
ABC INTERMEDIATE SUPPORT
INSIDE ANGLE SUPPORT UP TO
30° LINE DEVIATION

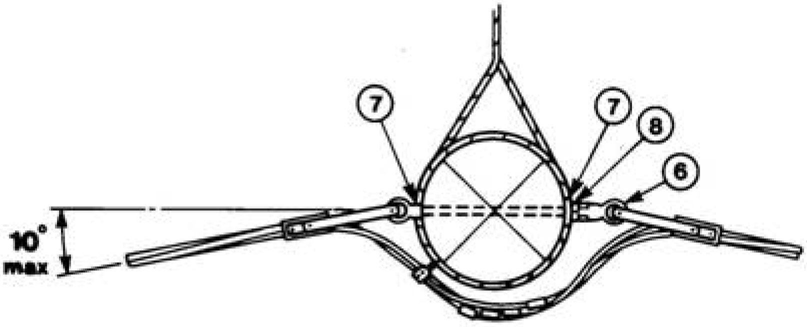
drawn	traced	drawing number
approved	date	HQ.A4.51.09-380



1. Pigtail hook bolt, alternatively use M20 bolt and hook nut
2. Heavy duty suspension clamp
3. Rubber insert for clamp size to suit (HQ.A4.51.09-450)
4. Stay assembly to ESI 43-91
5. Curved square washer

.visions	ABC INTERMEDIATE SUPPORT UP TO 60° LINE DEVIATION	drawn	traced	drawing number
scale		approved	date	HQ.A4.51.09-381





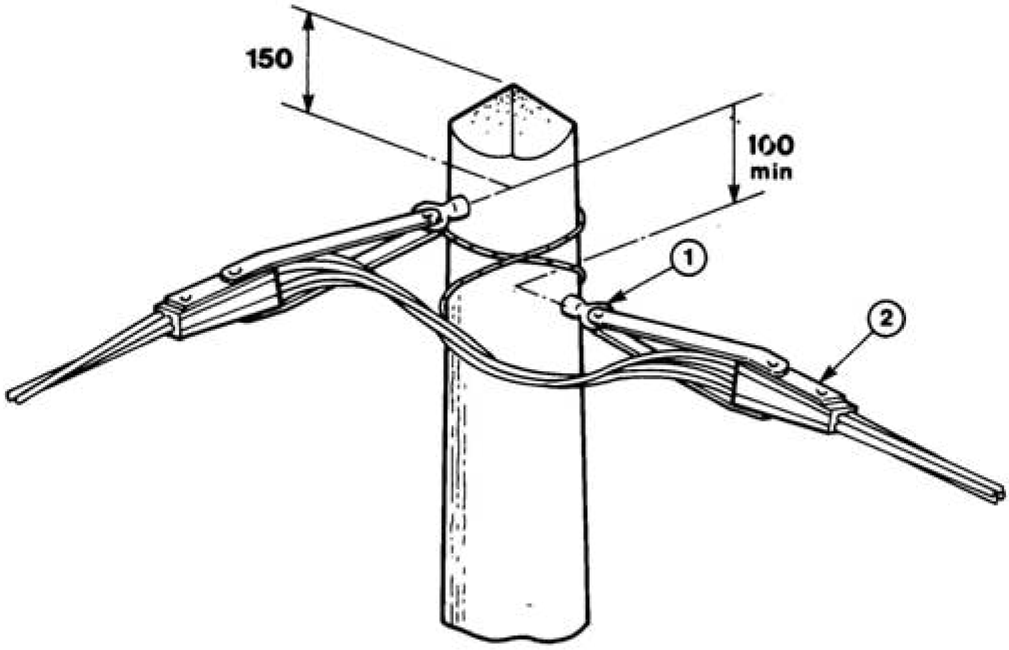
1. M20 eye bolt diameter to suit pole
2. Anchor clamp
3. Insulated non-tension joints (if required)
4. Stand off cleat
5. Stay to ESI 43-91
6. Eye nut M20
7. Curved square washer
8. Lock nut

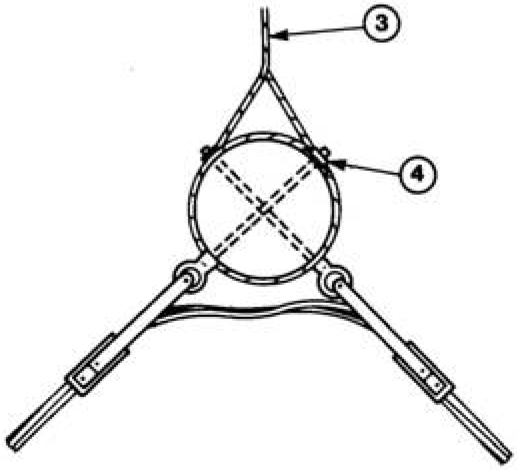
revisions

scale

ABC SECTION SUPPORT
ANGLES 0° - 20° LINE DEVIATION

drawn	traced	drawing number
approved	date	HQ.A4.51.09-382





1. M20 Eye bolt length to suit pole
2. Anchor clamp
3. Stay to ESI 43-91
4. Curved square washer

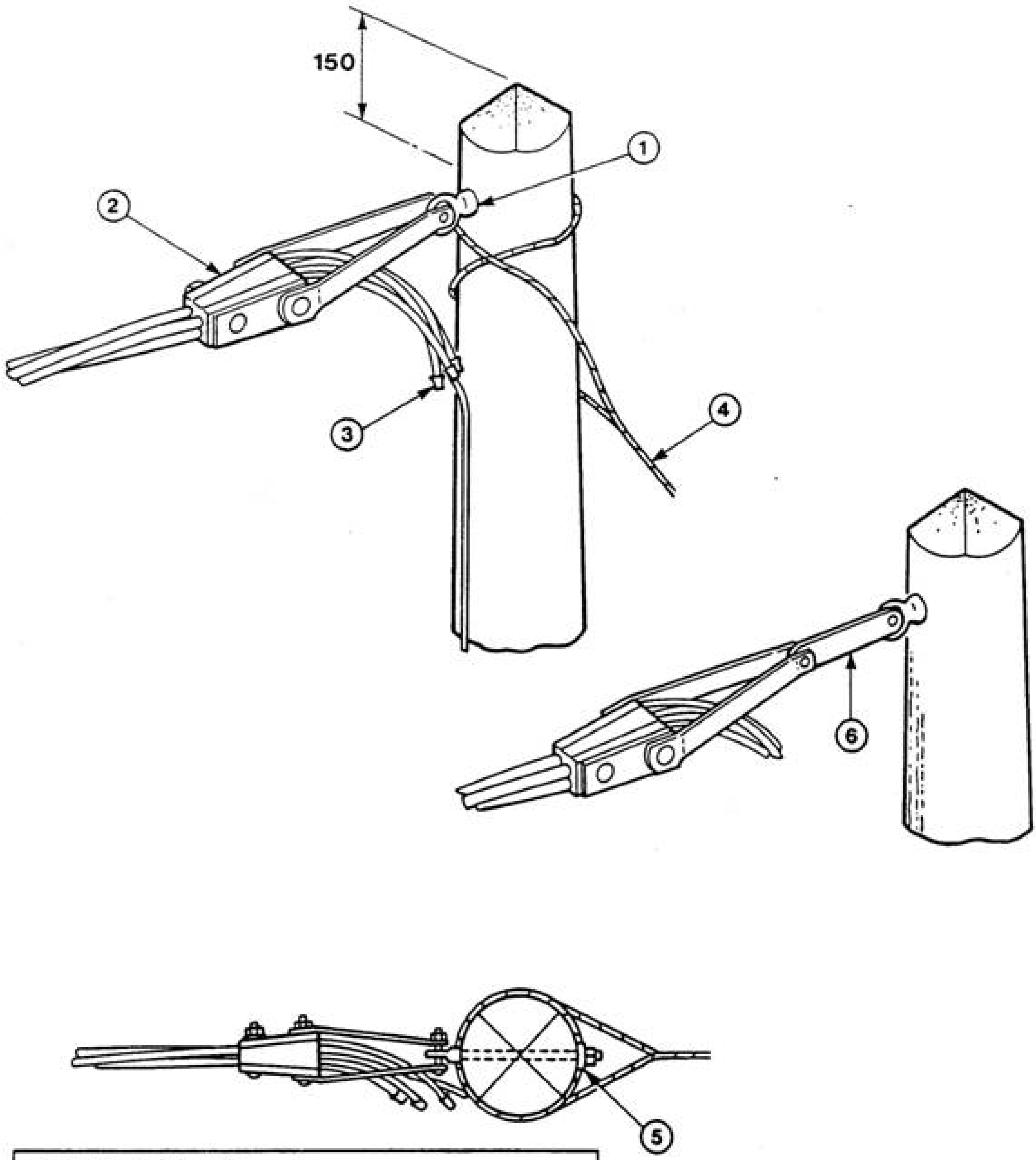
revisions

scale

ABC SECTION SUPPORT
ANGLES 20° - 90° LINE DEVIATION

drawn traced drawing number

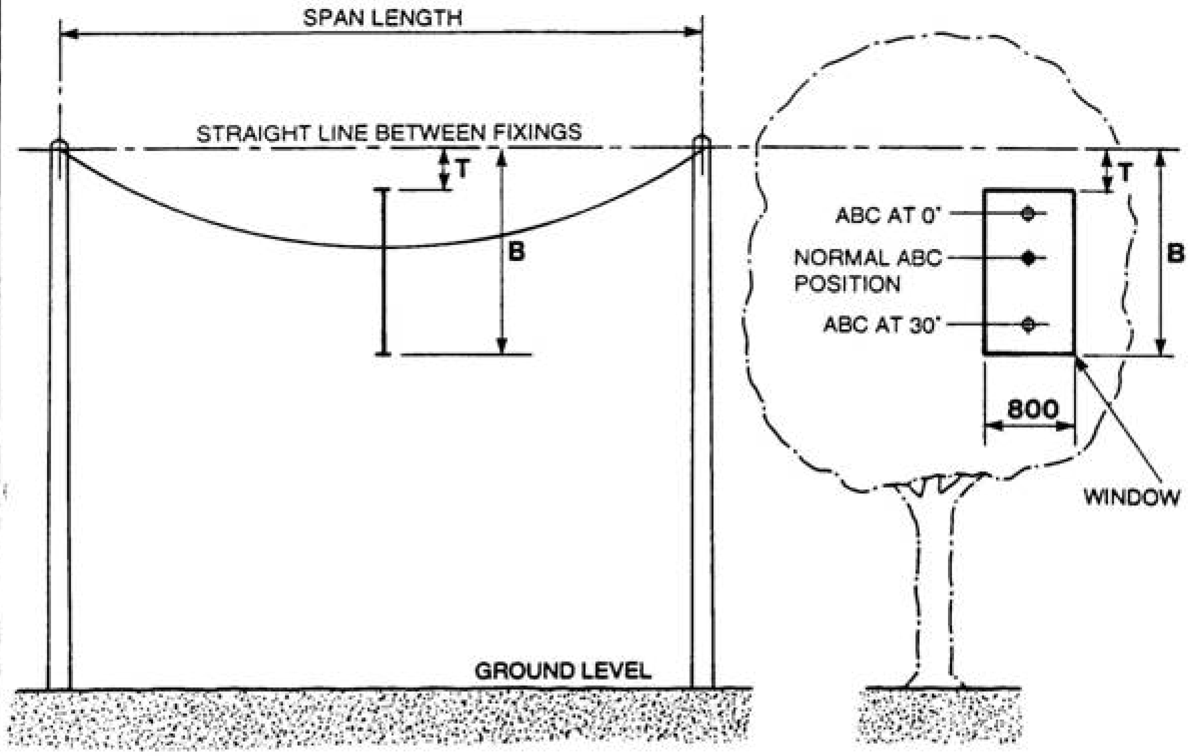
approved date HQ.A4.51.09-383



1. M20 Eye bolt length to suit	
2. Anchor clamp	
3. End caps	
4. Stay assembly to ESI 43-91	
5. Curved square washer	
6. Weak link (if required)	

isions

scale	ABC TERMINAL SUPPORT	drawn	traced	drawing number
		approved	date	HQ.A4.51.09-384



SPAN LENGTH (m)	DISTANCE TO TOP OF WINDOW T (min)	DISTANCE TO BOTTOM OF WINDOW B (min)	GENERAL GUIDE CLEARANCE FROM BUNDLE, ALL TEMPS.
UP TO 50	0.55m	1.37m	0.53m above 0.67m below
50 TO 70	1.09m	2.58m	0.84m above 1.2m below
70 TO 90	1.80m	4.43m	1.2m above 2.0m below

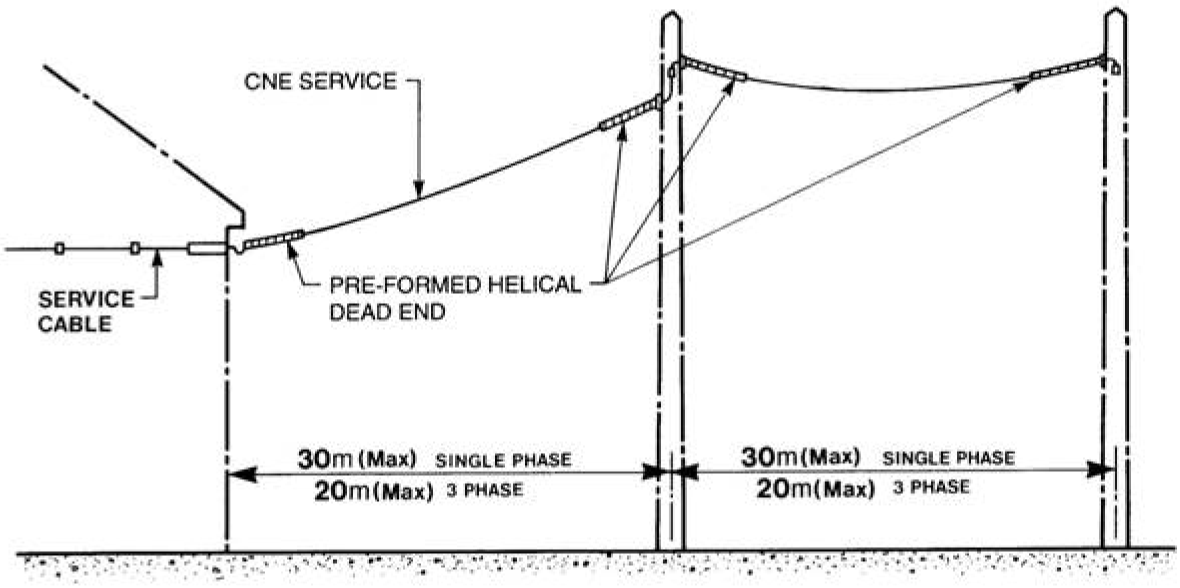
Notes:

1. The above figures are for the midspan position.
2. The distances will decrease as the window comes closer to the pole.
3. Width of window is to be 400mm either side of the ABC.

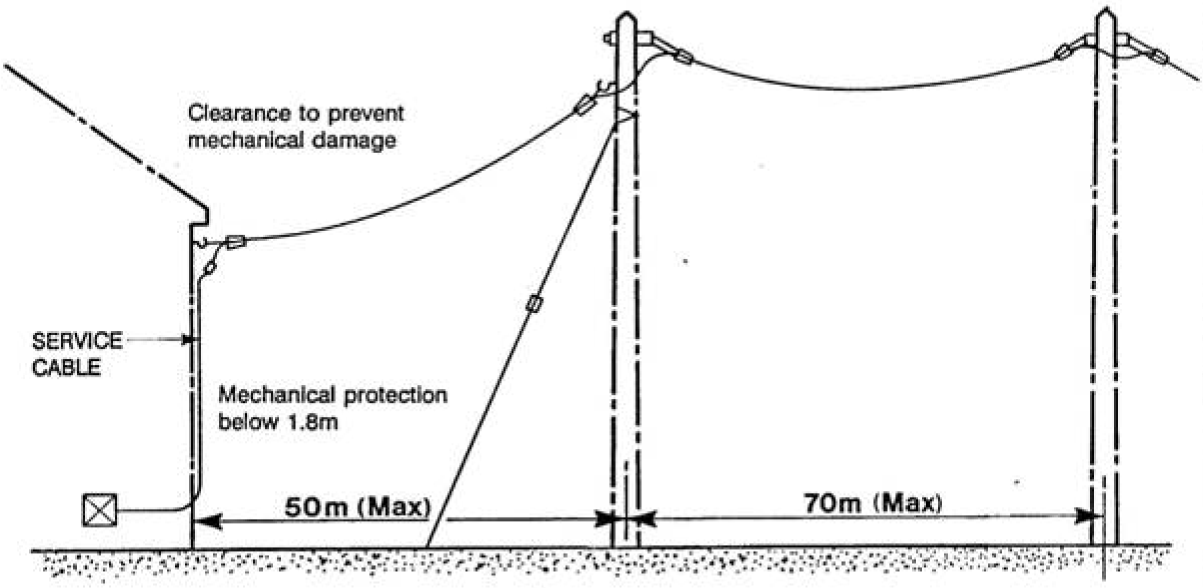
visions
scale

TREE CLEARANCE WINDOW
FOR ABC

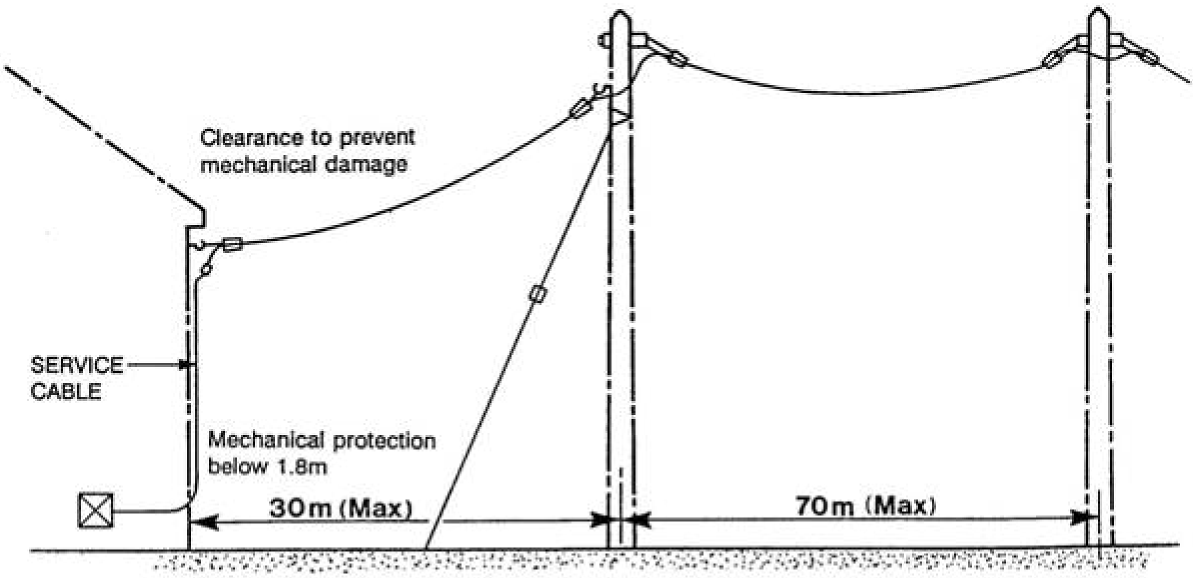
drawn | traced | drawing number
approved | date | HQ.A4.51.09-385



scale nts	CNE SERVICES	drawn JS	drawing number
		approved DPH date 15 7 02	HQ.A4.51.09-386



