NSP/004/043 –Specification for Overhead Services, Surface Wiring and Eaves Wall Mains

1. Purpose

The purpose of this document is to provide a common specification detailing the requirements for new overhead services, surface wiring and under eaves mains. This specification has been prepared to satisfy the requirements of "The Electricity Safety, Quality and Continuity Regulations 2002.

This document supersedes the following documents, all copies of which should be destroyed;

Document Reference	Document Title	Version	Published Date
NSP/004/043	Specification for Overhead Services, Surface Wiring and Eaves Wall Mains	2.1	November 2010

2. Scope

This specification covers the application policy and constructional requirements for all new overhead line services including surface wiring / Eaves Mains 35mm² Hybrid concentric service cable and 2/4 core 35mm2 ABC.

Details on new LV ABC Overhead Lines can be found in NSP/004/041

Details on the renovation of existing open wire networks to ABC construction and additions to existing open wire networks are detailed in the supporting document NSP/004/041/001.

2.1. Table of Contents

3. Technical Specification

3.1. New Services

New services shall be provided via either: -

- Hybrid concentric service cables – see clause 3.1.1
- Aerial Bundled Conductors – see clause 3.1.2
- A combined overhead/underground arrangement – see clause 3.1.3

New services from low voltage overhead lines shall wherever possible, be installed underground using direct hybrid concentric service cable terminated in Outdoor Meter Cupboards. See clause 3.8 below and IMP/001/911 for further details on these requirements.

Where site conditions prevent installation of an underground cable or the costs are prohibitive compared to overhead, then services may be supplied by an overhead service span, subject to a maximum span length of 30m and compliance with the clearance requirements details in NSP/004/011.

In order to limit the stress imposed at the building attachment point and the transverse loading on the network pole due to these services, MWT's have been limited as follows:

- 1.3kN for Hybrid Concentric services spans
- 1.3kN for 4 core 35mm2 ABC services spans
- 0.65kN for 16mm2 HDCu PVC insulated service spans

When considering the length of the service span, due regard must be paid to the strength of that part of the building at the service attachment position.

Every endeavour shall be made to keep the aerial length of the service as short as possible, 20 m spans shall be normally regarded as the maximum, but, in special circumstances this may be increased to 30 m.

Although looped services are no longer permitted for new services installations, un-fused loops are permitted for the replacement of existing services see clause 3.6

3.1.1. Hybrid Concentric Services

3.1.1.1. 35mm2 Solid Aluminium Single Phase

Hybrid concentric service spans shall be erected in accordance with NSP/004/105 to the sag charts provided in Appendix 3 & 4, subject to a maximum span length of 30m. All conductor types shall be pulled up to tension by hand without the use of mechanical assistance.

Where the length of the service span (the span to the building) is greater than 30m and an underground option is not practical, the service shall be supplied by 2 core 35mm^2 ABC erected as a small service line. The maximum span length between the service poles forming the service line shall be 30m.

3.1.1.2. 35mm² Solid Aluminium Three Phase

Hybrid concentric service spans shall be erected in accordance with NSP/004/105 to the sag charts provided in Appendix 5 & 6, subject to a maximum span length of 10m. Spans in excess of this value shall be erected using three core ABC to reduce the increasing sags.

3.1.2. Aerial Bundled Conductor as Services

4 core 35mm^2 ABC service spans shall be erected in accordance with NSP/004/105 to the sag charts provided in Appendix 7 & 8, subject to a maximum span length of 30m.

All conductor types shall be pulled up to tension by hand without the use of mechanical assistance.

Where the length of the service span (the span to the building) is greater than 30m and an underground option is not practical, the service shall be supplied by 4 core 35mm^2 ABC erected as a small service line.

Unless out of balance stays can be installed at the last service span, the maximum span length between the service poles forming the service line shall be 30m. Where it is possible to install a discrete section of service line the span length may be increased to a maximum of 50m, and the tensions increased to 4.1kN

See NSP/004/041 Appendix 3 for sagging details.

Where larger service capacities are required, they shall be provided using 4 core 70mm2 ABC erected as a main line in accordance with NSP/004/041 Appendix 5 with the last span arranged as a slack span in accordance with Appendix 9. This method can only be used where it is possible to backstay against the significantly higher main line tensions.

Connections for the ABC bundle at the last service pole and the building shall be as detailed in clause 3.2.4 to 3.2.6.

3.1.3. A Combined Overhead / Underground Service Arrangement

This arrangement may be formed in two ways: -

- Where the property is supplied from an underground LV main, but where it is not practical to service the meter position with an underground service cable directly. In these circumstances a hybrid concentric service cable shall be breached off the underground main, taken up a conveniently located service pole and then attached to the building via a service span. The hybrid service shall be maintained as a continuous length of cable from source to destination. This arrangement normally evolves as the most cost-effective solution when an overhead main is converted to an underground network. Thus, after the removal of the overhead network conductors, the existing network poles can be utilised as service poles to the properties.

- Where multiple joined up properties (terraced houses) require servicing from an underground LV main and it is deemed impractical to provide a separate service aerial cable to each individual property.

In these circumstances a 3 phase 35mm^2 Hybrid service cable or a 70mm^2 Waveform cable shall be breached off the LV underground main, attached to the surface of the building and terminated into a fused ABC wall box to drawing no.1000431417 sht1. An ABC wall main or eaves main shall be used to supply hybrid concentric services into each property. See Clause 3.3.2 for more details on construction of Eaves Mains.

3.2. New Service Attachments and Connections

3.2.1. Hybrid Concentric Service Attachments at Pole End to ABC Networks

Concentric or split-concentric service cables shall be terminated onto coachscrew service insulators or reel insulators (as appropriate) using helical fittings to drawing no. 1091193152 as indicated on the general arrangement drawing no. 1000431215. See NSP/004/106 and NSP/004/107 for more detailed guidance on the terminations and connections at the pole.

Both phase and neutral connections shall be made using single bolt insulation piercing connectors to drawing no. 1000431414, sheet 1 ensuring where possible that a phase balance is maintained on the main. When the neutral connection is made, a wrap of four layers of PVC tape at 50 % overlap shall be applied to the stranded neutral prior to connection.

A cable tie shall be applied to secure the tapping conductor to the conductor bundle otherwise work hardening of the service conductor may occur leading to eventual failure.

The application of electrical connections to the ABC shall not impair the environmental protection afforded by the insulation. Any connection applied following the removal of insulation shall be provided with an effective method of resealing the conductor against the effects of the environment and shall not reduce the mechanical and electrical strength of the insulation of the system. Due regard shall be taken of the possibility of insulation retraction.

No insulation piercing connector shall be reapplied at the position of a previously removed connector.

When the number of single-phase services is likely to exceed four, or three phase services exceeds two, the service connections shall be obtained through ABC Multi-tap connectors.

3.2.2. Hybrid Service Connections at Pole End to Open Wire Networks

Concentric or split-concentric service cables shall be terminated onto coachscrew insulators or reel insulators (as appropriate) using helical fittings to drawing no. 1091193152 as indicated on the general arrangement drawing no. 1091193313. See NSP/004/106 and NSP/004/107 for more detailed guidance on the terminations and connections at the pole.

3.2.3. Hybrid Service Attachment and Connections to Buildings

Hybrid concentric service cables shall be attached to the building to in accordance with drawing no. 1091193314.

When fixing LV overhead service equipment onto customers premises always select routes and fixing points to avoid damage to the fabric of the building and discuss options with the customer were practical. Never use the mortar seam of the building if visible as a fixing point, or place fixings within 600mm of the edge of a free standing or untied wall such as a gable end.

Always fix attachments using expanding bolts or rawl bolts into 11mm plastic rawl plugs. Ensure that the fixing points on the bracket are shared across as many bricks as practicable.

The hybrid concentric service cables shall be run in one continuous length from the pole top to the termination in the cut out, care being taken not to infringe the minimum bending radius or ground clearances. See NSP/004/011 for more details on appropriate ground clearances.

Where service lead ins are routed across a building face they shall be supported along the run with polypropylene saddles as shown on drawing no. 1091193112. The maximum spacing between saddles shall be 300 mm horizontally and 450 mm vertically.

3.2.4. ABC Service Attachments at Pole End to ABC Networks

The ABC shall be terminated at the pole by means of an M20 eyebolt and an appropriately rated ABC anchor clamp.

ABC service connections to ABC networks shall be treated like a mains Tee-off connections using a double bolt insulation piercing connectors to drawing no. 1000431414, sheet 2. See drawing no. 1000431211 for details. Further guidance has been provided in NSP/004/106.

3.2.5. ABC Service Attachments at Pole End to Open Wire Networks

The ABC shall be terminated at the pole as by means of an M20 eyebolt and an appropriately rated ABC anchor clamp.

The ABC service shall be connected to the open wire network conductors using double bolt IPC's to Drawing No 1000431414 Sheet 3. Arrangement drawing 1000431208 generally details the connections to the open wire main.

The requirement for a PME earth at this location as shown on the drawing will be dependent upon the size of the ABC service connection and the existing PME earthing provisions within the network. For small two core ABC services it is unlikely to be required.

3.2.6. ABC Service Attachments and Connections to Buildings

The ABC shall be terminated onto the building in accordance with drawing no. 1000431217 sht2. The method of attachment to the fabric of the building shall be as detailed clause 3.2.2.