2 - CORE 35mm^2 ABC SERVICE SPANS & SERVICE LINES

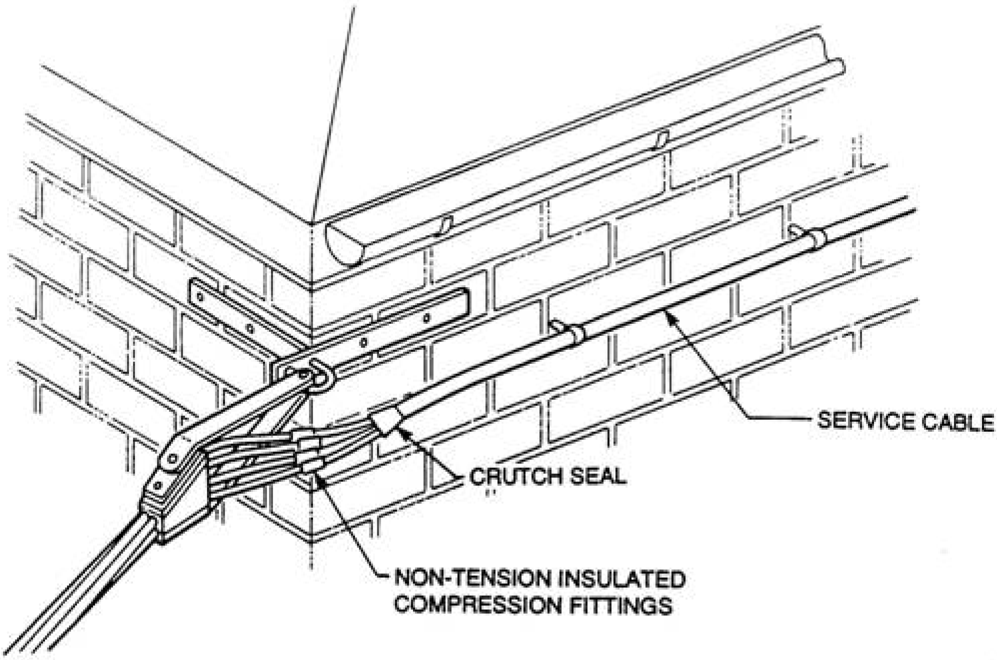


4 - CORE 35mm^2 ABC SERVICE SPANS & SERVICE LINES

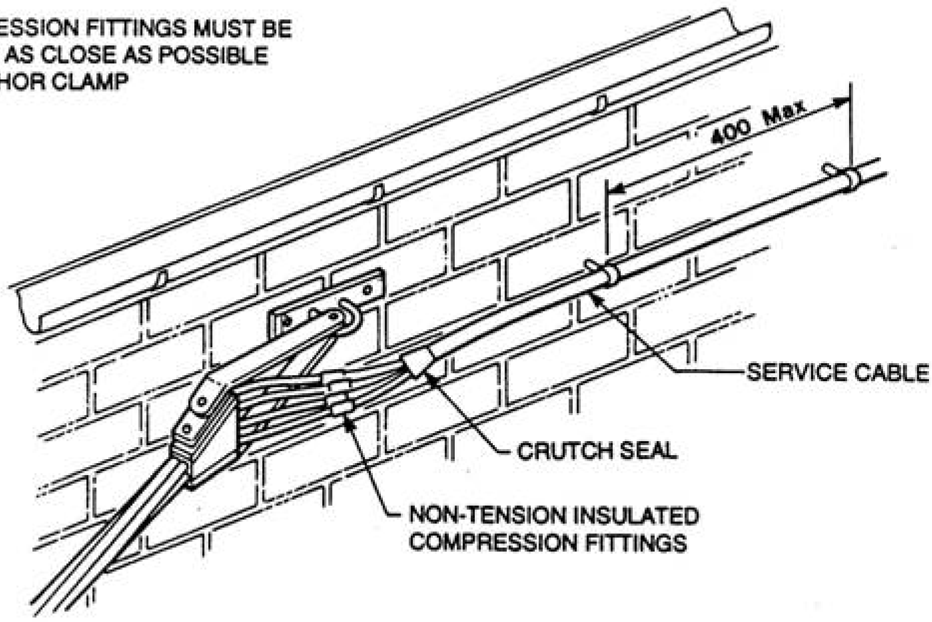
revisions
scale

ABC SERVICE SPANS

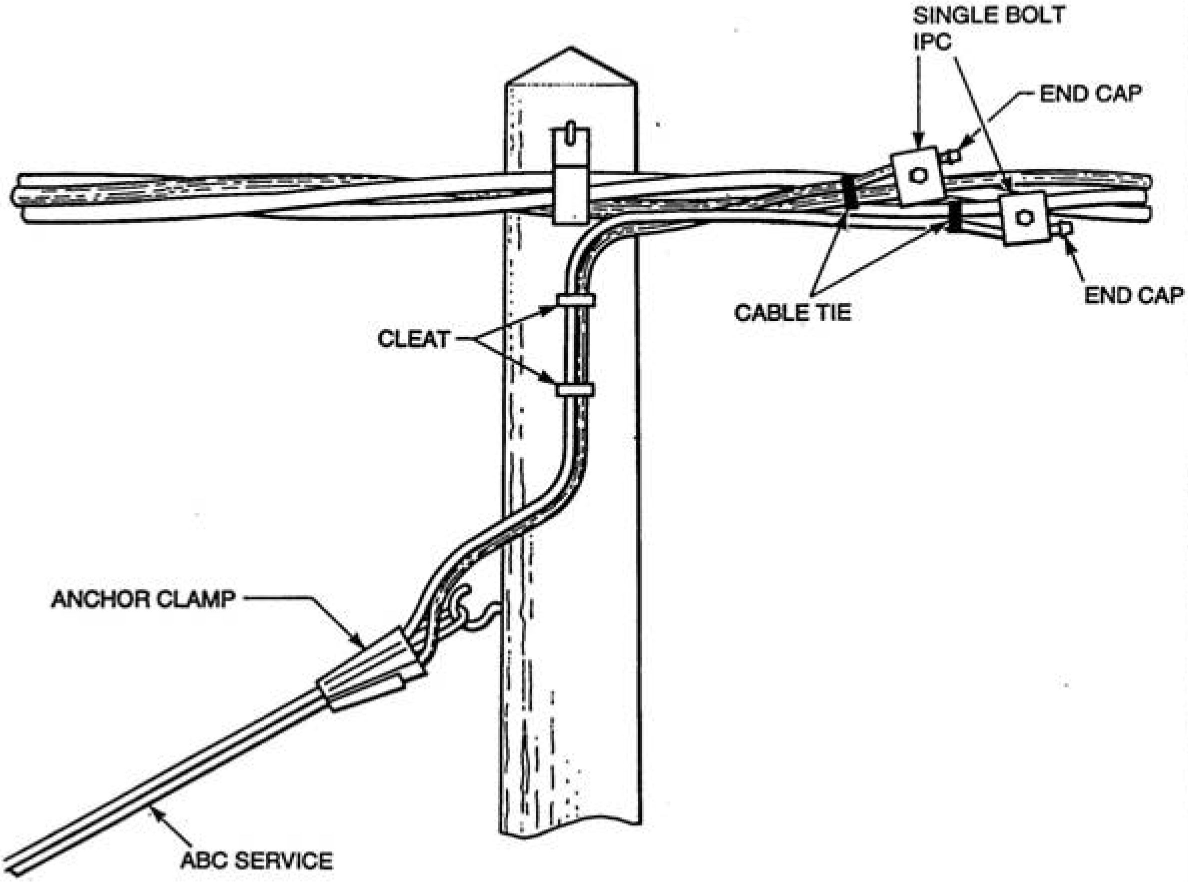
drawn | traced | drawing number
approved | date | HQ.A4.51.09-387



NOTE: THE COMPRESSION FITTINGS MUST BE POSITIONED AS CLOSE AS POSSIBLE TO THE ANCHOR CLAMP



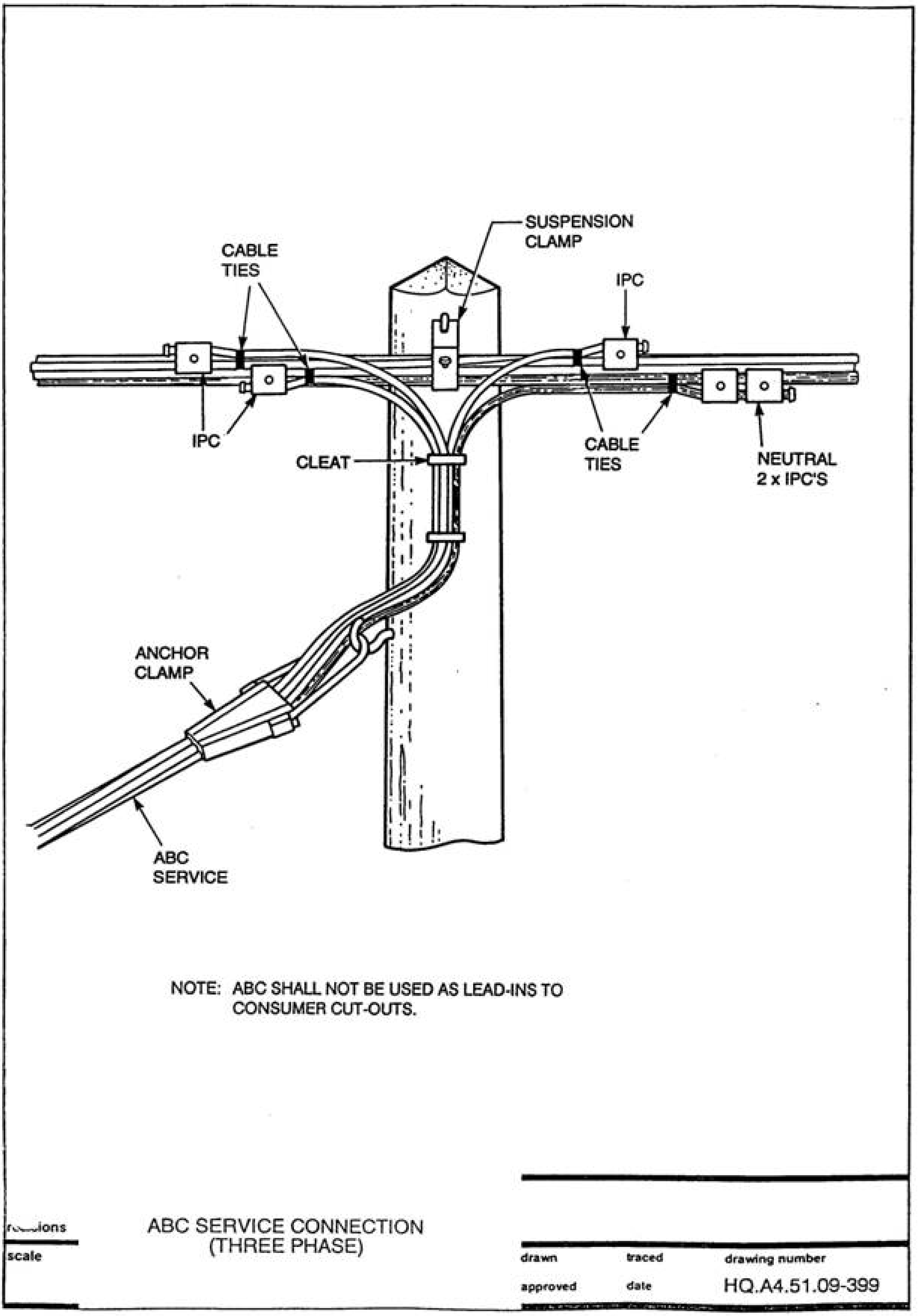
isions				
scale	ABC ATTACHMENTS TO BUILDINGS	drawn	traced	drawing number
		approved	date	HQ.A4.51.09-389

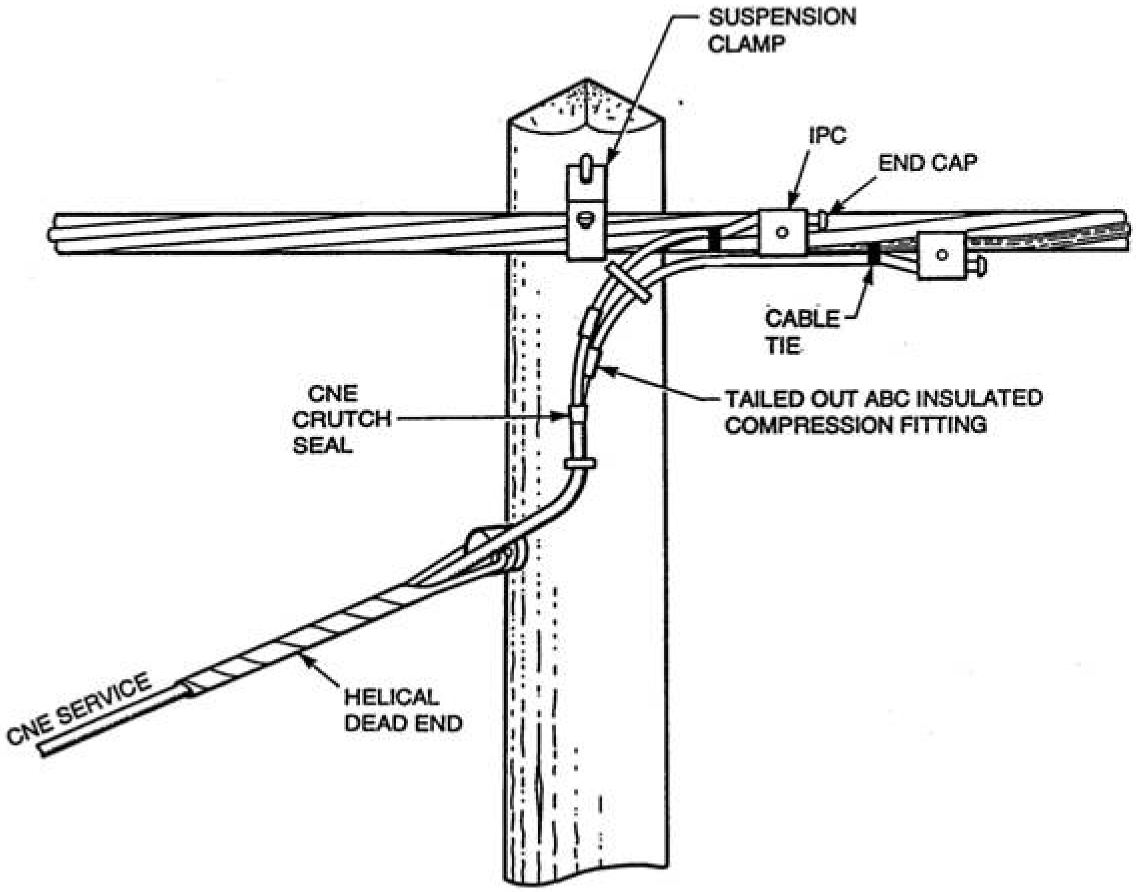


NOTE: ABC SHALL NOT BE USED AS LEAD-INS TO CONSUMER CUT-OUTS.