Hybrid service cables shall then be used as service lead-ins from ABC attachment point to the customers meter position. The Hybrid service cables shall be connected to the ABC service using single bolt IPC connectors in a similar way to that described in clause 3.2.1 for hybrid connections at pole positions to ABC networks.

3.3. Surface Wiring/Eaves Mains

3.3.1. General

Surface Wiring has historically been used as a generic term to describe two different wall main distribution systems within Northern Powergrid. Both systems provide the same functional outcome but using two distinctly different practical installation systems.

a) Surface wiring or wall mains (Yorkshire area)

This system was constructed from single core PVC insulated and PVC sheathed cables supported on the surface of the building using polypropylene cleats.

i) Three phase 35mm²CNE waveform or hybrid concentric service cables were typically used to supply the system, either via a wall box or jointed directly to the PVC insulated and sheathed cables. See drawing Y502L0101 (archived/historic) provided for historical reference

ii) Service branch connections were provided using single phase hybrid concentric CNE or SNE service cable jointed to the insulated and sheathed wall main.

b) Surface wiring or eaves main (Northern area)

This system was constructed from an ABC bundle supported on the surface of the building using appropriate ABC supports in accordance with ENA TS 43-12.

i) Three phase 95mm² CNE waveform cables were typically used to supply the systems via a 200A fused wall box.

ii) Service branch connections were provided by connecting hybrid service cables to the ABC main (using standard IPC connectors).

3.3.2. New Surface Wiring/Eaves Mains

All new surface wiring shall be provided using 4 x 35mm^2 or 4 x 70mm^2 ABC conductor as the surface wiring system. New PVC insulated and sheathed systems will no longer be installed.

Systems attached to buildings shall comply with the requirements of drawing numbers. 1000431219 and 1000431220. Account must be taken of the mechanical loadings on the building due to the attachment, which should not exceed 1.3 kN per fixing, unless special precautions are taken, and no system shall be constructed with full aerial tensions acting directly on buildings. All fixings should preferably be loaded in shear and not in tension. Angles of approach to buildings should take advantage of corners or structural features such that the angle to the building surface under load is minimised.

Where 4 x 35mm² ABC is used direct from an adjacent overhead network or as a slack span to bridge the gap between buildings, the ABC shall be terminated using a special reduced tension anchor clamp. All other sizes of ABC shall be terminated at the reduced tensions detailed in Appendix 9.

ABC attached to the face of a building shall be secured with fixing devices as specified in drawing no. 1000431409 to provide a minimum spacing of 10 mm between the core insulation and the surface of the building. The frequency of cleating at a maximum interval of 1000 mm shall be such that the ABC when erected shall not be allowed to touch the fabric of the building or be attached in such a manner that the ABC may inadvertently contact the building, after erection. Routing of ABC shall take into account potential points of hazard to the installed system.

All ABC cut ends shall be fitted with end caps or earthed with a PME connection similar to that shown in drawing no. 1000431209.

Where ABC is required to pass in close proximity (less than 50 mm) to any metallic pipe work or cables not part of the Company's network, the ABC shall be secured against contact or alternatively be protected from contact by means of additional protection.

Where ABC is adjacent to an opening in the building, such as a window, and there is a possibility of interference by persons from within the building, then additional proximity protection shall be fitted. In assessing the need for this protection, account should be taken of the design of the window. If for example, the opening or fixed lights are such that they inhibit access to the ABC, then additional protection will not be required. Typical areas where consideration has to be given to fitting proximity protection are shown on drawing no. 1000431219.

Where the attachment of ABC above 2.4 metres from ground level is such that there is a potential risk of mechanical damage by the movement of vehicles, or by the placing of materials/equipment, the ABC shall be additionally protected for mechanical purposes by means of a suitable non-conducting cable guard.

Proximity Protection: -

Black non-conducting split tubing with a minimum wall thickness of 1.5 mm to drawing no. 1000431411 shall be used in those situations where vehicular damage is unlikely (i.e., above 2.4 metres). Typical areas requiring proximity shrouding are detailed in drawing no. 1000431219. The tubing shall be secured by cable ties ensuring that the bundle is totally enclosed.

3.3.3. Service Connections to New Surface Wiring/Eaves Mains

Hybrid concentric service cable shall be connected to the ABC eaves main as detailed in clause 3.2.1.

3.4. Existing PVC Insulated & Sheathed Surface Wiring

Where it is proposed to renew existing surface wiring, the replacement wiring system will be an ABC Eaves Main compliant with this document or individual hybrid concentric service aerials.

It is appreciated that each situation must be considered individually. The general arrangement drawings are therefore intended to provide guidelines on the preferred arrangements and to specify the application of approved fittings. The selection of cable size, type and route shall be determined locally using the criteria of cost, load, volt drop and amenity.

3.5. Existing Open Wire Service Spans

PVC covered open wire services aerials shall no longer be installed on new services. However existing services may be retained providing the following criteria is confirmed: -

- The service aerial complies with the min ground clearance requirements detailed in table 3.6.1 of NSP/004/011 i.e., 5.2m at any point not over a road and 5.8m at any point over a road.

Note – Concentric service cables are classified in NSP/004/011 as effectively insulated conductors and as such can benefit from the reduced clearance allowances in table 3.6.3.1 i.e., 4.3m (providing the conductor does not cross over any public roadways). Hence replacing an open wire service with a concentric service can sometimes assist in complying with difficult clearance infringements.

- All service aerial phase conductors are PVC insulated throughout their length from the network pole to the service lead in cable and they have a minimum CSA of 16mm^2.

Note: - Providing the integrity of any bare service aerial neutral conductors can be confirmed and that they comply with all other requirements of this clause it is no longer necessary to replace the service just because it is un-insulated.

- All connections between the open wire services and concentric lead in cables shall utilise insulated mechanical service connectors as detailed on drawing no. 1091193311 maintaining a complete fully insulated system. Any exposed bare conductor shall be insulated with a wrap of outdoor grade PVC insulating tape.
- The neutral conductors of the service spans are positioned 150 mm above the phase conductors (see exception were service aerial is in proximity to BT lines).
- All service lead-ins utilise concentric CNE or SNE service cables.
- When an open wire service aerial without a continuous earthwire is replaced and there is an existing SNE type lead in cable then care must be taken to ensure that the earth continuity conductor in the SNE cable is left disconnected at each end and covered with two layers of approved PVC tape. It shall not be connected to the neutral.

3.5.1. Service Spans in Proximity to Telecommunication Service Lines

The requirements for crossings and proximities of Northern Powergrid Low voltage service cables and telecommunication service lines are detailed within PO5.

Where telecommunication service lines and aerial service conductors are attached to a building, they may be erected above or below the aerial service conductors providing the following clearances are achieved and that at least one set of plant is insulated sufficiently for the voltage of the aerial service.

DNO Cable Type	Clearance from Telecommunication Cables when Telecommunication cables are below	Clearance from Telecommunication cables when Telecommunication cables are above
Concentric Neutral Service cable	200mm	200mm
ABC	600mm	400mm
Open Wire	900mm	900mm

At crossing points which are within 600mm of the support points, e.g., respective poles or house/building fixing points) then appreciable movement of the lines due to temperature or ice loading can be considered to be unlikely. In these cases, the vertical clearance can be reduced to 400mm.

Where Northern Powergrid service cables and telecommunication service lines are attached to the same building, then the clearance between the respective points of attachments shall be as follows: -

Northern Powergrid Cable Type	Clearance to Telecommunication Cables
Concentric Neutral Service Cable	200mm
ABC	600mm
Open wire service cable	600mm

The clearances above are taken from the edge of any fixing position or brackets used.

Where telecommunication cables and Northern Powergrid cables run parallel, cleated to walls or fixed to walls or other surfaces, there shall be a minimum separation of 500mm between two sets of plant.

3.5.2. Attachment to Buildings

The open wire service aerials shall be attached to buildings using house service brackets to drawing numbers. 1091193311 or 1091193314.

The service aerial conductors shall be terminated onto the house service brackets using helical grip dead ends as shown on drawing numbers. 1091193155 ensuring that a 150 mm tail is left protruding through the preformed helical fitting to allow subsequent attachment of the concentric lead in cables.

The connection to the open wire service aerial shall be made using insulated compression sleeves to drawing no. 1091193150. Any exposed bare conductor shall be insulated with a wrap of outdoor grade PVC tape to maintain a fully insulated system. For more information on service terminations see NSP/004/106.

3.5.3. Attachment to Poles

Open wire service aerials shall be fixed to the network poles using insulated attachments as shown on the general arrangement drawing no. 1.091193310 and 1091193313.

3.5.4. Multi-Phase Service Aerials

Where two or three of the above service aerials are used constituting a single phase 3 wire or three phase 4 wire service respectively, then the neutrals of each cable shall be paralleled at the terminations on each end of the cable.

Provided there is a continuous earth wire on the overhead network, the earth continuity conductors in SNE cables shall be paralleled and connected to the continuous earth wire at the 'supply end' of the cable and at the service termination end of the cables to the earth terminal.

3.6. Wiring within Buildings

Extensive existing cable runs within buildings are generally unacceptable

However, non sub-fused existing service positions may be retained and or replaced providing the maximum run of the service does not extend beyond the depth / width of a house or up and down half a floor.

E.g., it is unnecessary to install fused wall boxes for services that run through lofts and down to service positions on upstairs landings (or thereabouts) or for an underground service cable to run to a position beneath the stairs.

Similarly, it is acceptable to install an un-fused replacement service to an upstairs property or a back/back branch to next door and to install three phase cut-outs with multiple back-to back branches (e.g., Tyneside flats)

In all cases the cables runs must utilise PVC or XLPE insulated concentric cables that are in good condition and free from joints.

Where no practical solutions are available to re-locate service positions that fall outside of the above criteria, the service position may be retained/replaced provided that the service cable is sub-fused.

No new service cables shall be run through buildings unless it is not practical to do otherwise and where this is the case the cable must be installed through a 38mm duct to allow easy replacement.

3.7. Wall Boxes

Drawing no. 1000431417 sht1 provides details on a typical ABC fused wall box. Typically, the fused wall boxes will be installed with 200A fuses to provide discrimination against the 100A service fuses.

3.8. Outdoor Meter Cupboards

All new services will preferably be provided into an outdoor meter cupboard. Drawing numbers 1121020177 Sht 5 and Sht 6 provide details on approved service arrangements into outdoor meter cupboards.

Two types of outdoor meter cupboard are available; -

a) Surface mounted

b) Flush mounted

Where the property is supplied using an outdoor surface mounted cabinet, the cabinet shall be serviced by entering the cabinet from the top as shown in drawing 1121020177 Sht 6. The cable from the cabinet entry point to the high-level wall attachment shall be run vertically up the wall with cleats spaced a maximum of 400mm apart and protected with a suitable sized conduit of capping.

Where the customer has a flush mounted cabinet, this must be serviced from below using a hockey stick arrangement as used on normal underground services. In order to create a continuous duct arrangement and thus aid the future replacement of a service supplied in this way it is recommended that the female connectors of the two hockey sticks are joined together with a short length of service duct.

Adequate precautions must be taken to prevent water entering the cabinet.

Note: -

In line with the requirements of IMP/001/911 the minimum service csa for a new property serviced using an external duct/capping arrangement shall be 35mm^2.

3.9. Public Lighting Services

Public lighting service cables shall be connected to new ABC networks using single bolt IPCs to drawing No. 1000431414, sheet 1, ensuring that the conductor ends are doubled prior to the application of a wrap of four layers of PVC tape at 50% overlap. All services must be secured to the bundle using nylon cable ties.

All new public lighting services shall be in accordance with the requirements of Engineering Recommendation G39/1 "Model Code of Practice Covering Electrical Safety in the Planning, Installation, Commissioning & Maintenance of Public Lighting and Other Street Furniture".

3.10. Service Connections to Public Telephone Housings

Service connections to telephone housing shall be compliant with Engineering Recommendation PO4/1.

3.11. Hybrid Service Cable Connected to Pole Mounted Transformers (U/G Service Cable)

Drawing no. Y502L0115 & Y502L0116 have been provided to detail typical connection requirements to enable Hybrid single and three service cable to be terminated into LV pole mounted fuse cut-outs on transformer poles.

3.12. Hybrid Service Cable Connected to Typical Line Pole (U/G Service Cable)

Drawing no Y502L0114 has been provided to detail a typical connection arrangement for a three-phase hybrid concentric service cable connected to an open wire network.

3.13. Clearances

The minimum height of all service conductors and clearances to other objects shall be compliant with Code of Practice NSP/004/011. The above document supplements the basic clearance requirements as recommended by ENA TS 43-8 "Overhead Line Clearances" with any additional Company requirements to compensate for long term conductor creep etc.

The statutory ground clearance at any point not over a road is 5.2m and over a road is 5.8m as quoted in clause 3.6.1.1 or 3.6.1.2 of NSP/004/011. The ESQCR regs do not apply reduced clearances just because it is a service span.

3.14. Earthing

Under the new ESQC regulations, Reg 24 (4) the company has a statutory requirement to provide new customers with earthing facilities. It is the company's policy to try to meet this requirement through the provision of a PME earth wherever feasible.

Only where a customer's installation is not suitable for a PME earth shall a SNE earthing terminal be provided.

Reg 24

(4) "Unless he can reasonably conclude that it is inappropriate for safety, a distributor shall, when providing a new connection at low voltage, make available his supply neutral conductor or, if appropriate, the protective conductor of his network for connection to the protective conductor of the consumer's installations".

(5) "In this regulation the expression "new connection" means the first electric line or replacement of an existing electric line, to one or more consumer's installations".

Earthing shall be compliant with IMP/010/011 "Code of practise for earthing LV Networks and HV Distribution Substations".

Additional information related to LV networks can be found in NSP/004/041 clause 3.11

The following key values or requirements have been inserted for ease of reference.

PME connections shall be made using a single double bolted Insulation Piercing Connector as shown on drawing no. 1000431414 Sht 2. The connection to earth shall be made using 32 sq.mm Hard Drawn Copper insulated with black PVC.

At the cut end of ABC eaves-mains this will form the end of the LV network and the neutral conductor must be connected to earth in accordance with drawing no. 1000431209.

3.15. Service Aerials Attached to Chimney's

Historically service aerials where attached to chimneys to facilitate increased ground clearances. This practice is no longer acceptable for new or replacement services as no safe practical methodology exists to gain access to these attachment positions. As under the working at height regulations the use of roof ladders is no longer acceptable with these positions now needing to be accessed via scaffolding or MEWP (Mobile Elevated Working Platform).

The exception to the above statement (which is only acceptable for replacement services) is where the service is attached to a chimney on the gable end of a property that can be accessed from a MEWP or a ladder that can be placed against the gable end.

Where this attachment position is re-utilised, it shall be achieved through the use of the following: -

- The replacement service must be a concentric service cable terminated with limited tension helical deadends (the helical deadends are designed to slip where the line tension increases due to ice loading etc. in excess of 1.3kN). Existing chimney brackets shall be secured to the chimney using a loop of galvanised wire wrapped around the chimney with protective corner pieces thus distributing

the load around the outside of the chimney. It is not acceptable to create a single point load attachment using a standard service bracket secured to the chimney with rawl bolt fixings.

Where it is not possible to comply fully with the above criteria, then the existing service arrangement must be re-engineered via the installation of a service pole adjacent to the property or the installation of an underground service.

4. References

4.1. External Documentation

Reference	Title
ENA TS 43-8	Overhead Line Clearances
ESQCR	The Electricity Safety, Quality and continuity Regulations 2002, SI 2665
G39/1	Model Code of Practice Covering Electrical Safety in the Planning, Installation, Commissioning & Maintenance of Public Lighting and Other Street Furniture
PO4/1	Services to BT Public Telephone Housings
PO5	Protection of Telecommunication Lines from Power Lines

4.2. Internal Documentation

Reference	Title
IMP/001/911	Code of Practice for the Economic Development of the LV System
IMP/010/011	Code of Practice for Earthing LV Networks and HV Distribution Substations
NSP/004/011	Guidance on Overhead Line Clearances
NSP/004/041	Code of Practice for the Construction of LV ABC Overhead Lines
NSP/004/041/001	Specification for the renovation of existing LV O/H Lines
NSP/004/105	(OHI 5) Guidance on the selection, erection and sagging of O/H line conductors
NSP/004/106	(OHI 6) Guidance on the Selection and Application of Conductor Joints, Terminations & Binders
NSP/004/107	(OHI 7) Guidance on the selection of conductor jumpers and non-tension connections

4.3. Amendments from Previous Version

Reference	Description
3.2.1 – Attachments to ABC for Multiple Services	The use of service distribution boxes has been replaced with multi-tap connectors
Appendix 1 – Arrangement Drawings	Non-compliant branding document templates removed
Section 3.0 – Technical Specification	The use of 25mm² aluminium service cable has been removed for new services
Whole Document	Reference to British Telecom (BT) has been replaced with telecommunication provider

5. Definitions

Term	Definition
n/a	

6. Authority for Issue

6.1. CDS Assurance

I sign to confirm that I have completed and checked this document and I am satisfied with its content and submit it for approval and authorisation.

		Date
Deb Dovinson	Governance Administrator	18/03/2024

6.2. Author

I sign to confirm that I have completed and checked this document and I am satisfied with its content and submit it for approval and authorisation.

Review Period - This document should be reviewed within the following time period:

Standard CDS review of 3 years?	Non-Standard Review Period & Reason	
Yes	Period:	Reason:
Should this document be displayed on the Northern Powergrid external website?		Yes
		Date
Steven Salkeld	Policy and Standards Engineer	25/03/2024

6.3. Technical Assurance

I sign to confirm that I am satisfied with all aspects of the content and preparation of this document and submit it for approval and authorisation.

		Date
Ged Hammel	Lead Policy and Standards Engineer	26/03/2024

6.4. Authorisation

Authorisation is granted for publication of this document.