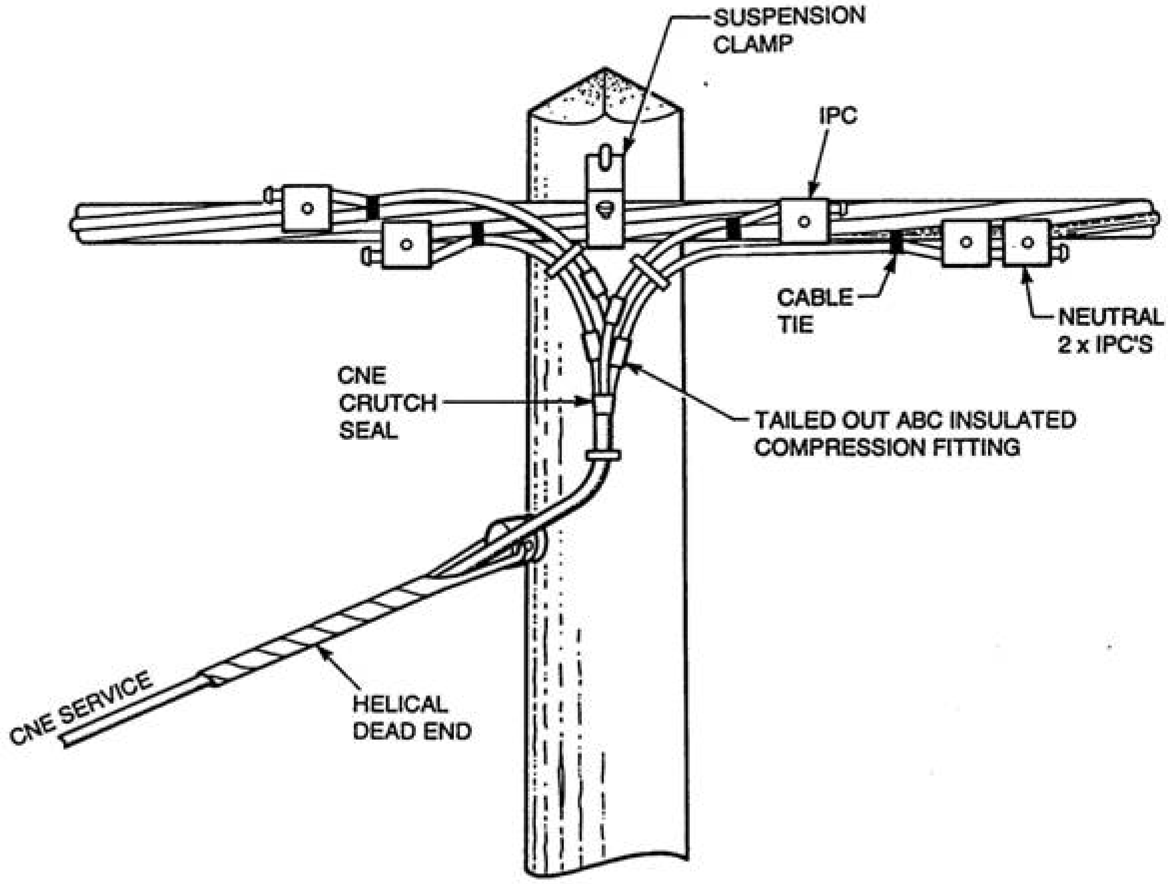
sions	ABC SERVICE CONNECTION (SINGLE PHASE)		
scale		drawn	traced
		approved	date

drawing number: HQ.A4.51.09-398

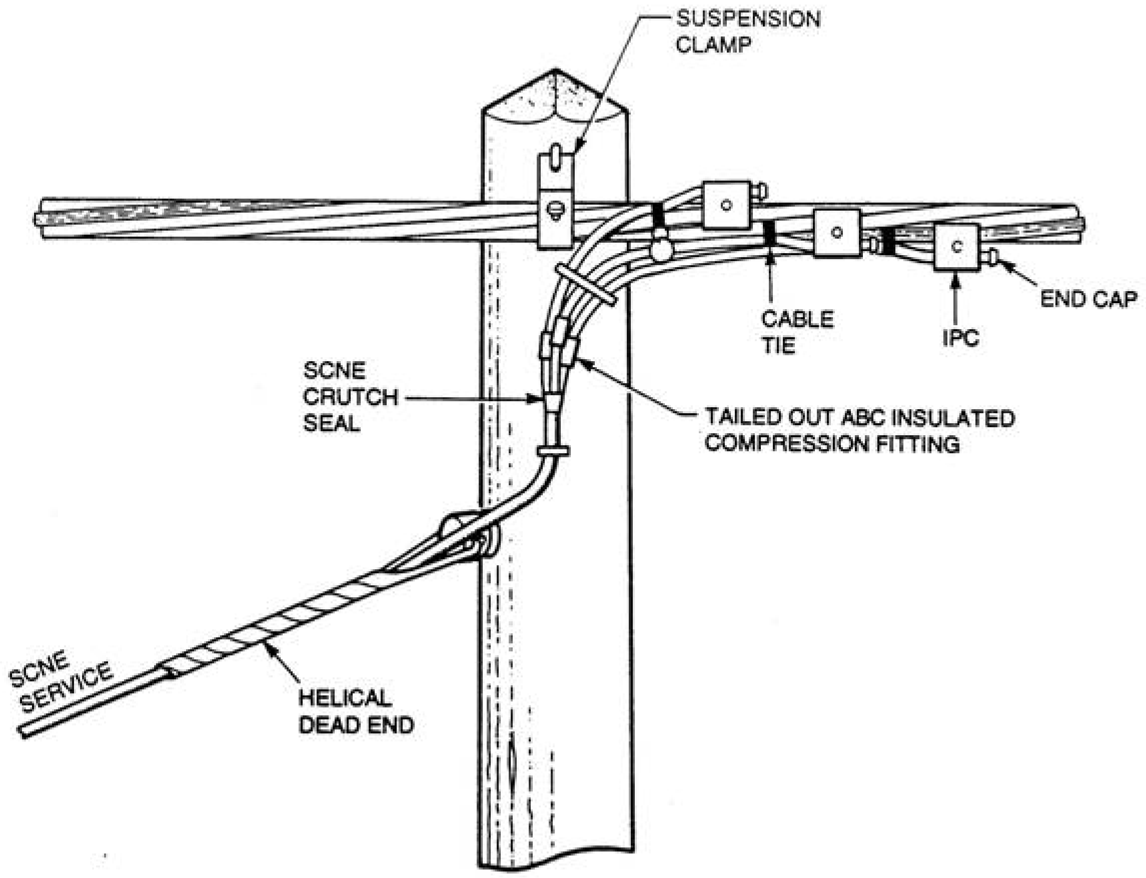

SUSPENSION
CLAMP
CABLE
TIES
IPC
IPC
CLEAT
CABLE
TIES
NEUTRAL
2 x IPC'S
ANCHOR
CLAMP
ABC
SERVICE
NOTE: ABC SHALL NOT BE USED AS LEAD-INS TO
CONSUMER CUT-OUTS.
scale
ABC SERVICE CONNECTION
(THREE PHASE)
drawn
traced
drawing number
approved
date
HQ.A4.51.09-399



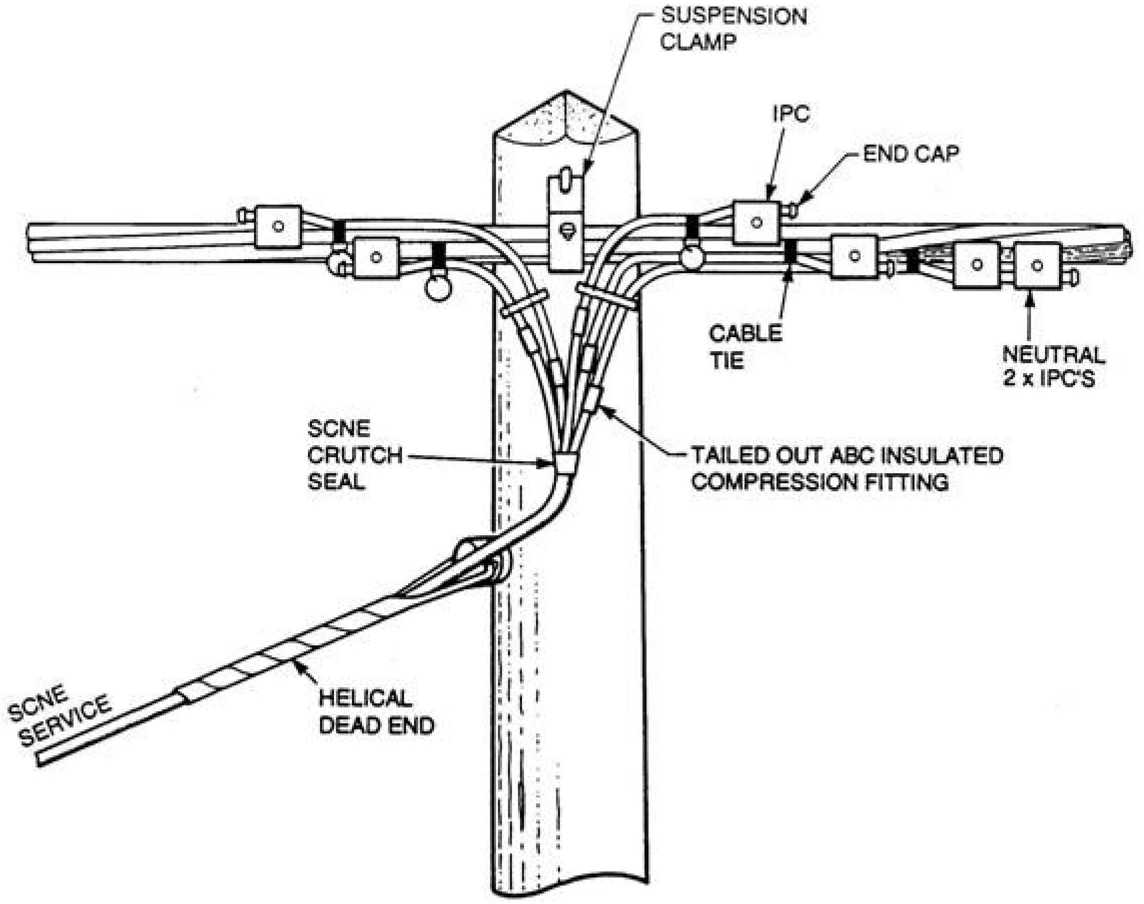
revisions				
scale	CNE SERVICE CONNECTION (SINGLE PHASE)	drawn	traced	drawing number
		approved	date	HQ.A4.51.09-400



revisions				
scale	CNE SERVICE CONNECTION (THREE PHASE)	drawn	traced	drawing number
		approved	date	HQ.A4.51.09-401



r. Jons			
scale	SCNE SERVICE CONNECTION (SINGLE PHASE)	drawn / traced	drawing number
		approved / date	HQ.A4.51.09-402

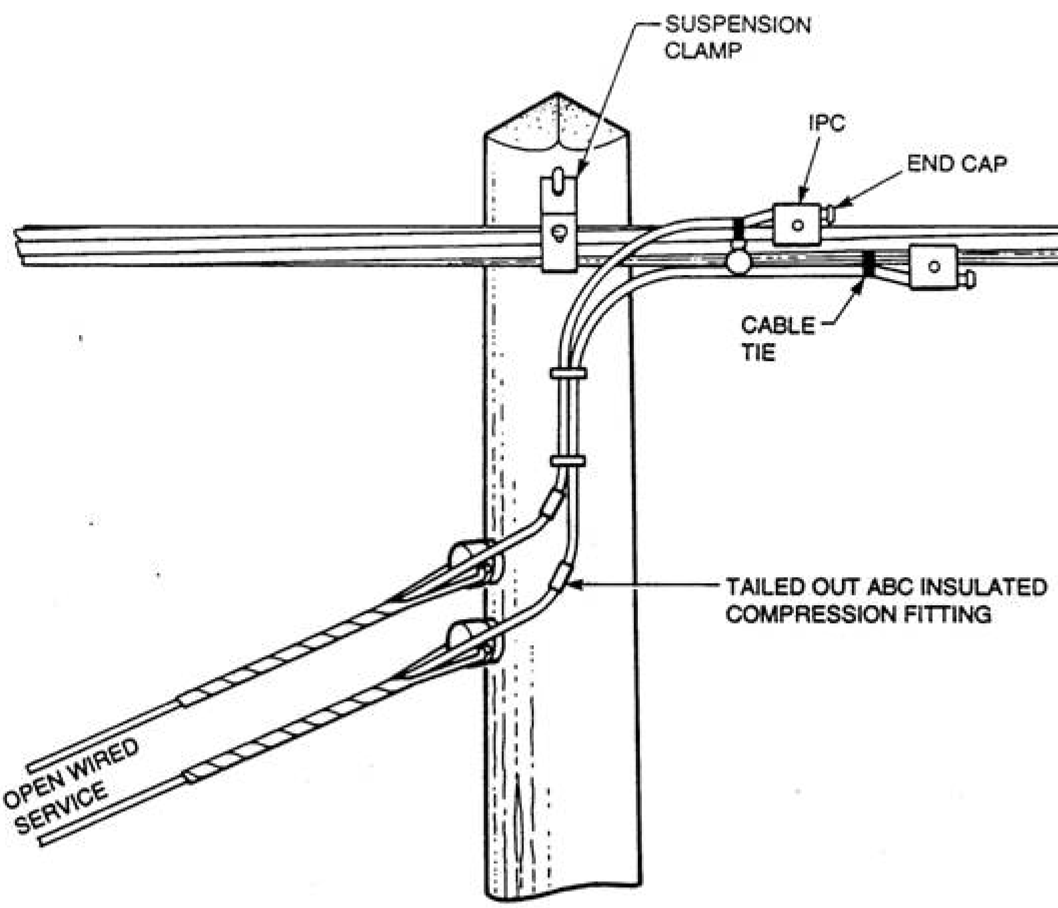


visions

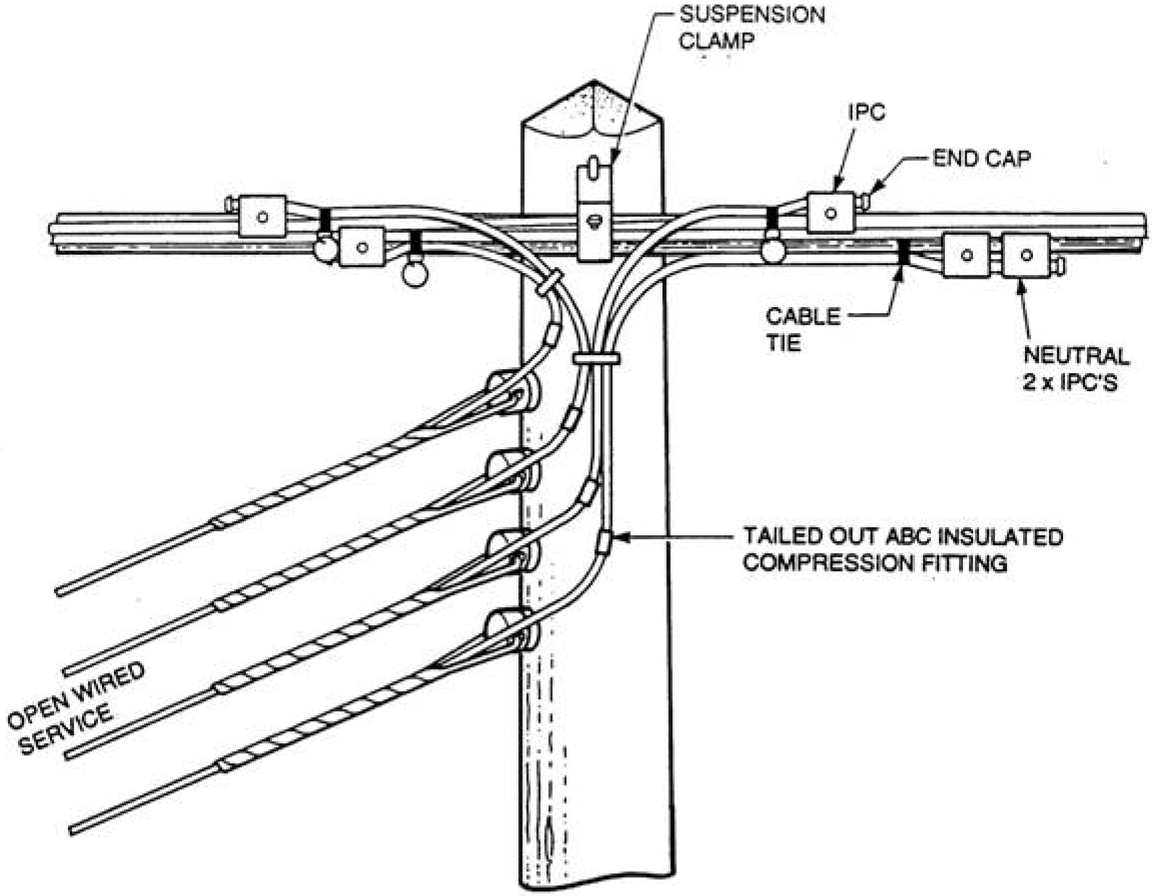
scale

SCNE SERVICE CONNECTION (THREE PHASE)

drawn	traced	drawing number
approved	date	HQ.A4.51.09-403



:isions	OPEN WIRED SERVICE CONNECTIONS (SINGLE PHASE)	drawn	traced	drawing number
scale		approved	date	HQ.A4.51.09-404



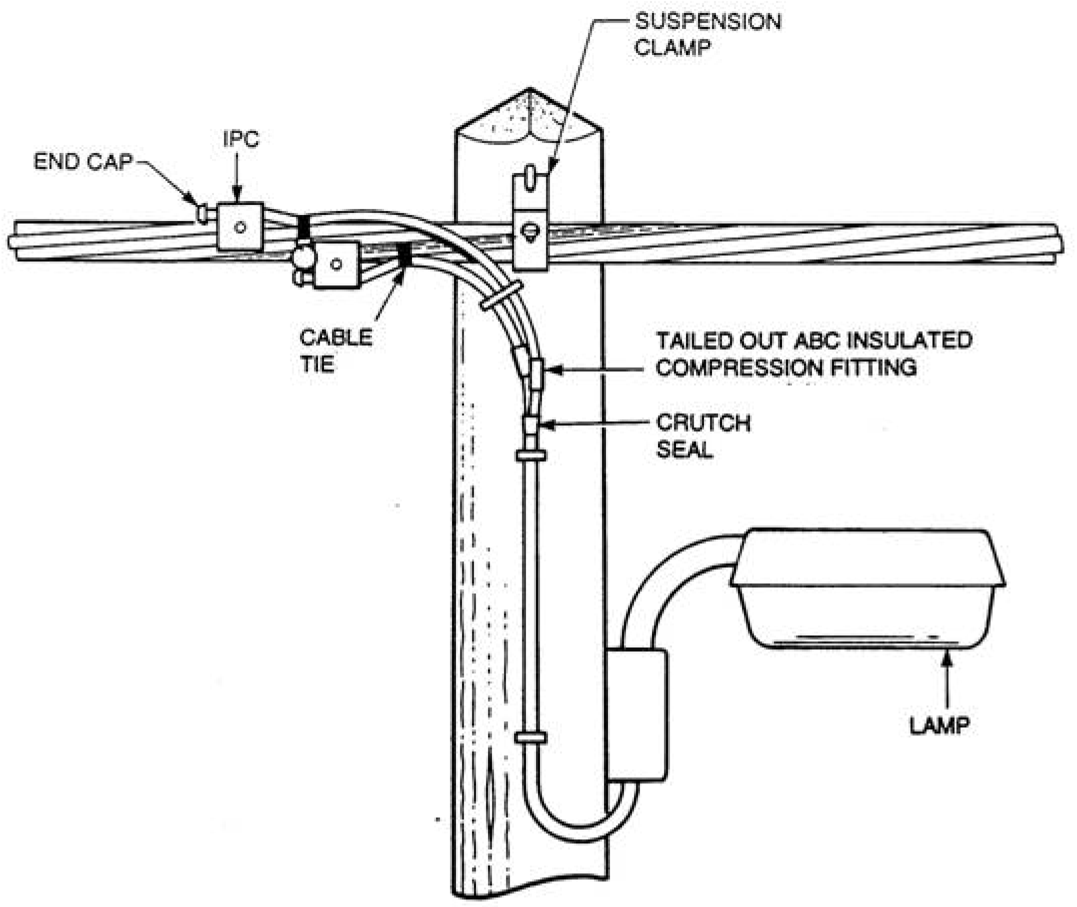
r. sions

scale

OPEN WIRED SERVICE CONNECTIONS
(THREE PHASE)

drawn traced drawing number

approved date HQ.A4.51.09-405



isions	STREET LIGHTING SERVICE CONNECTION			
scale		drawn	traced	drawing number
		approved	date	HQ.A4.51.09-406