		Date
Paul Black	Head of System Engineering	05/04/2024

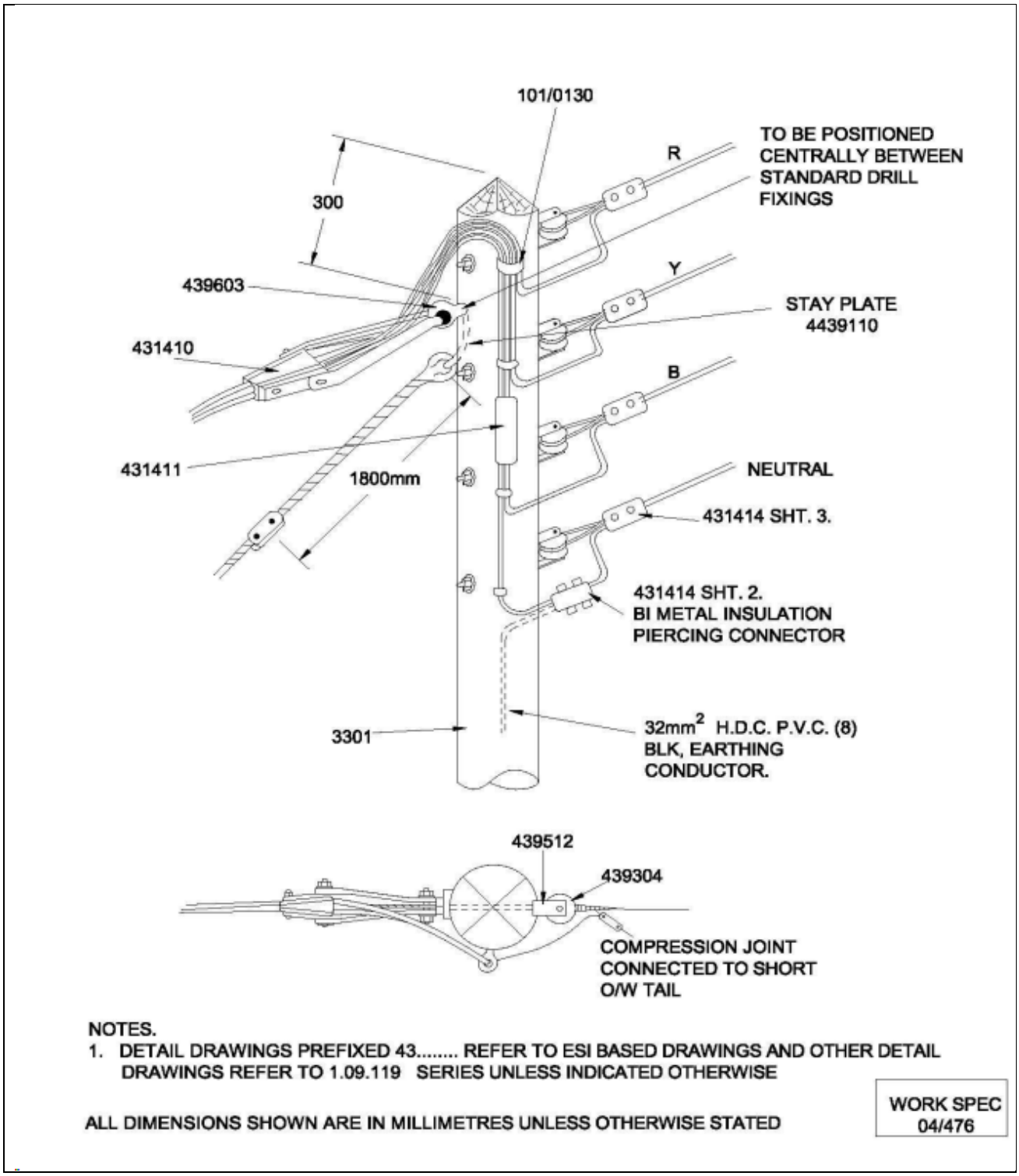
Appendix 1 – Arrangement Drawings

Drawing Number	Drawing Title	Comments
1000431208	Transition Support ABC to Open Wire	Included to show typical termination of ABC slack span to open wire network
1000431209	Arrangement of Typical ABC Terminal Support	Included to show Typical PME connection on the end of an ABC Eaves Main bundle
1000431211	Arrangement for Typical ABC Tee-off from Intermediate pole	Included to show typical slack termination and connection of ABC slack span to ABC Network.
1000431215	Arrangement for typical multiple service take off from ABC network	Included to show typical connections for Hybrid concentric service cable terminated on ABC network
1000431217 Sht 2	Arrangement of typical attachments to buildings	Included to show typical termination of ABC slack span to a building
1000431219	Area's requiring proximity protection	Included to show typical area's requiring proximity protection
1091193310	Typical open wire service attachment to line pole showing alternative types of insulator	Included to show typical service or service line attachment to open wire network pole
1091193313	Typical aerial hybrid concentric service cable attachment to line support	Included to show typical termination and connections for hybrid service connected to open wire network pole.
1091193314	Typical aerial concentric service cable attachment to buildings	Included to show typical hybrid service cable or open wire service span attachment to a building
1121020177 Sht 1	Standard ENA TS 12-3 Meter Cabinet with cable entry from below	Included to show typical hybrid service termination entry into outdoor meter cupboard
1121020177 Sht 6	Standard ENA TS 12-3 Meter Cabinet with down coming surface mounted service cable	Included to show typical hybrid service termination entry into outdoor meter cupboard
Y502L0101	General Arrangement using PVC Insulated PVC sheathed single core copper conductor	Included only to highlight past wall mains arrangement. - No longer approved for new installations
Y502L0114	3 Phase CNE 35mm2 service cable connection to line support	Included to show typical connection arrangements for 3 phase U/G Hybrid service Cable
Y502L0115	Hybrid concentric service connection to pole mounted transformer	Included to show typical hybrid to transformer service connection to fuse's
Y502L0116	3 Phase CNE 35mm service cable connections to pole mounted transformer	Included to show typical hybrid to transformer service connection to fuse's

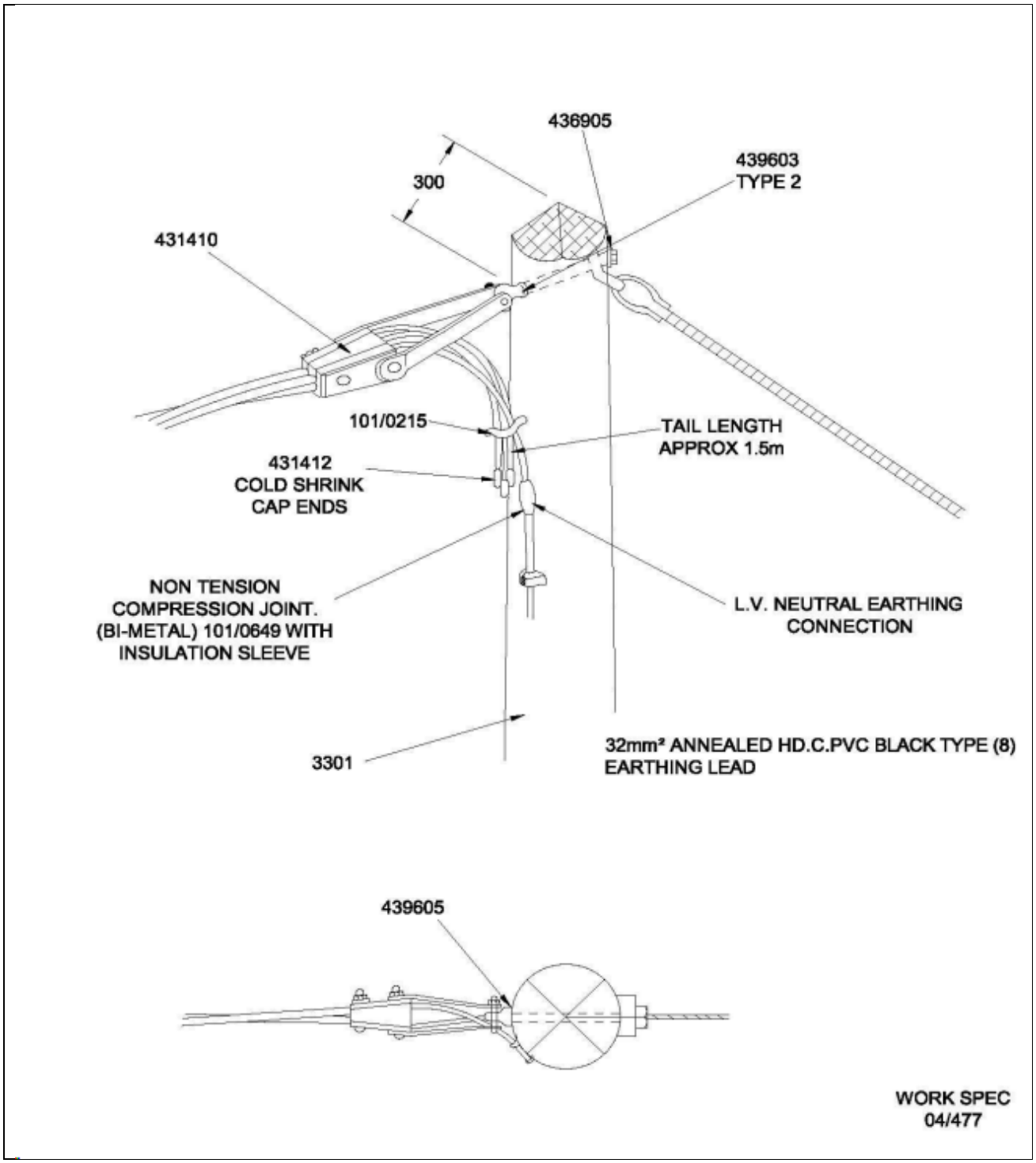
Notes.