Based on 95mm ABC

Span length	40	45	50	55	60	65	70	75	80	85	90
A Max sag @ 75c	0.88	1.11	1.37	1.65	1.97	2.31	2.68	3.08	3.5	3.95	4.43
B Ground clearance (min)	<-----	--------	--------	--------	5.2	mts	--------	----------	----------	----------	-------->
Height to top of pole A+B+150mm	6.23	6.46	6.72	7	7.32	7.66	8.03	8.43	8.85	9.3	9.78
Extra for road crossing 0.6m	<-----	--------	--------	--------	0.6	mts	--------	----------	---------	----------	------->
Planting Depth	<-----	--------	--------	1.5	mts	--------	--------	--------->	<-------	1.8	mts >

Notes:

1. Sags for 95mm 4-core, 2-core & 5-core ABC are the same)
2. If ground is uneven or contains obstacles, ground clearance should be adjusted accordingly.

sions

scale

POLE HEIGHT SELECTION CHART

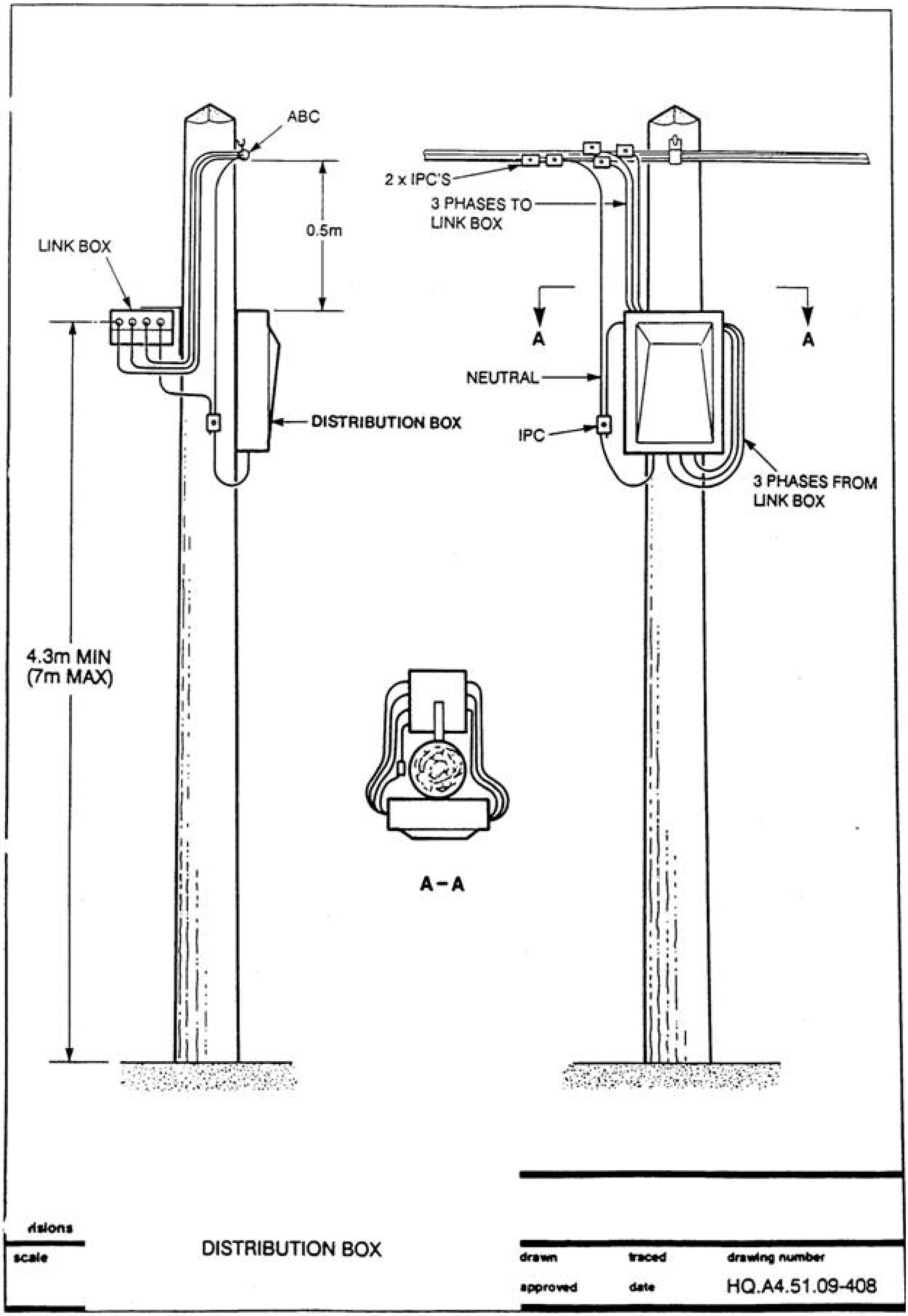
drawn

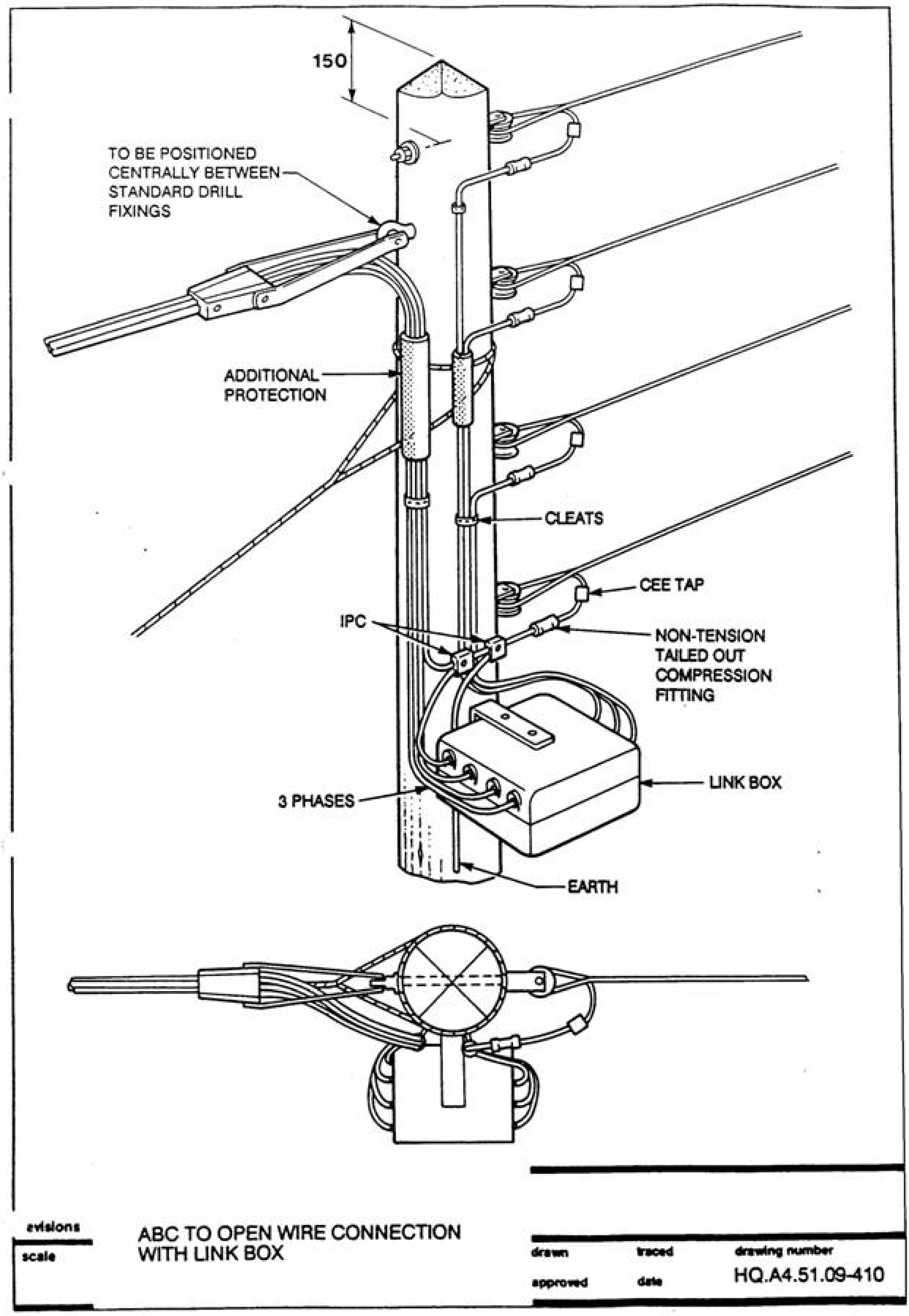
approved

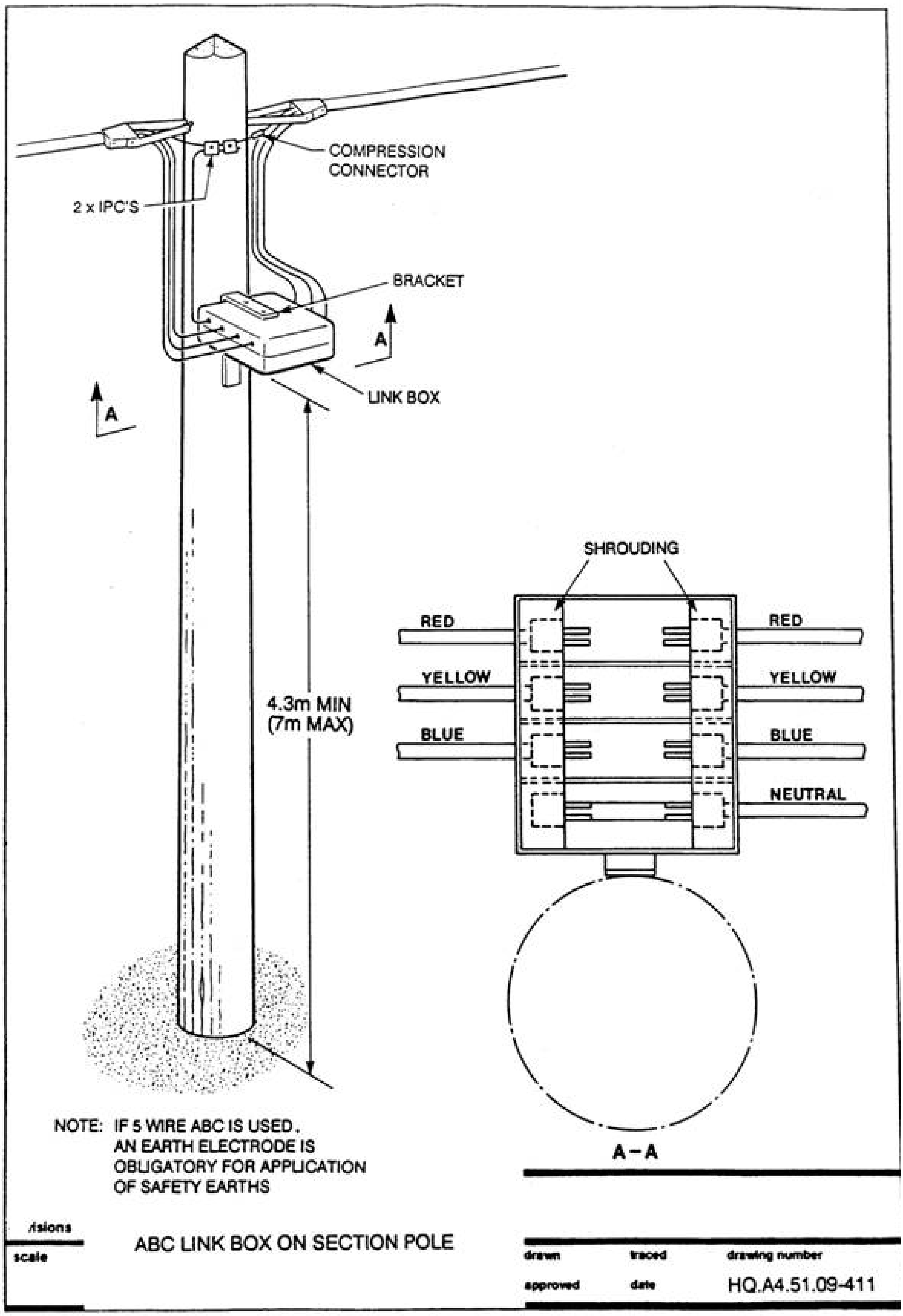
traced

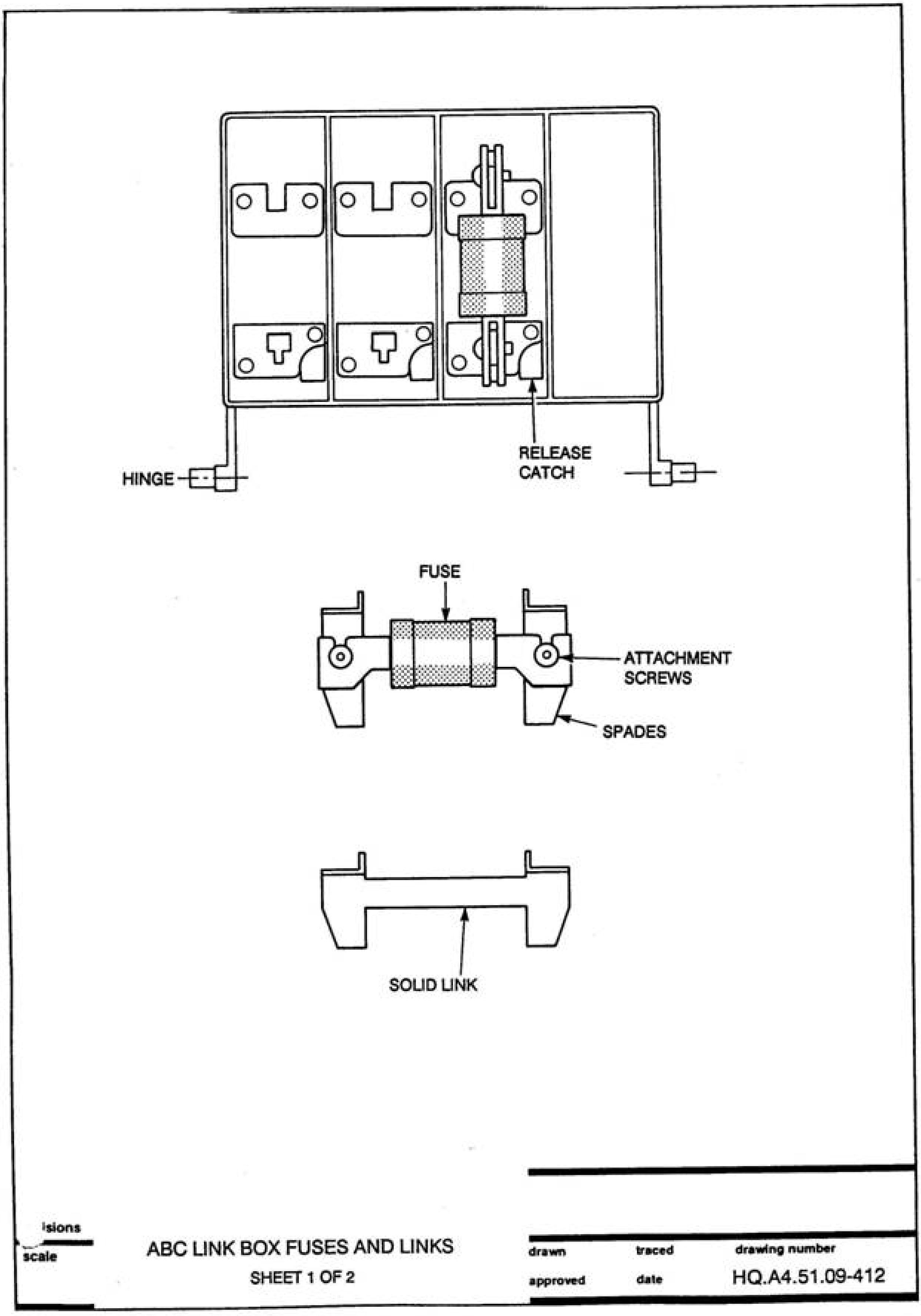
date

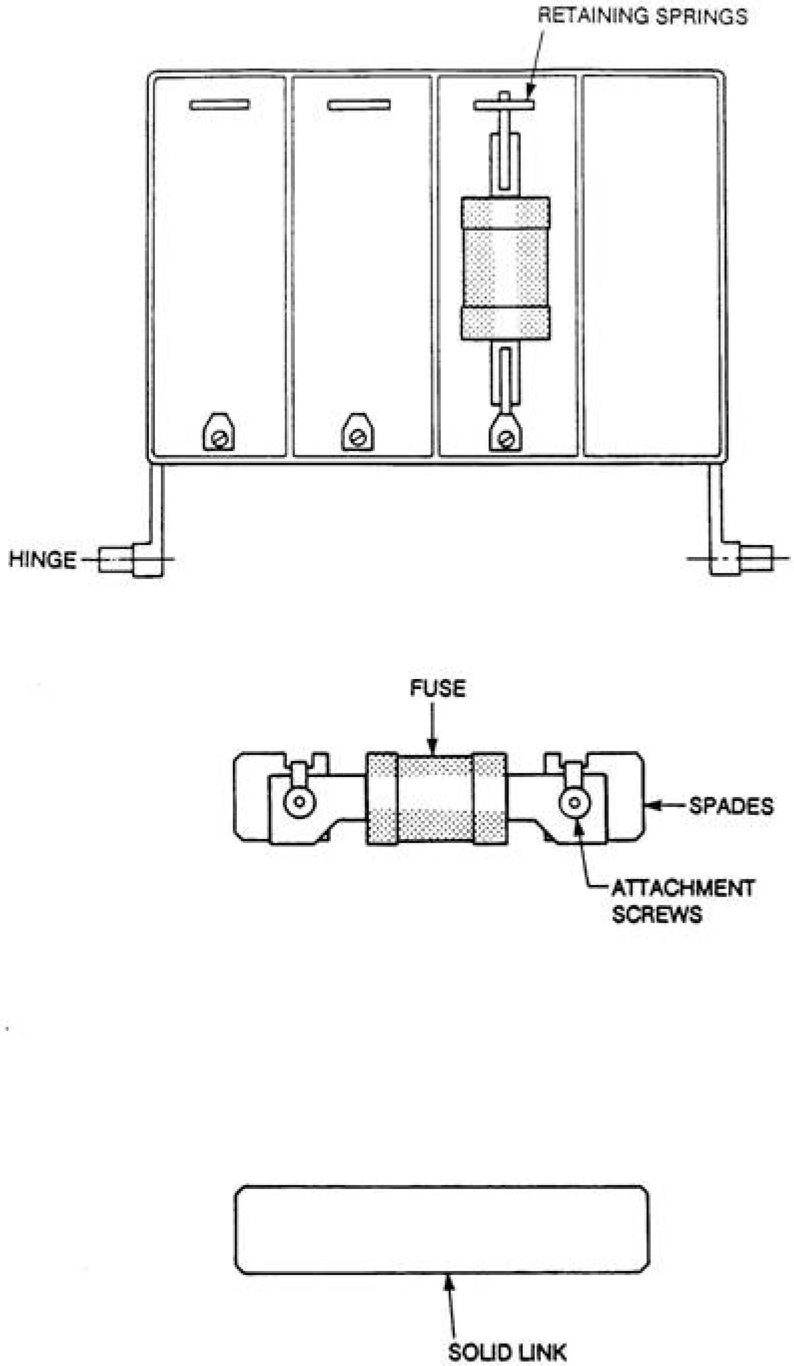
drawing number HQ.A4.51.09-407


ABC
0.5m
LINK BOX
DISTRIBUTION BOX
4.3m MIN
(7m MAX)
2 x IPC'S
3 PHASES TO
LINK BOX
A
A
NEUTRAL
IPC
3 PHASES FROM
LINK BOX
A – A
visions
scale
DISTRIBUTION BOX
drawn
traced
drawing number
approved
date
HQ.A4.51.09-408