Drawings included within this specification have been limited to those associated with general arrangements. Other drawings specific to components may be viewed via the company's intranet by using the "Search by Drawing No." application located under the applications menu system.

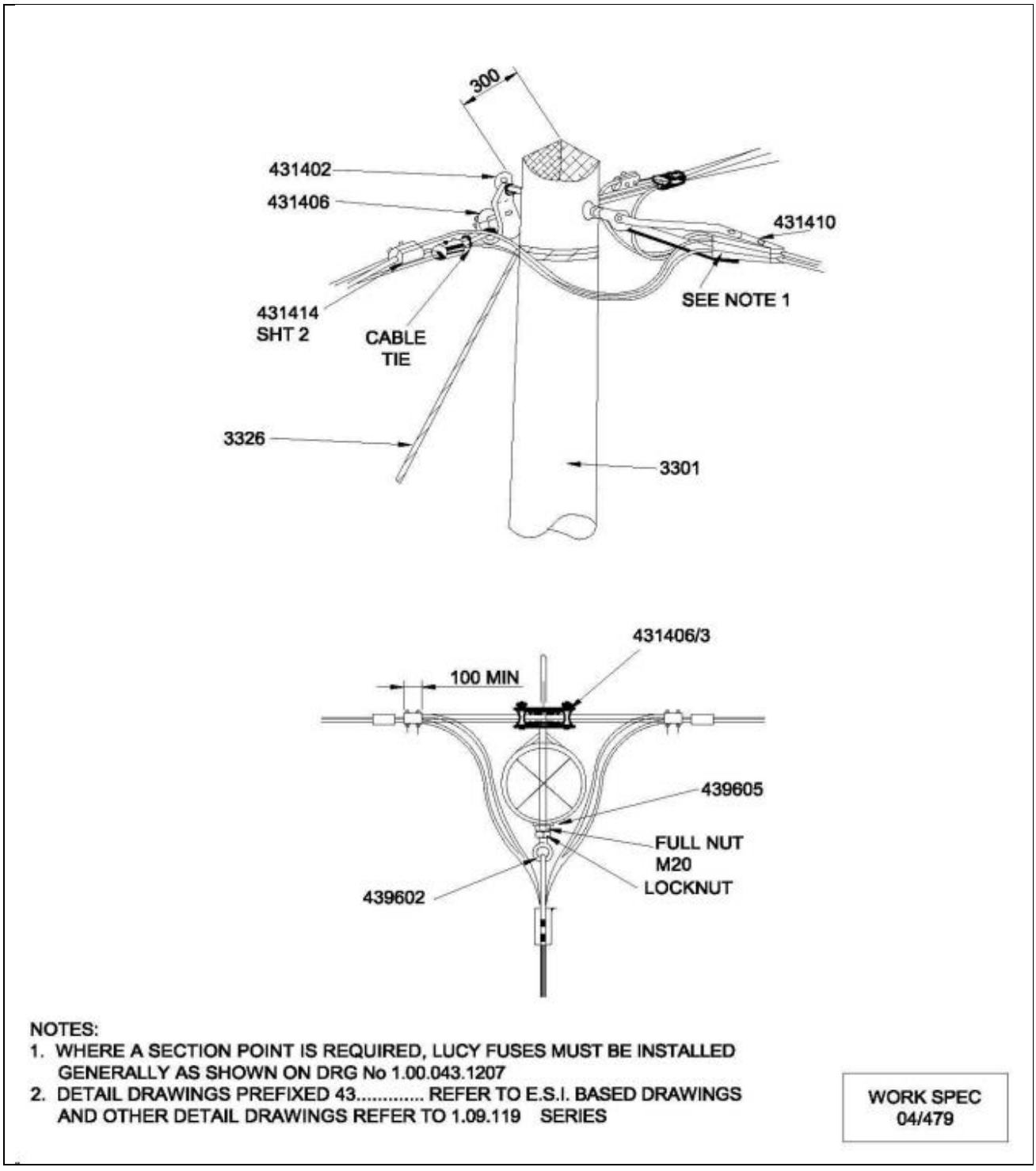
Title – Transition Support ABC to Open Wire System
Historic Drawing Number – 1000431208 Sheet 1
Reference Number – C318809



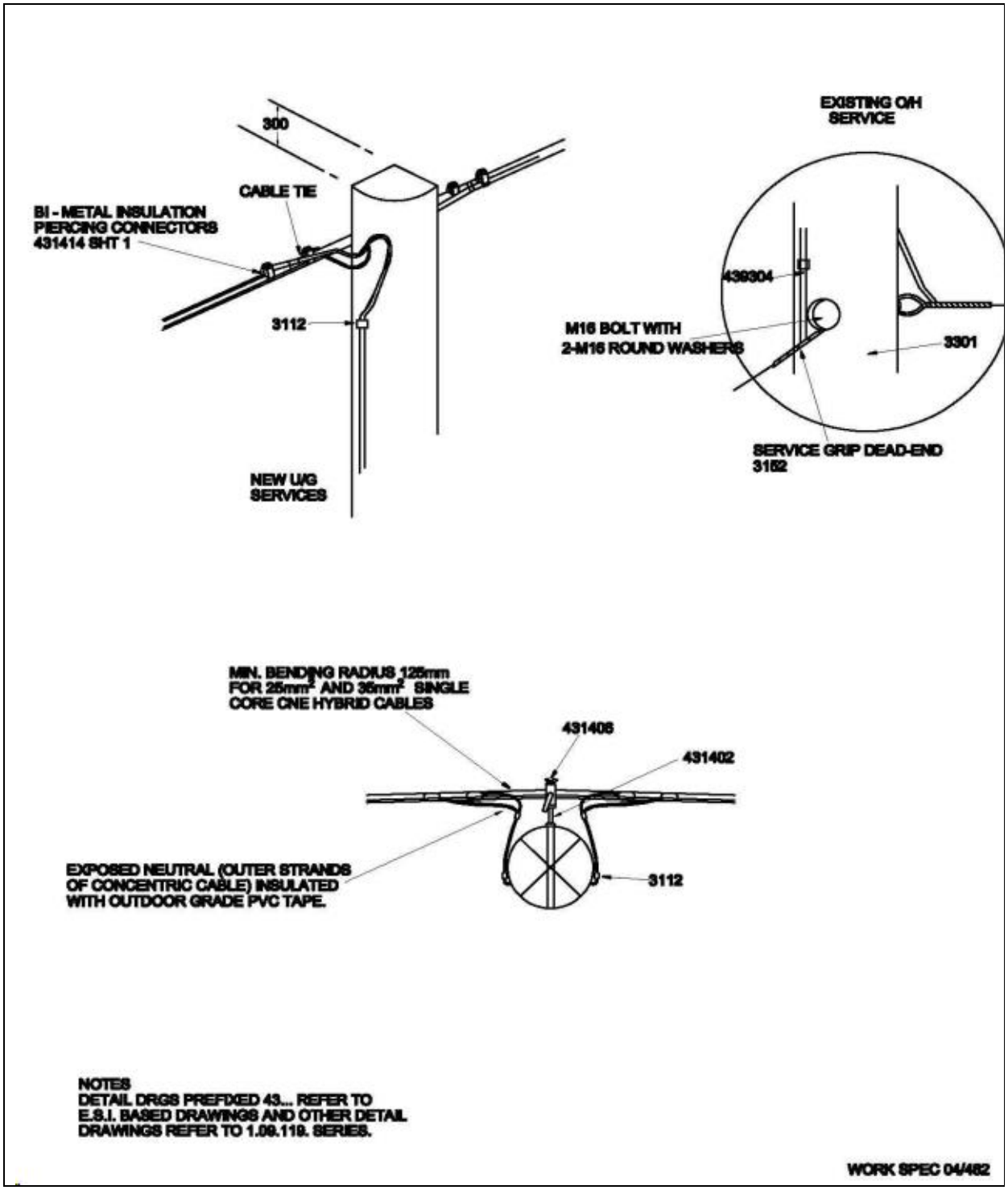
Title – Arrangement for Typical ABC Terminal Support
Historic Drawing Number – 1000431209 Sheet 1
Reference Number – C319031