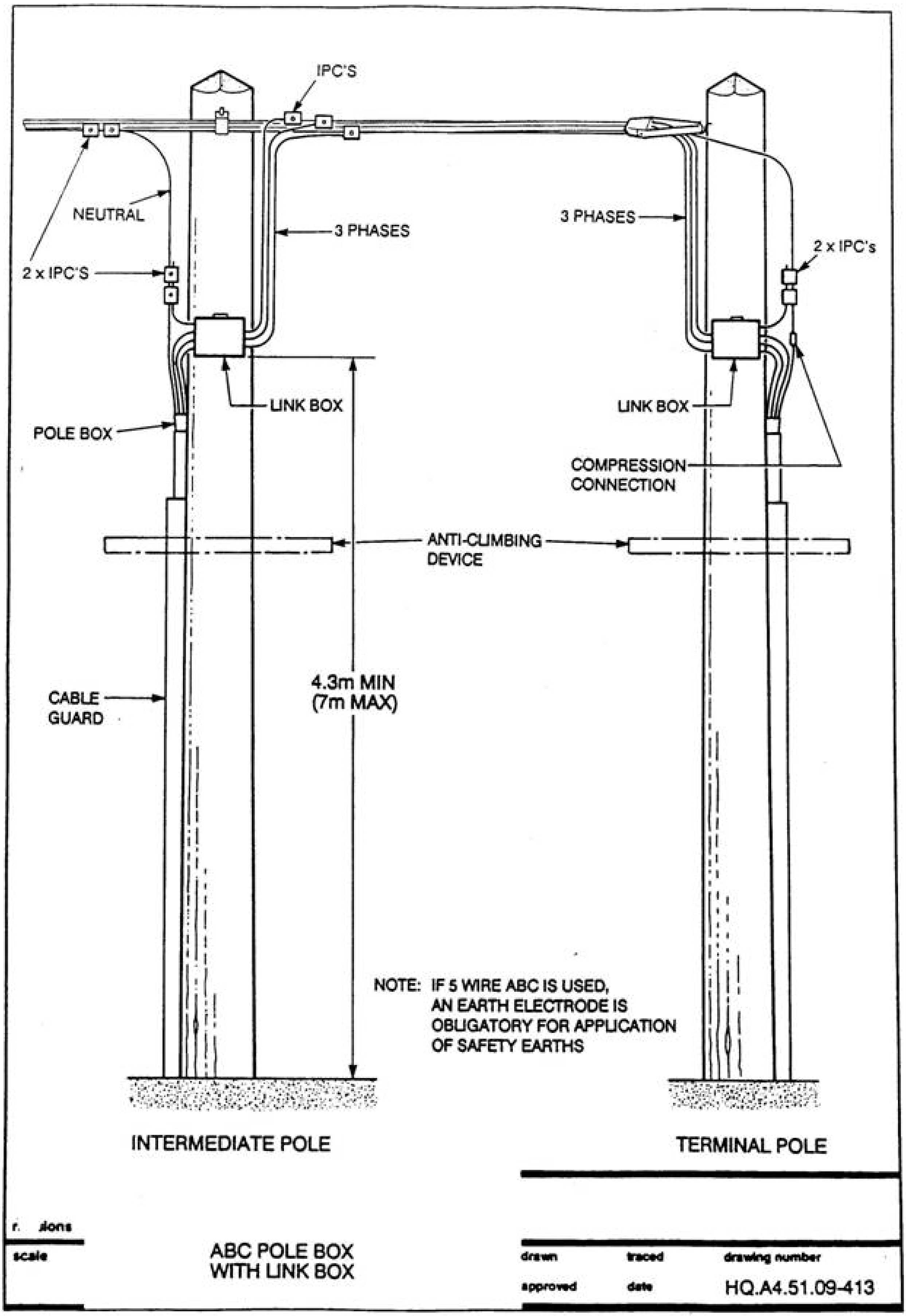

150
TO BE POSITIONED CENTRALLY BETWEEN STANDARD DRILL FIXINGS
ADDITIONAL PROTECTION
CLEATS
CEE TAP
IPC
NON-TENSION TAILED OUT COMPRESSION FITTING
LINK BOX
3 PHASES
EARTH
evisions
scale
ABC TO OPEN WIRE CONNECTION WITH LINK BOX
drawn
traced
drawing number
approved
date
HQ.A4.51.09-410

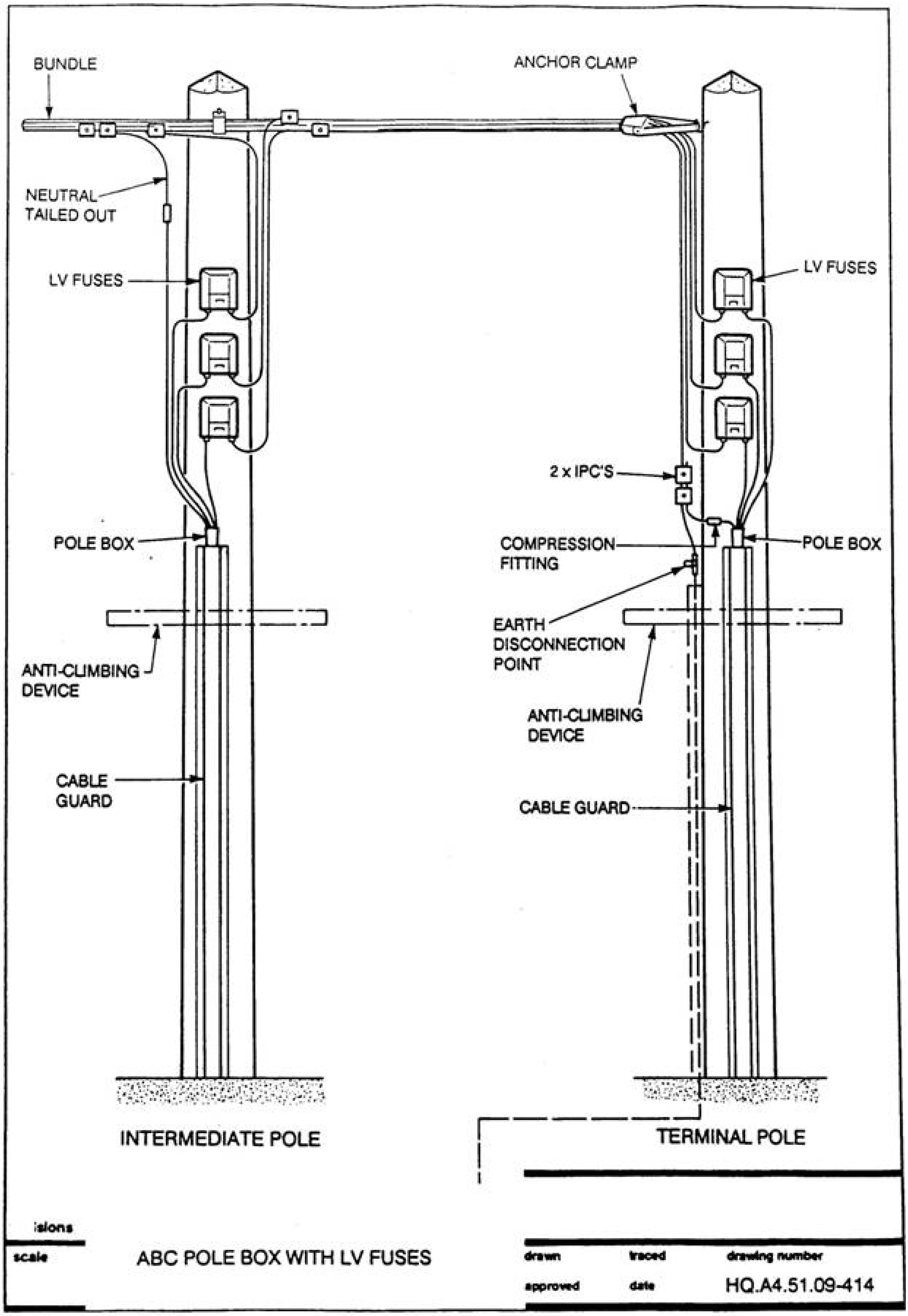

COMPRESSION CONNECTOR
2 x IPC'S
BRACKET
A
LINK BOX
A
4.3m MIN (7m MAX)
SHROUDING
RED
YELLOW
BLUE
RED
YELLOW
BLUE
NEUTRAL
A – A
NOTE: IF 5 WIRE ABC IS USED, AN EARTH ELECTRODE IS OBLIGATORY FOR APPLICATION OF SAFETY EARTHS
/isions
scale
ABC LINK BOX ON SECTION POLE
drawn
traced
drawing number
approved
date
HQ.A4.51.09-411

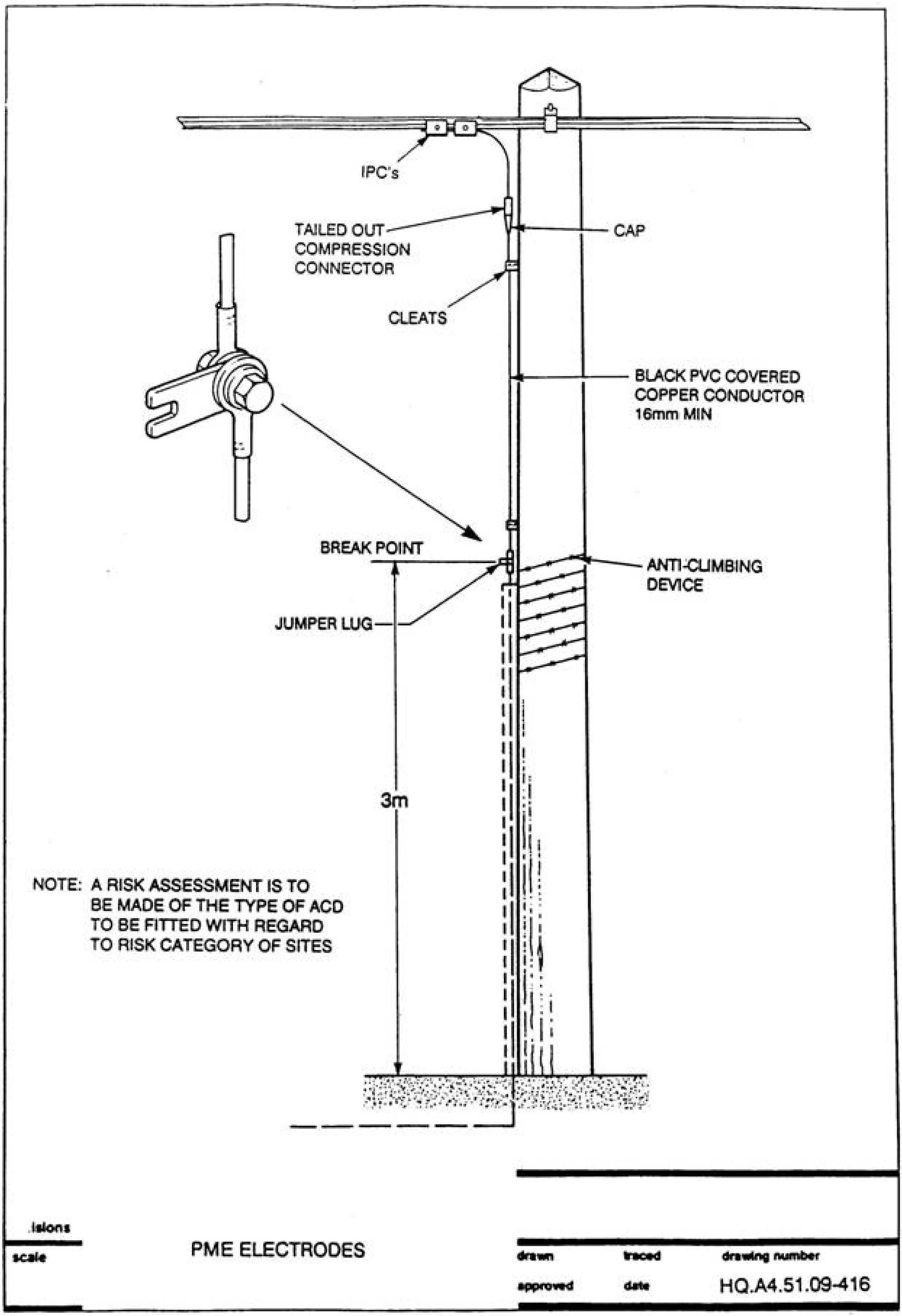

RELEASE CATCH
HINGE
FUSE
ATTACHMENT SCREWS
SPADES
SOLID LINK
isions
scale
ABC LINK BOX FUSES AND LINKS
SHEET 1 OF 2
drawn
traced
drawing number
approved
date
HQ.A4.51.09-412

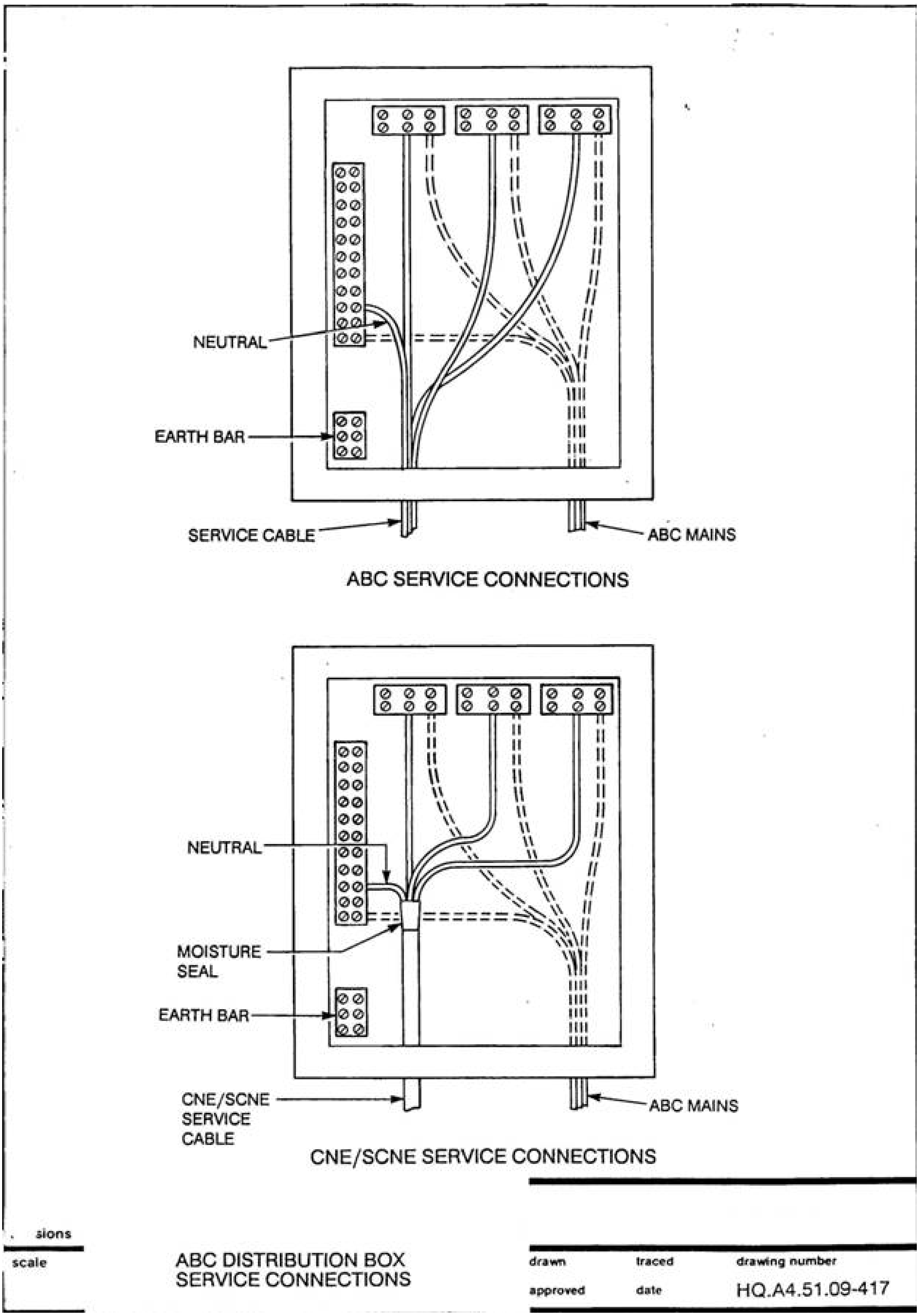


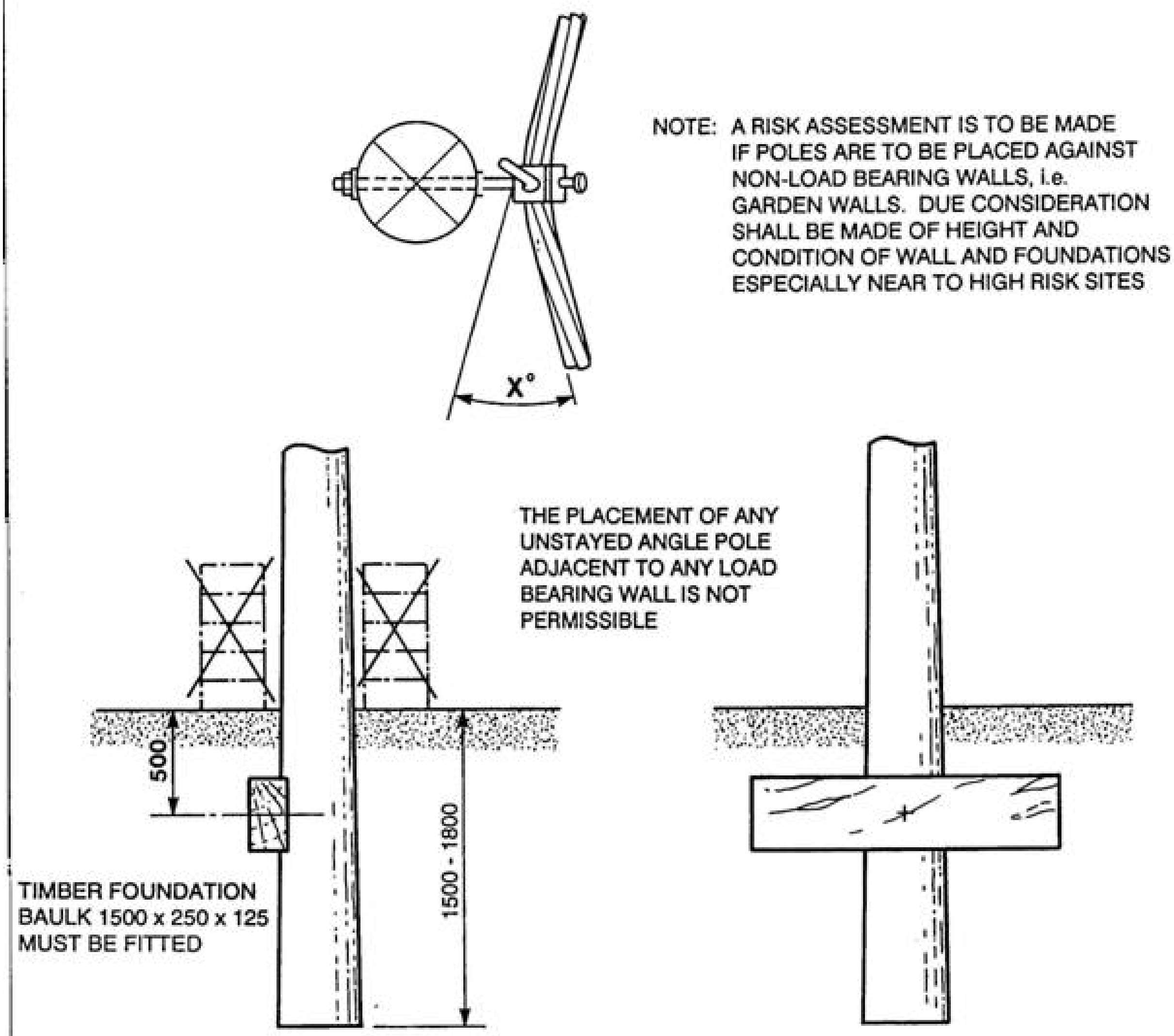
.sions				
scale	ABC LINK BOX FUSES AND LINKS	drawn	traced	drawing number
	SHEET 2 OF 2	approved	date	HQ.A4.51.09-412


IPC'S
NEUTRAL
3 PHASES
2 x IPC'S
LINK BOX
POLE BOX
CABLE GUARD
4.3m MIN (7m MAX)
ANTI-CLIMBING DEVICE
3 PHASES
2 x IPC's
LINK BOX
COMPRESSION CONNECTION
NOTE: IF 5 WIRE ABC IS USED, AN EARTH ELECTRODE IS OBLIGATORY FOR APPLICATION OF SAFETY EARTHS
INTERMEDIATE POLE
TERMINAL POLE
scale
ABC POLE BOX WITH LINK BOX
drawn
traced
drawing number
approved
date
HQ.A4.51.09-413


BUNDLE
ANCHOR CLAMP
NEUTRAL TAILED OUT
LV FUSES
LV FUSES
2 x IPC'S
POLE BOX
COMPRESSION FITTING
POLE BOX
EARTH DISCONNECTION POINT
ANTI-CLIMBING DEVICE
ANTI-CLIMBING DEVICE
CABLE GUARD
CABLE GUARD
INTERMEDIATE POLE
TERMINAL POLE
isions
scale
ABC POLE BOX WITH LV FUSES
drawn
traced
drawing number
approved
date
HQ.A4.51.09-414


IPC's
TAILED OUT COMPRESSION CONNECTOR
CAP
CLEATS
BLACK PVC COVERED COPPER CONDUCTOR 16mm MIN
BREAK POINT
ANTI-CLIMBING DEVICE
JUMPER LUG
3m
NOTE: A RISK ASSESSMENT IS TO BE MADE OF THE TYPE OF ACD TO BE FITTED WITH REGARD TO RISK CATEGORY OF SITES
.isions
scale
PME ELECTRODES
drawn
traced
drawing number
approved
date
HQ.A4.51.09-416


NEUTRAL
EARTH BAR
SERVICE CABLE
ABC MAINS
ABC SERVICE CONNECTIONS
NEUTRAL
MOISTURE SEAL
EARTH BAR
CNE/SCNE SERVICE CABLE
ABC MAINS
CNE/SCNE SERVICE CONNECTIONS
sions
scale
ABC DISTRIBUTION BOX
SERVICE CONNECTIONS
drawn
traced
drawing number
approved
date
HQ.A4.51.09-417



Wind span	PERMITTED ANGLES X°			
	Stout Poles		Medium Poles	
	Without service	With service	Without service	With service
Up to 40m	24 (19)	19.5 (15)	10.5 (8)	6.5 (4)
50m	23 (18)	18.5 (14)	9.5 (7)	5.5 (3)
60m	22 (17)	17.5 (13)	8.5 (6)	4.5 (2)
70m	21 (16)	17 (12.5)	8 (5.5)	3.5 (1)
80m	20 (15)	16 (11)	7 (4.5)	2.5 (0.5)
90m	19 (14)	15 (10)	6 (3.5)	2 (N.A.)

* Figures in brackets denote Factor of Safety (FS) 3.0

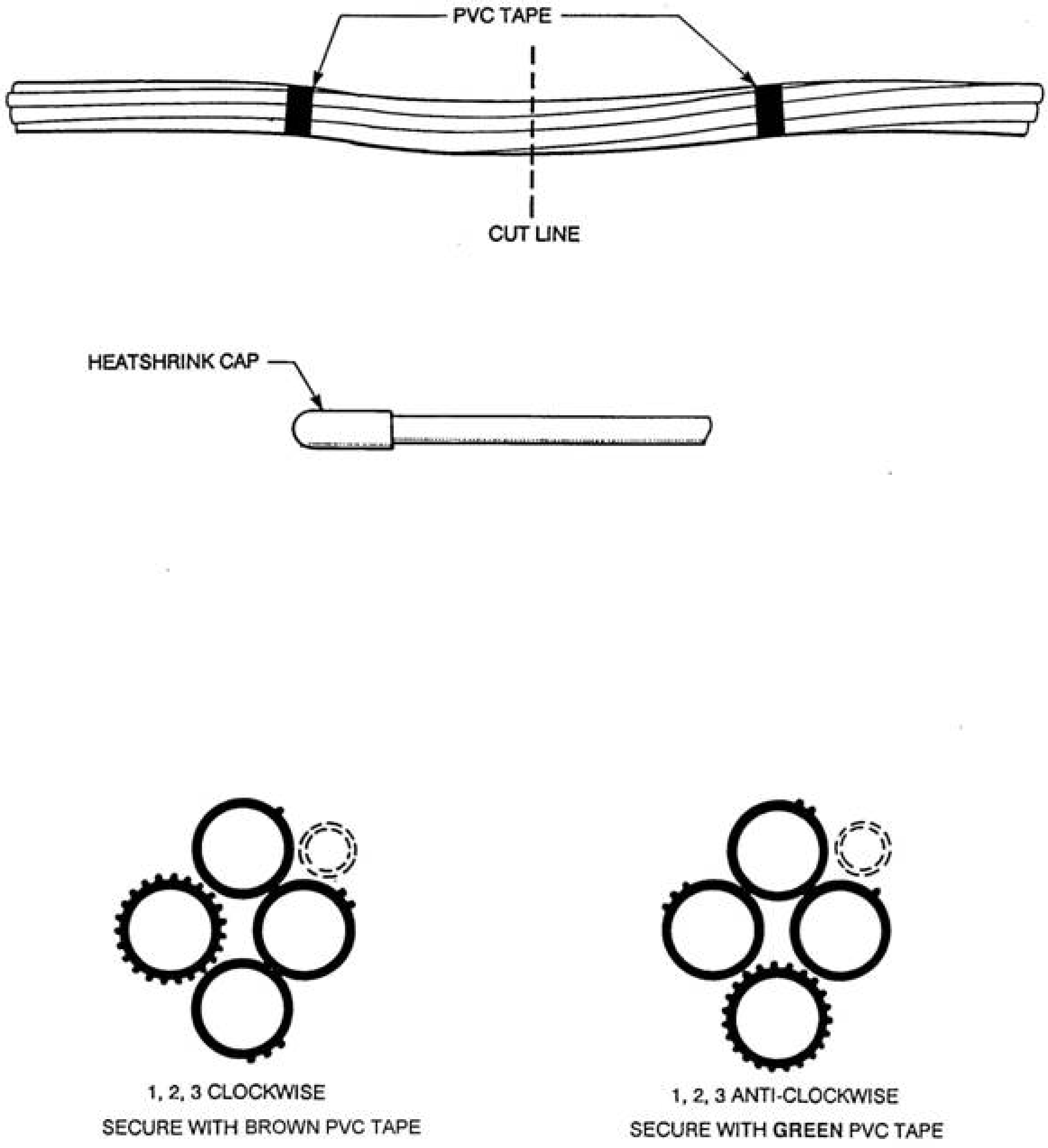
* For 5 wire A.B.C. use figures in brackets

sions

scale

UNSTAYED ANGLE POLES
PERMITTED ANGLES
(ALL WITH 1500 x 250 x 125mm BLOCK)

drawn | traced | drawing number
approved | date | HQ.A4.51.09-430



1. ALL ABC CUT ENDS SHALL BE SECURED TO PREVENT THEM FROM UNRAVELLING AND IDENTIFIED TO PREVENT BUNDLES BEING CONNECTED WITH THE WRONG LAY.

2. CONNECTING THE WRONG LAY WILL CAUSE THE BUNDLE TO UNRAVEL WHEN UNDER TENSION.

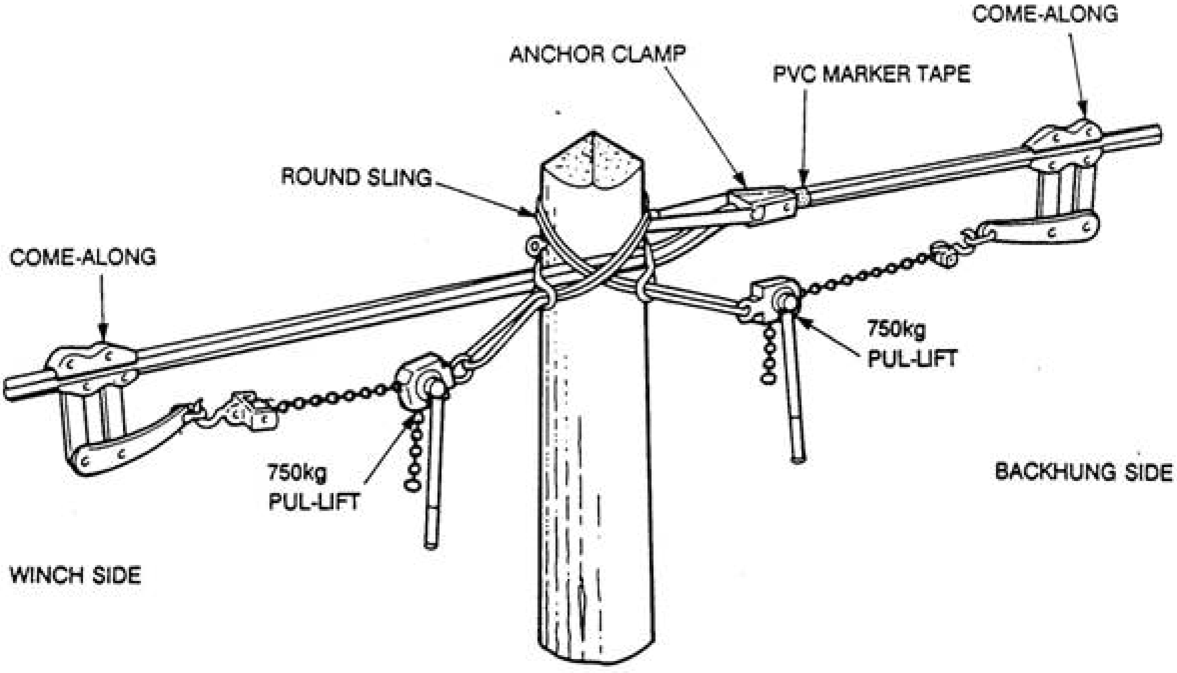
revisions

CUTTING AND CAPPING ABC

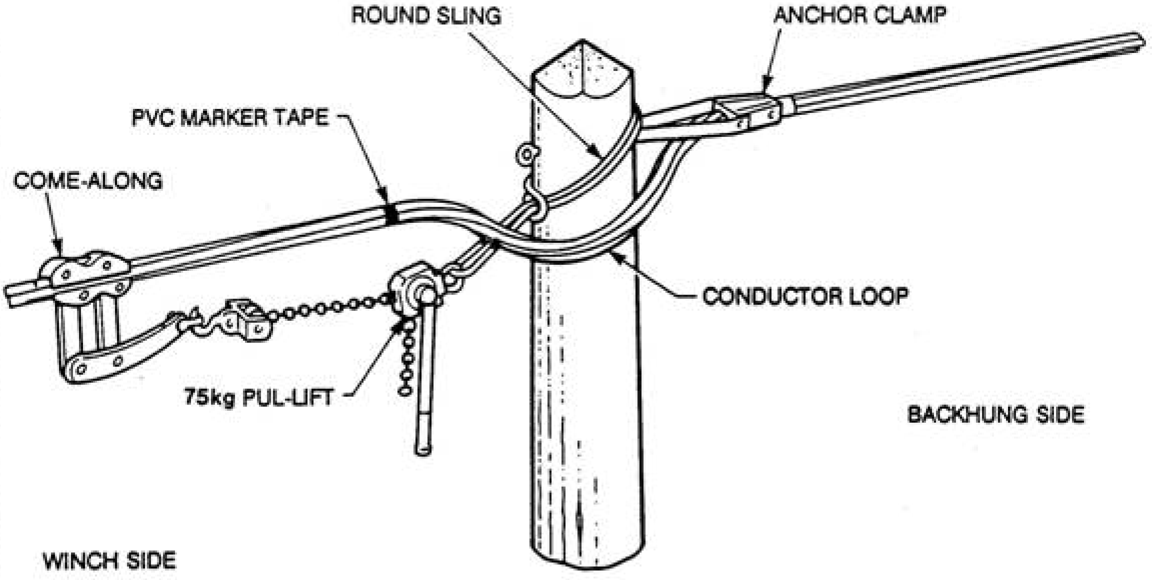
scale

drawn traced drawing number

approved date HQ.A4.51.09-440



r alons	CONNECTING ABC CONDUCTORS TO SECTION POLES		
scale		drawn	traced	drawing number
	SHEET 1 OF 2	approved	date	HQ.A4.51.09-443