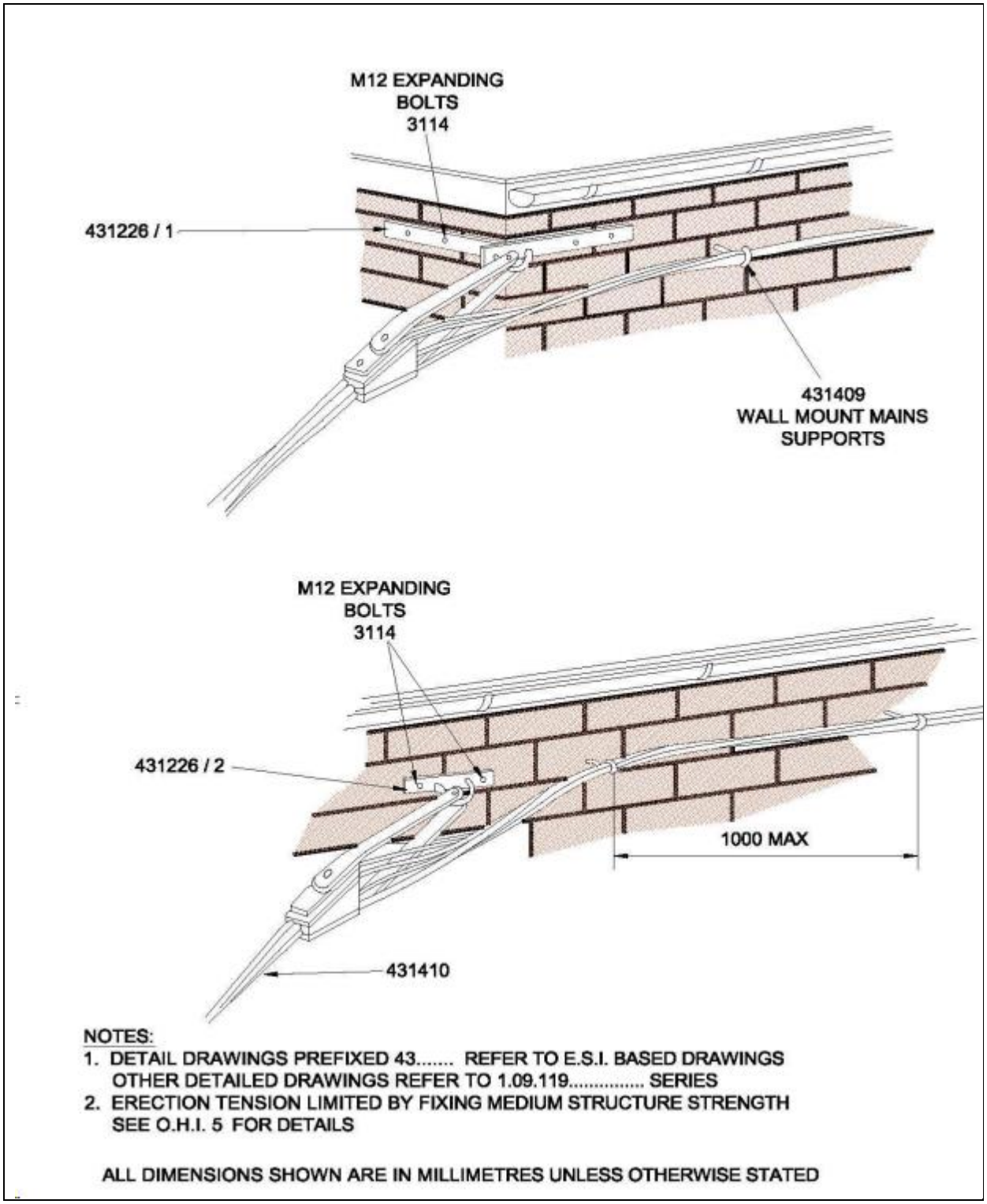
Title – Arrangement for Typical ABC Tee-off from Intermediate Support
Historic Drawing Number – 1000431211 Sheet 1
Reference Number – C147606



Title – Arrangement for Typical Multiple Service Tee-off from ABC
Historic Drawing Number – 1000431215 Sheet 1
Reference Number – C317362



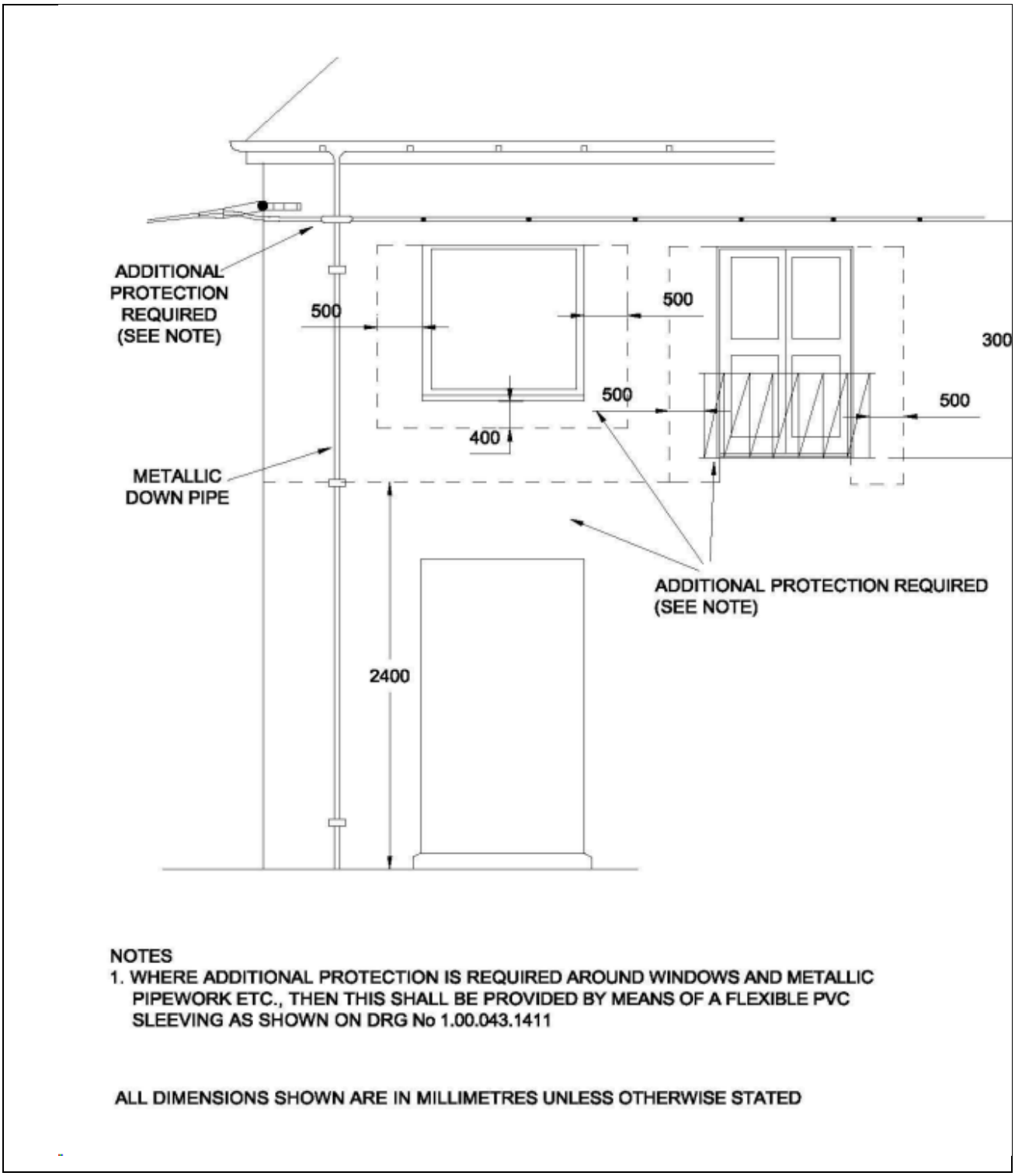
Title – Arrangement for Typical Attachments to Buildings
Historic Drawing Number – 1000431217 Sheet 1
Reference Number – C316867



NOTES:
1. DETAIL DRAWINGS PREFIXED 43..... REFER TO E.S.I. BASED DRAWINGS
   OTHER DETAILED DRAWINGS REFER TO 1.09.119..... SERIES
2. ERECTION TENSION LIMITED BY FIXING MEDIUM STRUCTURE STRENGTH
   SEE O.H.I. 5 FOR DETAILS