visions

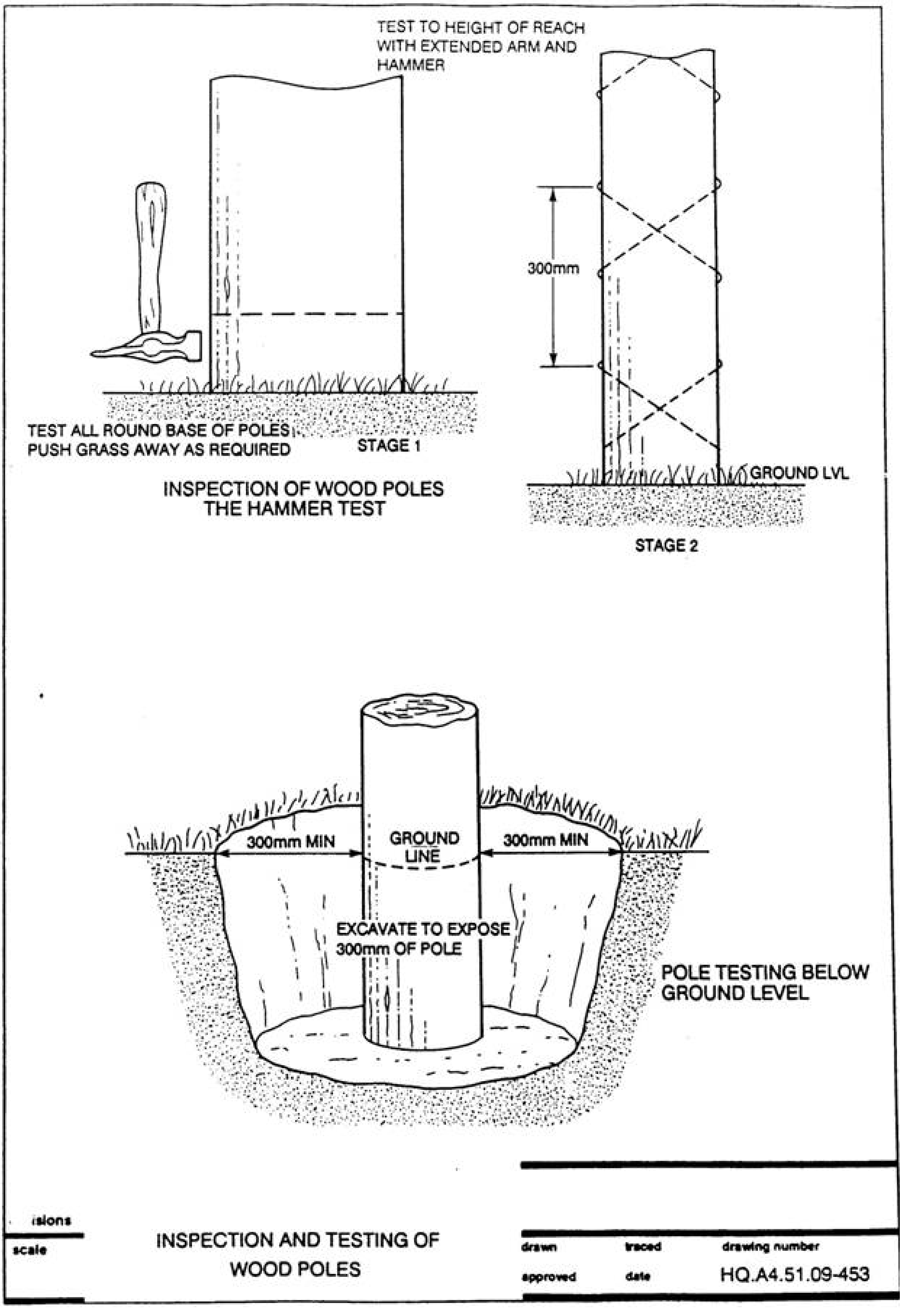
scale

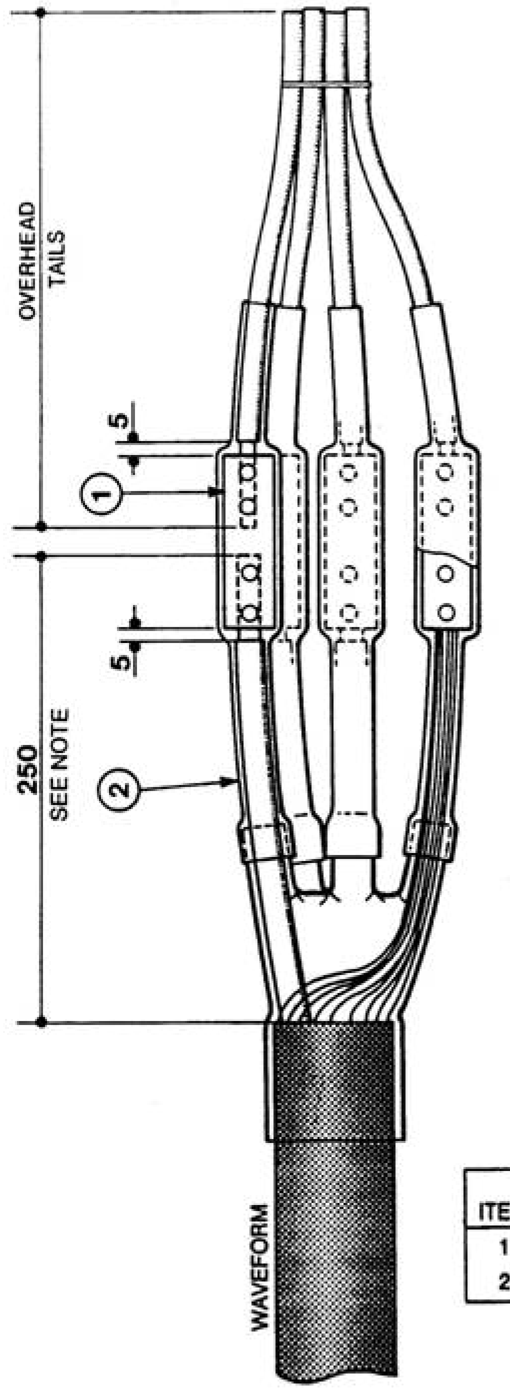
CONNECTING ABC CONDUCTORS
TO SECTION POLES

SHEET 2 OF 2

drawn | traced | drawing number

approved | date | HQ.A4.51.09-443


TEST TO HEIGHT OF REACH WITH EXTENDED ARM AND HAMMER
TEST ALL ROUND BASE OF POLES PUSH GRASS AWAY AS REQUIRED
STAGE 1
INSPECTION OF WOOD POLES THE HAMMER TEST
300mm
GROUND LVL
STAGE 2
300mm MIN
GROUND LINE
300mm MIN
EXCAVATE TO EXPOSE 300mm OF POLE
POLE TESTING BELOW GROUND LEVEL
isions
scale
INSPECTION AND TESTING OF WOOD POLES
drawn
traced
drawing number
approved
date
HQ.A4.51.09-453



NOTE: AN ADDITIONAL 150MM OF CABLE MUST BE STRIPPED TO ALLOW THE FORMATION OF NEUTRAL/EARTH WIRE

ITEM	DESCRIPTION	CABLE SIZE 95mm² COMMODITY CODE	CABLE SIZE 185mm² COMMODITY CODE
1	CONNECTOR KIT	143219	143219
2	HEATSHRINK KIT	142700	142700

evisions

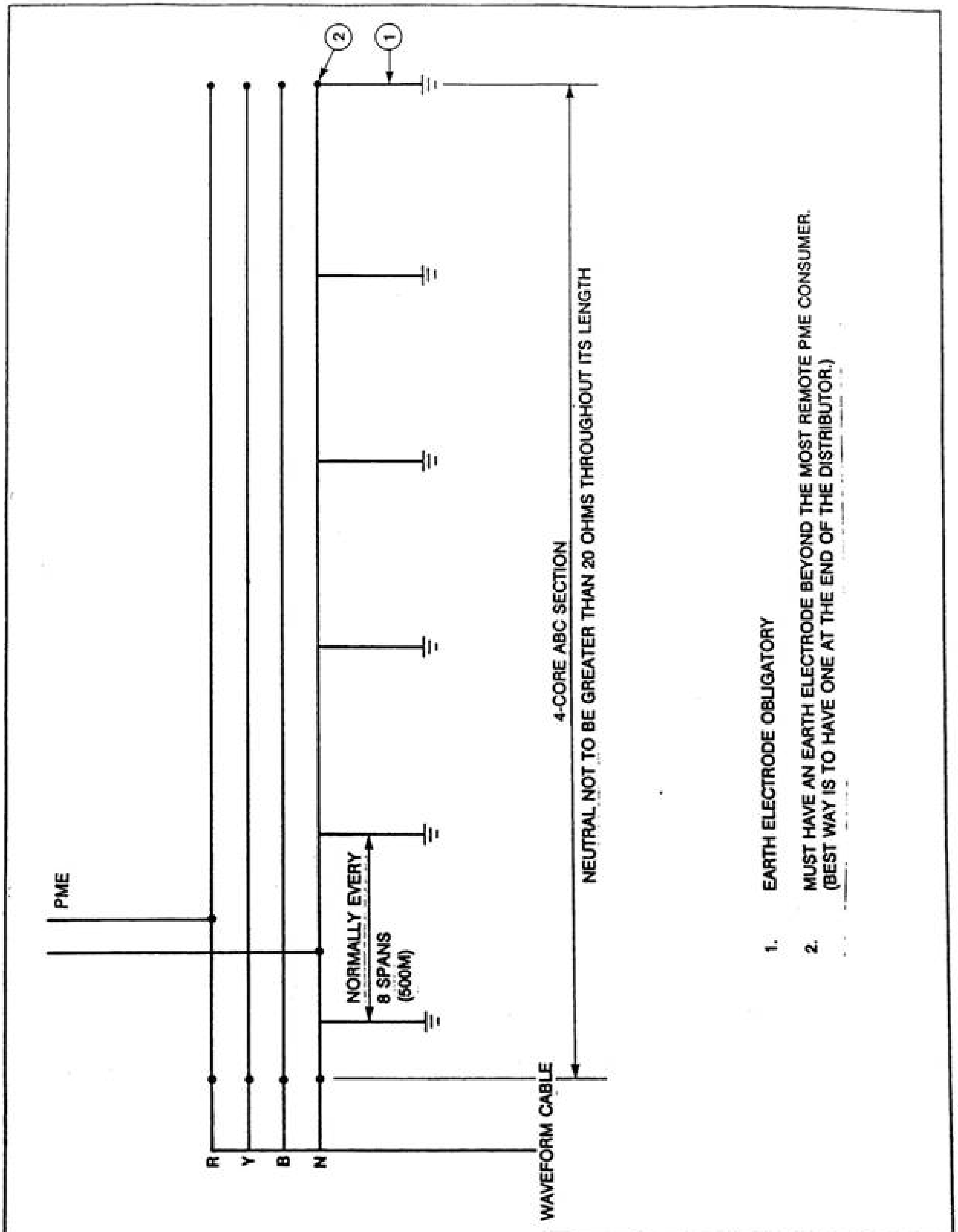
scale

3 CORE WAVEFORM POLE TOP TERMINATION

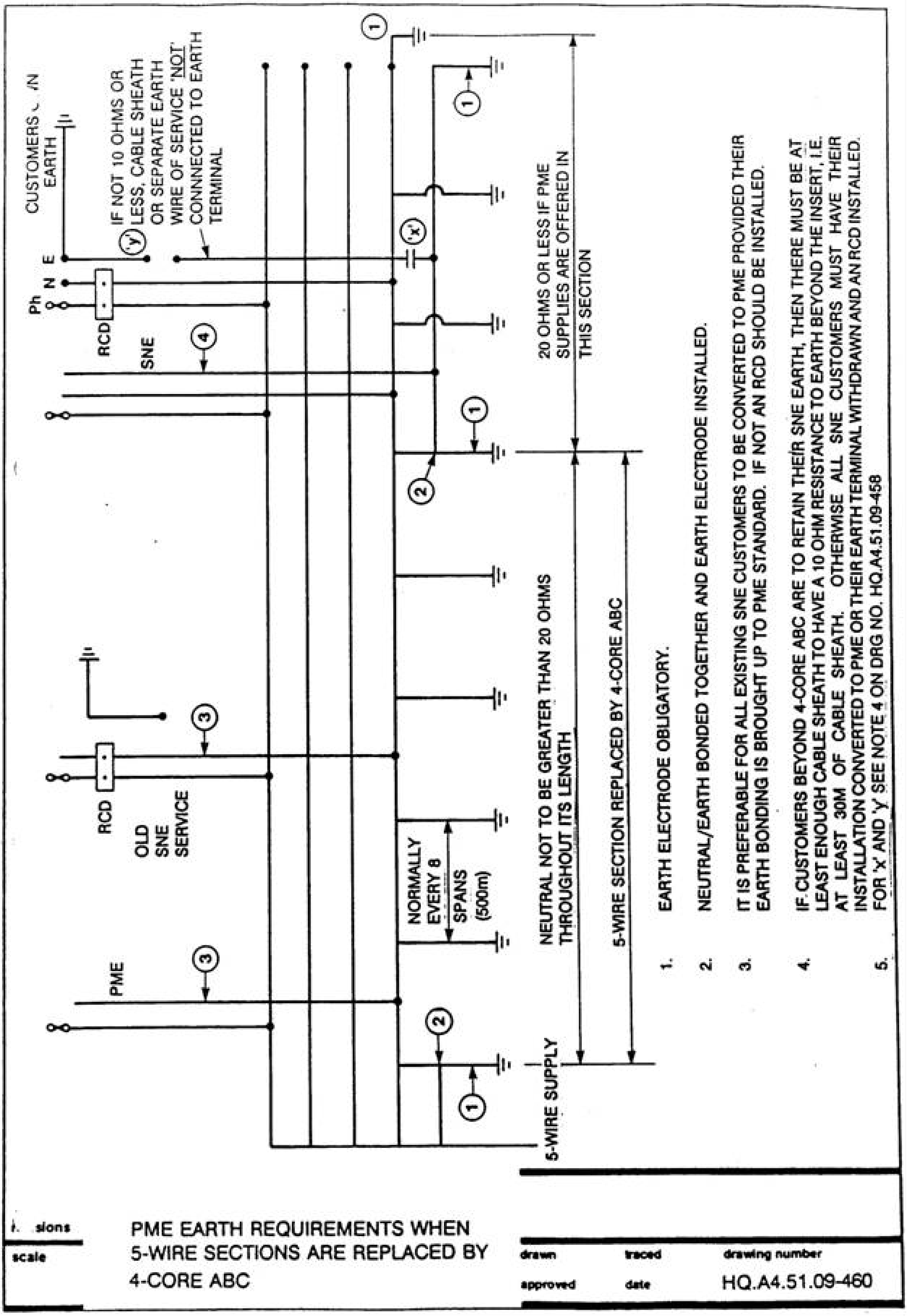
JP 3/301

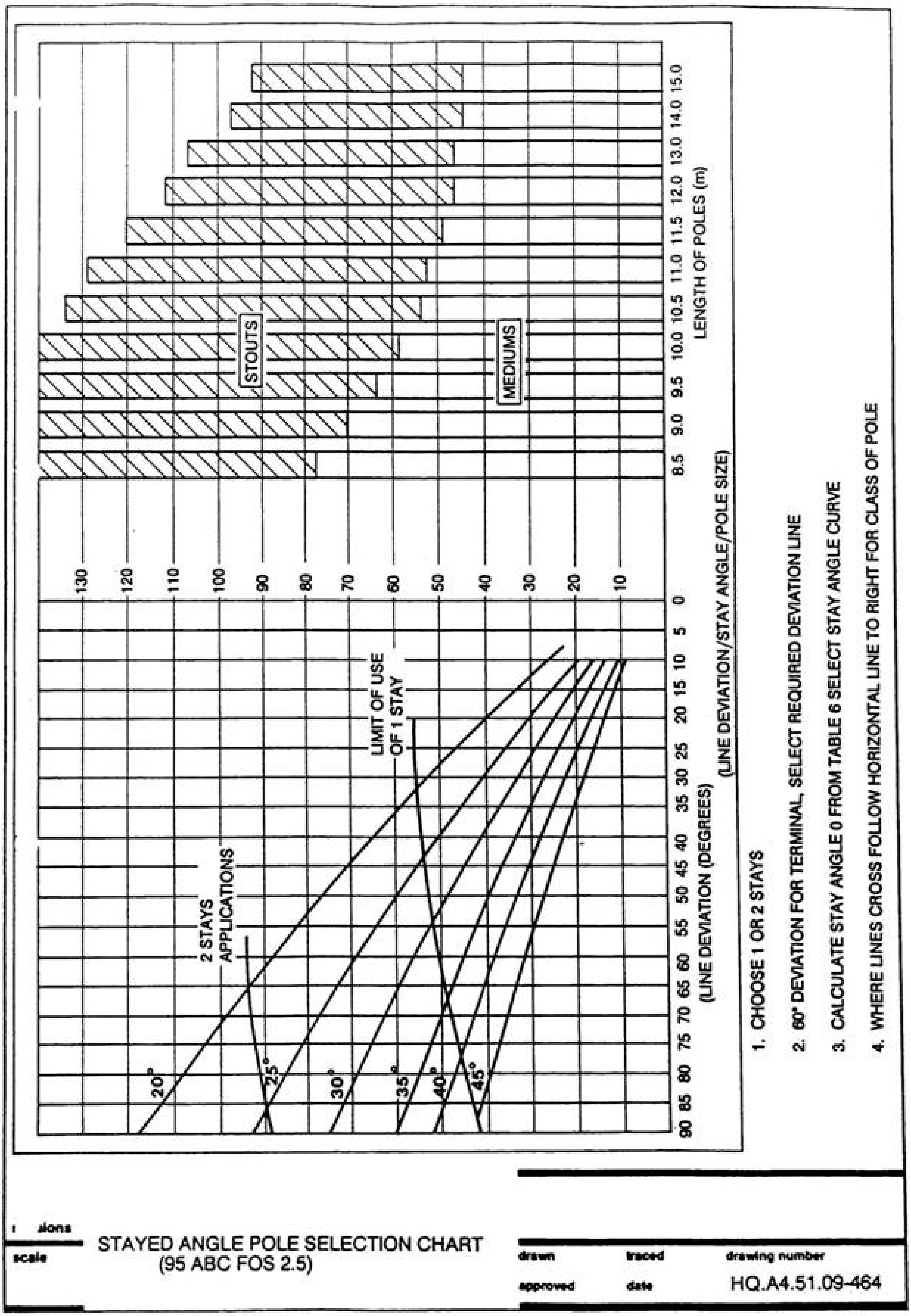
drawn | traced | drawing number HQ.A4.51.09-456

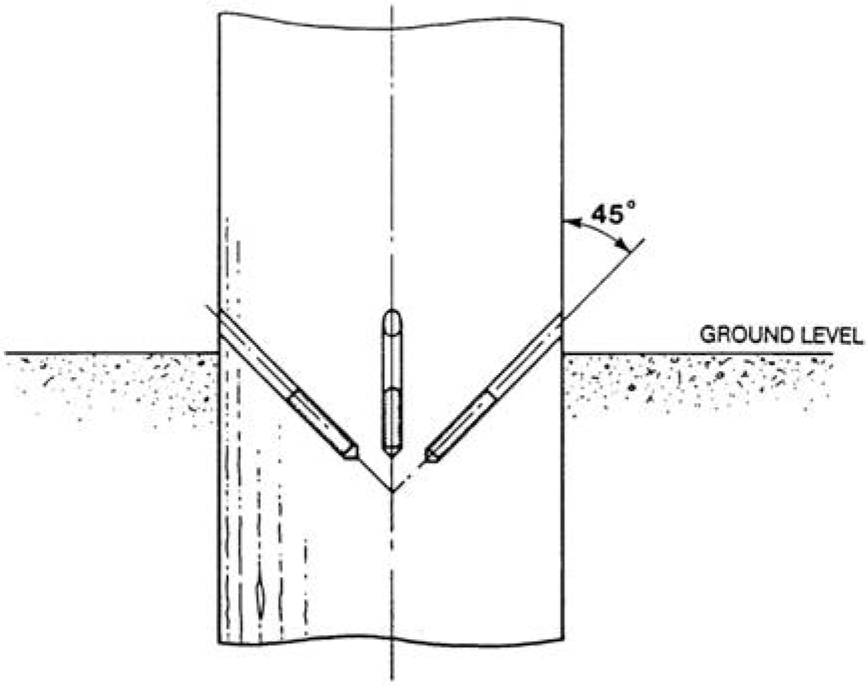
approved | date



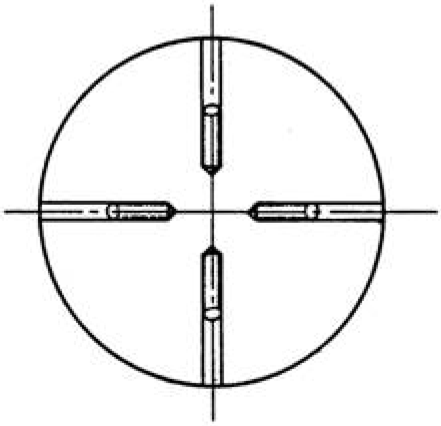
isions	PME EARTH REQUIREMENTS FOR 4-CORE WAVEFORM TO 4-CORE ABC			
scale		drawn	traced	drawing number
		approved	date	HQ.A4.51.09-459


CUSTOMERS OWN EARTH
IF NOT 10 OHMS OR LESS, CABLE SHEATH OR SEPARATE EARTH WIRE OF SERVICE 'NOT' CONNECTED TO EARTH TERMINAL
'Y'
'X'
Ph N E
RCD
SNE
20 OHMS OR LESS IF PME SUPPLIES ARE OFFERED IN THIS SECTION
OLD SNE SERVICE
NORMALLY EVERY 8 SPANS (500m)
PME
NEUTRAL NOT TO BE GREATER THAN 20 OHMS THROUGHOUT ITS LENGTH
5-WIRE SECTION REPLACED BY 4-CORE ABC
5-WIRE SUPPLY
1. EARTH ELECTRODE OBLIGATORY.
2. NEUTRAL/EARTH BONDED TOGETHER AND EARTH ELECTRODE INSTALLED.
3. IT IS PREFERABLE FOR ALL EXISTING SNE CUSTOMERS TO BE CONVERTED TO PME PROVIDED THEIR EARTH BONDING IS BROUGHT UP TO PME STANDARD. IF NOT AN RCD SHOULD BE INSTALLED.
4. IF CUSTOMERS BEYOND 4-CORE ABC ARE TO RETAIN THEIR SNE EARTH, THEN THERE MUST BE AT LEAST ENOUGH CABLE SHEATH TO HAVE A 10 OHM RESISTANCE TO EARTH BEYOND THE INSERT, I.E. AT LEAST 30M OF CABLE SHEATH. OTHERWISE ALL SNE CUSTOMERS MUST HAVE THEIR INSTALLATION CONVERTED TO PME OR THEIR EARTH TERMINAL WITHDRAWN AND AN RCD INSTALLED.
5. FOR 'X' AND 'Y' SEE NOTE 4 ON DRG NO. HQ.A4.51.09-458
scale
PME EARTH REQUIREMENTS WHEN 5-WIRE SECTIONS ARE REPLACED BY 4-CORE ABC
drawn
traced
drawing number
approved
date
HQ.A4.51.09-460


LENGTH OF POLES (m)
8.5 9.0 9.5 10.0 10.5 11.0 11.5 12.0 13.0 14.0 15.0
STOUTS
MEDIUMS
130 120 110 100 90 80 70 60 50 40 30 20 10
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90
(LINE DEVIATION/STAY ANGLE/POLE SIZE)
(LINE DEVIATION (DEGREES)
LIMIT OF USE OF 1 STAY
2 STAYS APPLICATIONS
20° 25° 30° 35° 40° 45°
1. CHOOSE 1 OR 2 STAYS
2. 60° DEVIATION FOR TERMINAL, SELECT REQUIRED DEVIATION LINE
3. CALCULATE STAY ANGLE 0 FROM TABLE 6 SELECT STAY ANGLE CURVE
4. WHERE LINES CROSS FOLLOW HORIZONTAL LINE TO RIGHT FOR CLASS OF POLE
STAYED ANGLE POLE SELECTION CHART
(95 ABC FOS 2.5)
scale
drawn
traced
drawing number
approved
date
HQ.A4.51.09-464

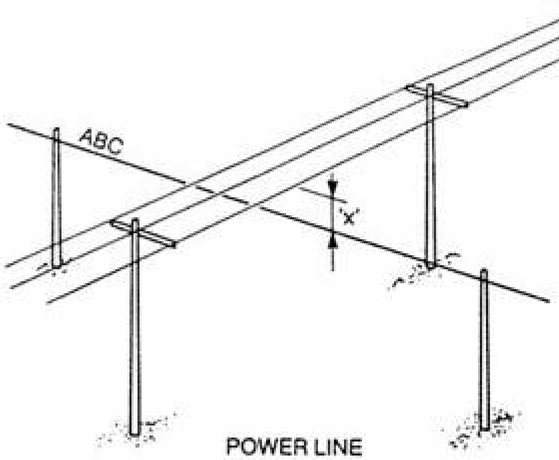


VERTICAL SECTION THROUGH POLE

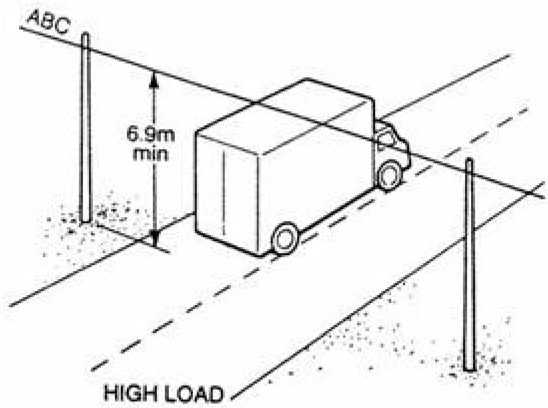


HORIZONTAL SECTION THROUGH POLE

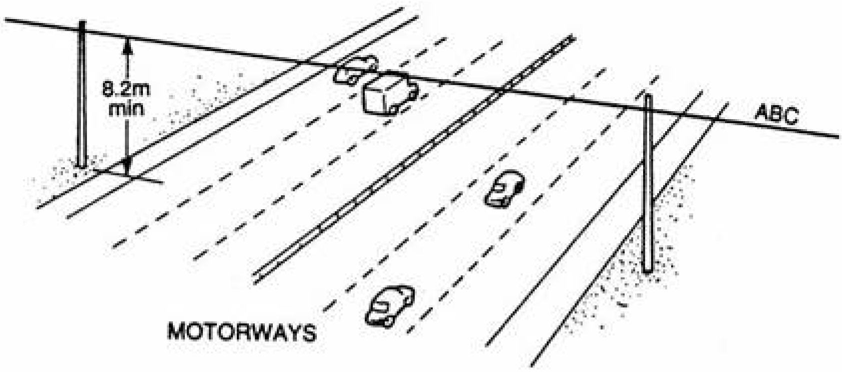
sions	INSTALLING BORON RODS			
scale		drawn	traced	drawing number
		approved	date	HQ.A4.51.09-468



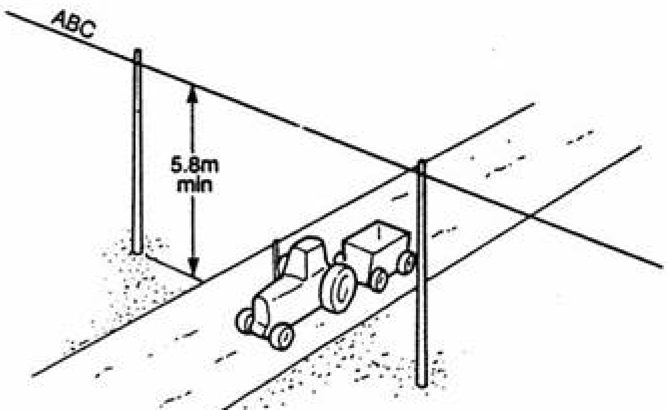
POWER LINE CROSSINGS



HIGH LOAD ROUTES



MOTORWAYS



ROAD CROSSINGS

TYPE OF LINE CROSSING	MINIMUM CLEARANCE 'x' (m)
LV OPEN WIRE	1.0 +
11 kV	1.8
33 kV	2.0
132 kV	2.7
275 kV	3.7
400 kV	4.4

.sions

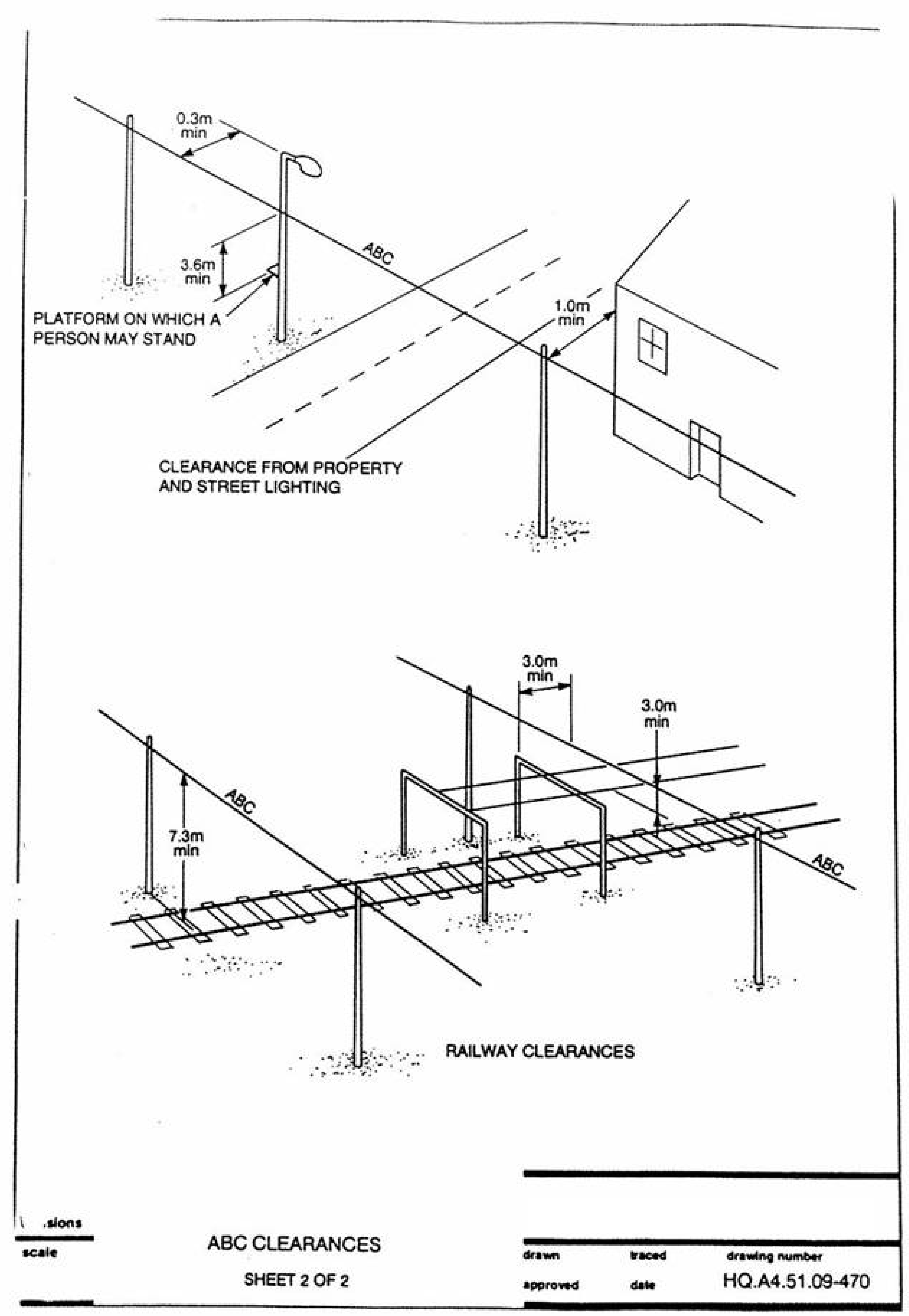
scale

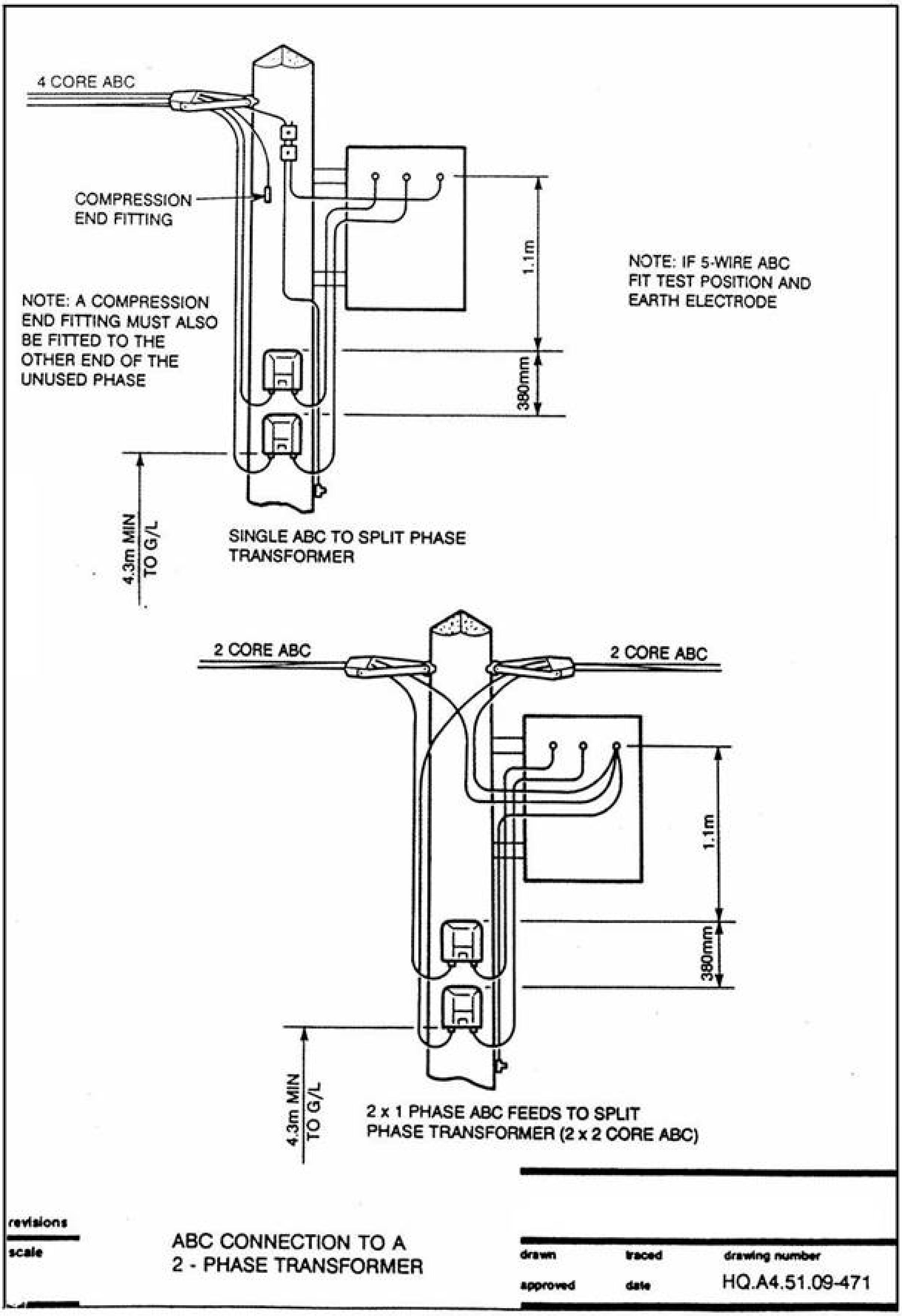
ABC CLEARANCES

SHEET 1 OF 2

drawn | traced | drawing number

approved | date | HQ.A4.51.09-470


0.3m
min
3.6m
min
ABC
PLATFORM ON WHICH A
PERSON MAY STAND
1.0m
min
CLEARANCE FROM PROPERTY
AND STREET LIGHTING
3.0m
min
3.0m
min
7.3m
min
ABC
ABC
RAILWAY CLEARANCES
.sions
scale
ABC CLEARANCES
SHEET 2 OF 2
drawn
traced
drawing number
approved
date
HQ.A4.51.09-470


4 CORE ABC
COMPRESSION END FITTING
NOTE: A COMPRESSION END FITTING MUST ALSO BE FITTED TO THE OTHER END OF THE UNUSED PHASE
1.1m
380mm
NOTE: IF 5-WIRE ABC FIT TEST POSITION AND EARTH ELECTRODE
4.3m MIN TO G/L
SINGLE ABC TO SPLIT PHASE TRANSFORMER
2 CORE ABC
2 CORE ABC
1.1m
380mm
4.3m MIN TO G/L
2 x 1 PHASE ABC FEEDS TO SPLIT PHASE TRANSFORMER (2 x 2 CORE ABC)
revisions
scale
ABC CONNECTION TO A 2 - PHASE TRANSFORMER
drawn
traced
drawing number
approved
date
HQ.A4.51.09-471