ALL DIMENSIONS SHOWN ARE IN MILLIMETRES UNLESS OTHERWISE STATED

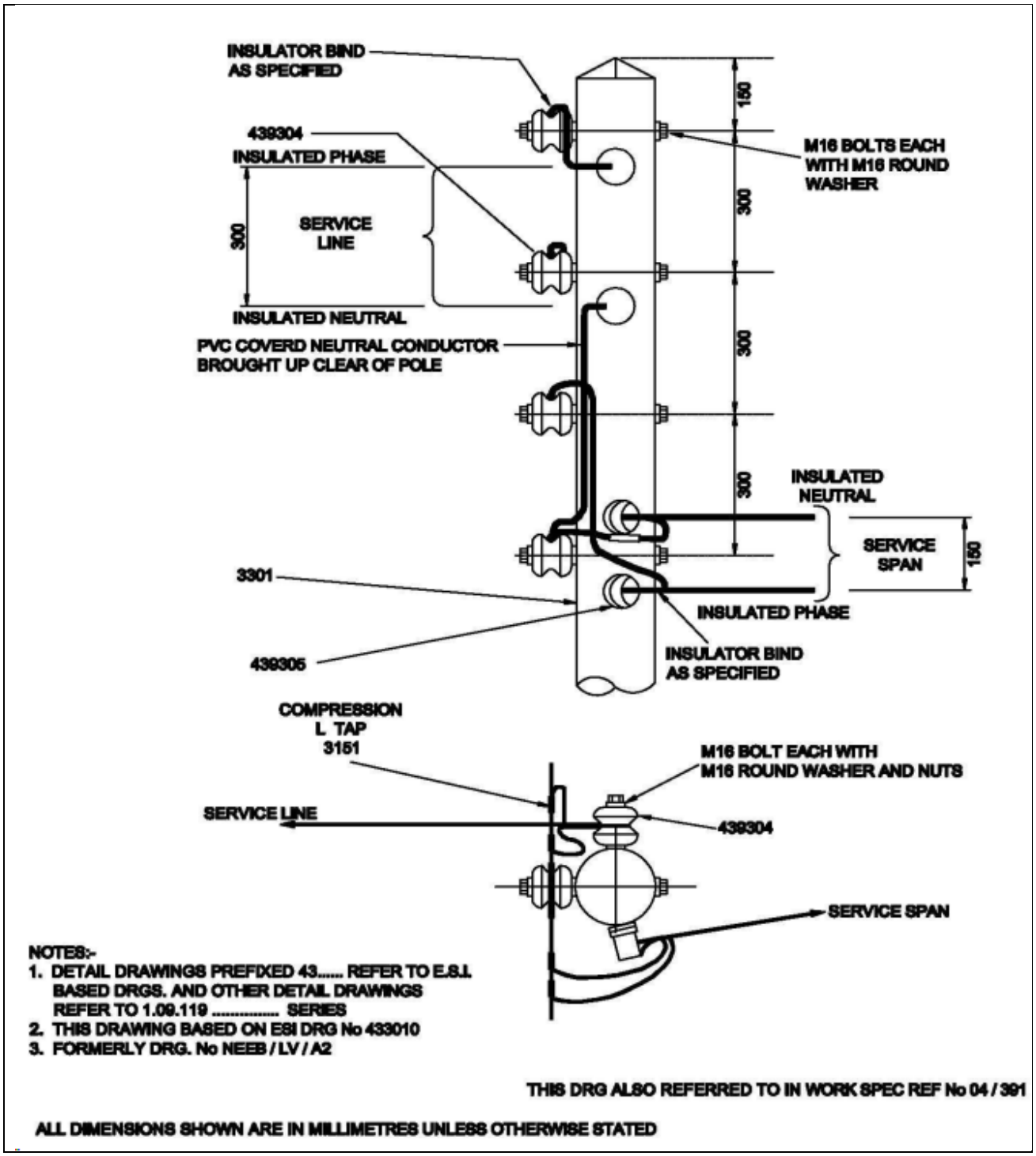
Title – Areas Requiring Proximity Protection
Historic Drawing Number – 1000431219 Sheet 1
Reference Number – C319026



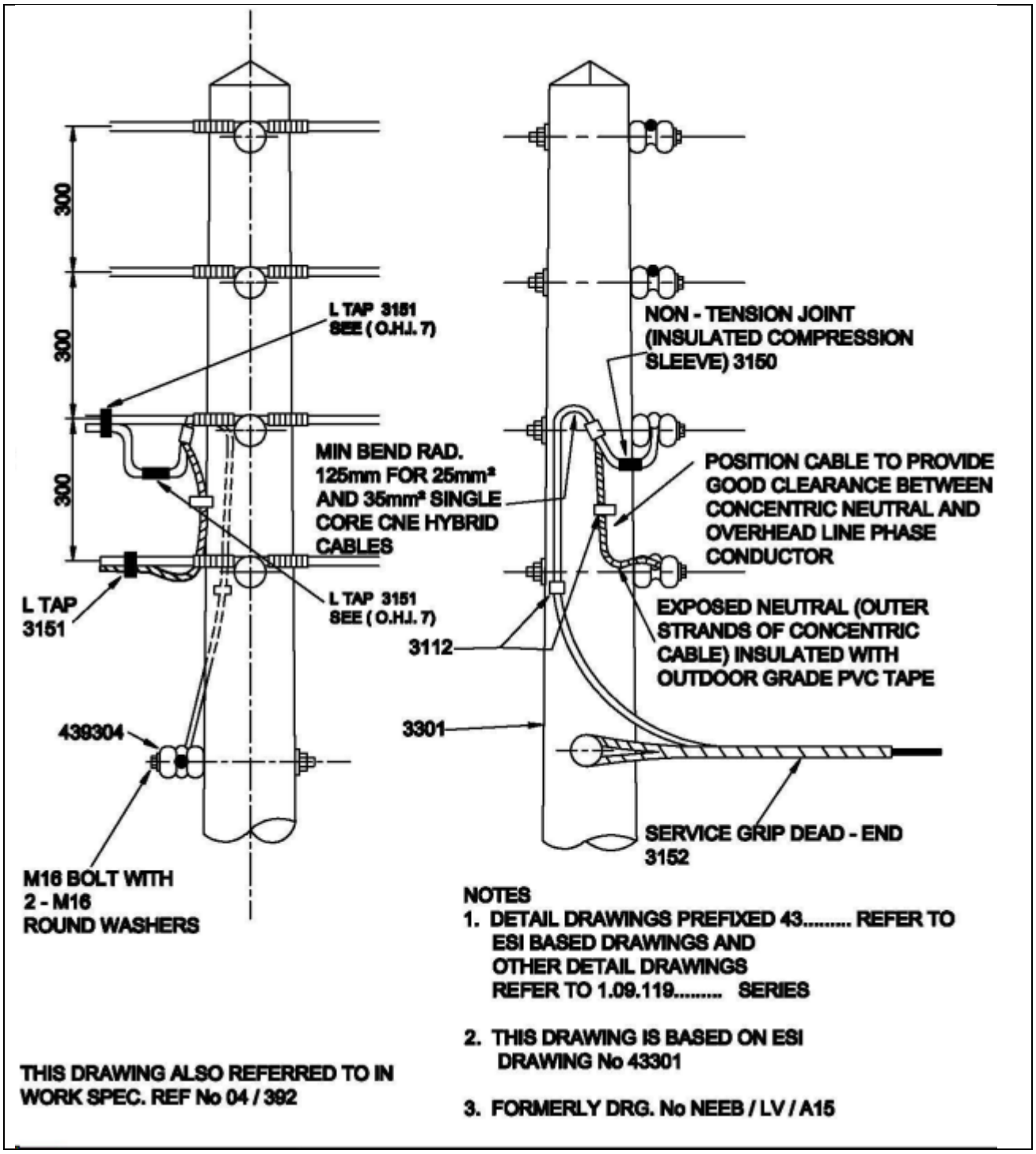
NOTES
1. WHERE ADDITIONAL PROTECTION IS REQUIRED AROUND WINDOWS AND METALLIC PIPEWORK ETC., THEN THIS SHALL BE PROVIDED BY MEANS OF A FLEXIBLE PVC SLEEVING AS SHOWN ON DRG No 1.00.043.1411

ALL DIMENSIONS SHOWN ARE IN MILLIMETRES UNLESS OTHERWISE STATED

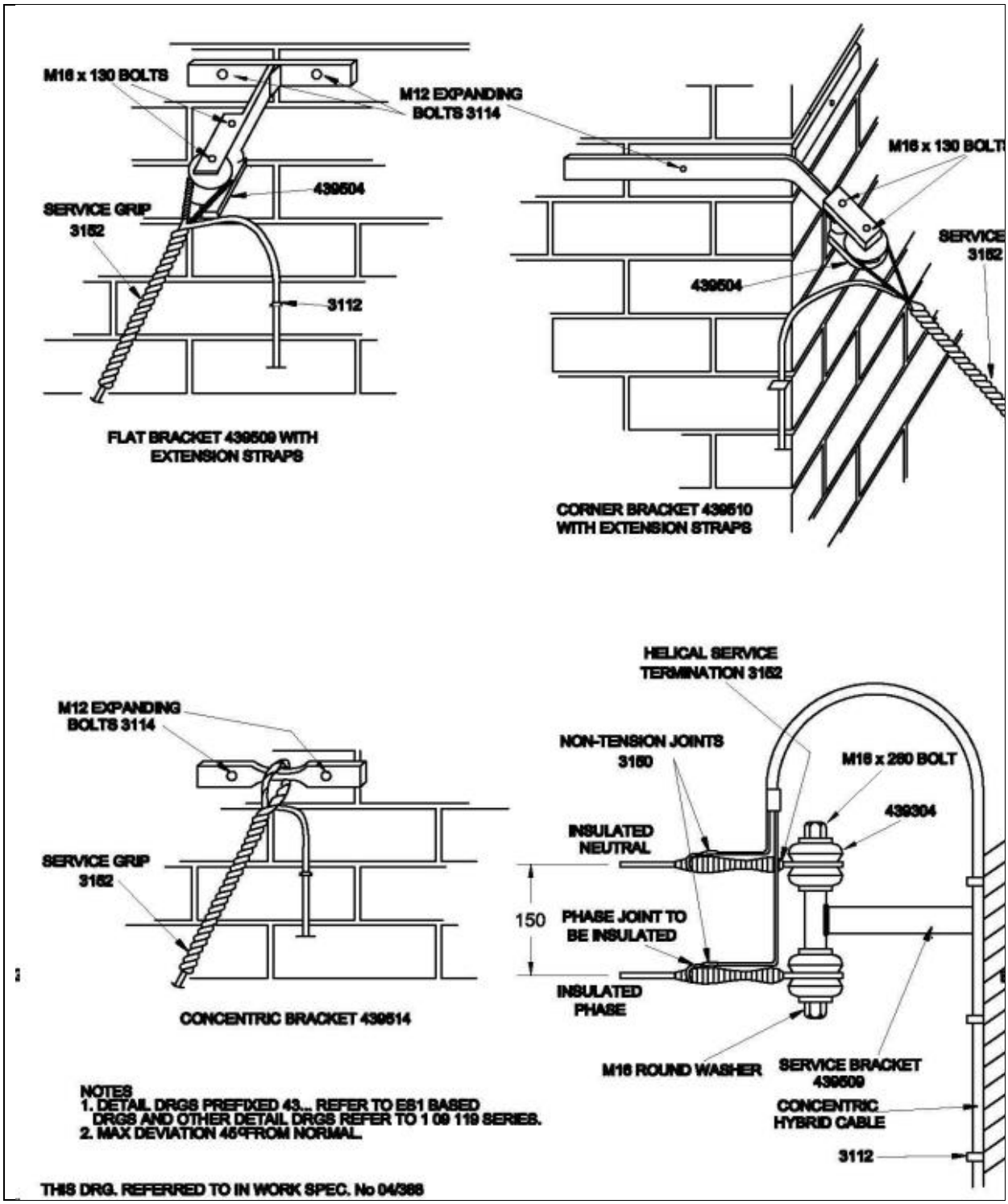
Title – Typical Open Wire Service Attachment to Line Pole Showing Alternative Types of Insulators
Historic Drawing Number – 1091193310 Sheet 1
Reference Number – C101831



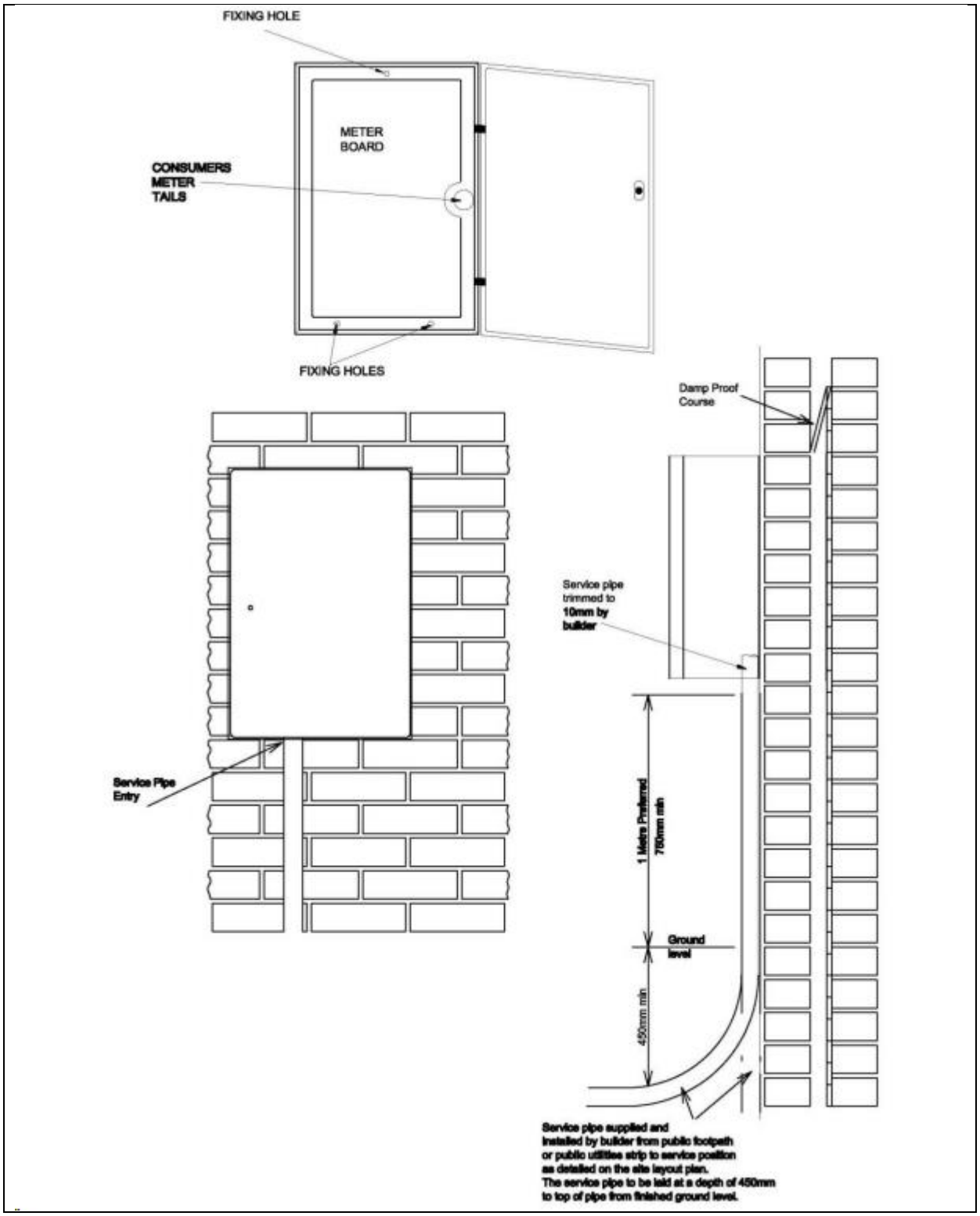
Title – Typical Aerial Concentric Service Cable Attachment to Line Support
Historic Drawing Number – 1091193313 Sheet 1
Reference Number – C101834



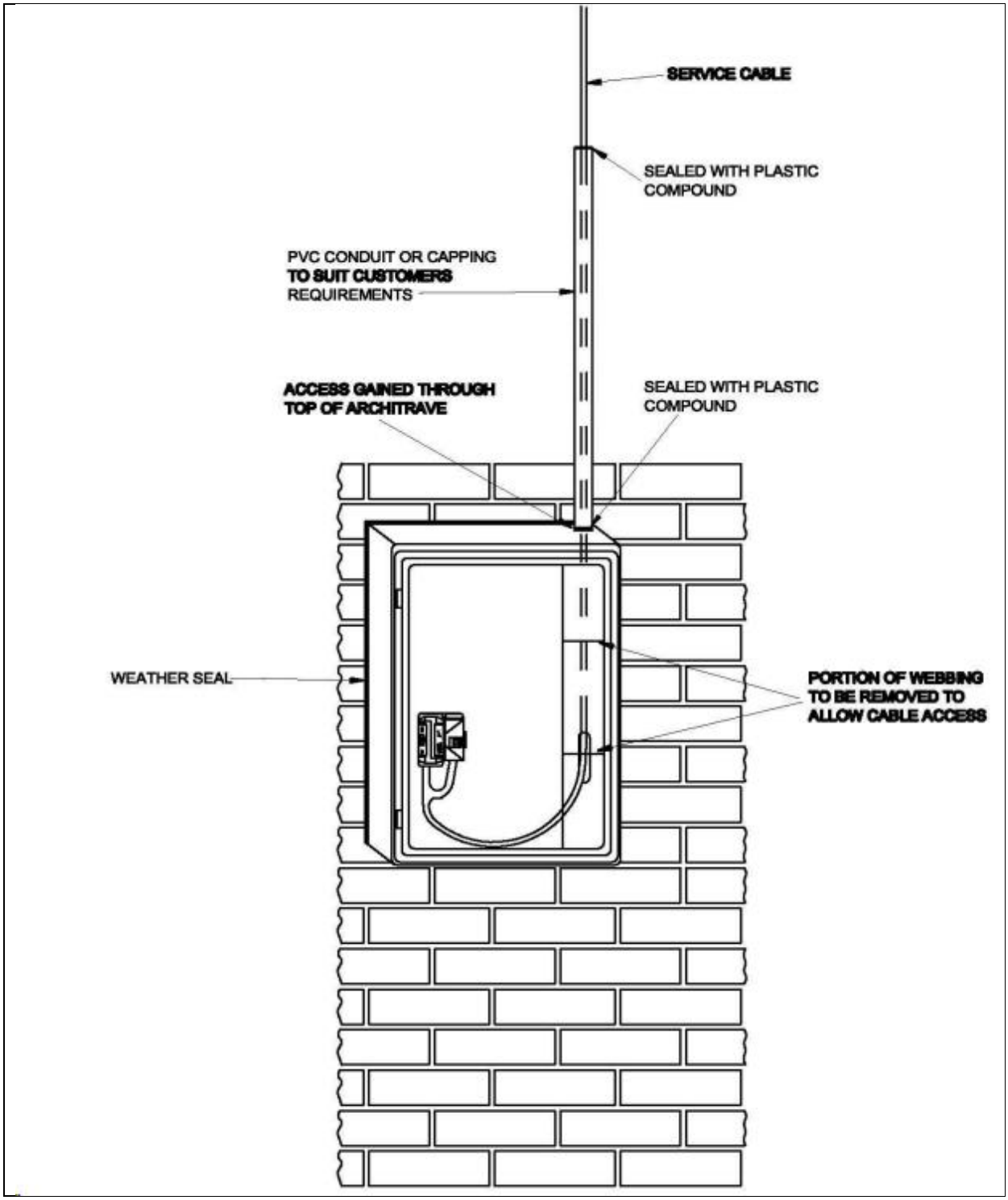
Title – Typical Aerial Concentric Service Cable Attachment to Building
Historic Drawing Number – 1091193314 Sheet 1
Reference Number – C101835



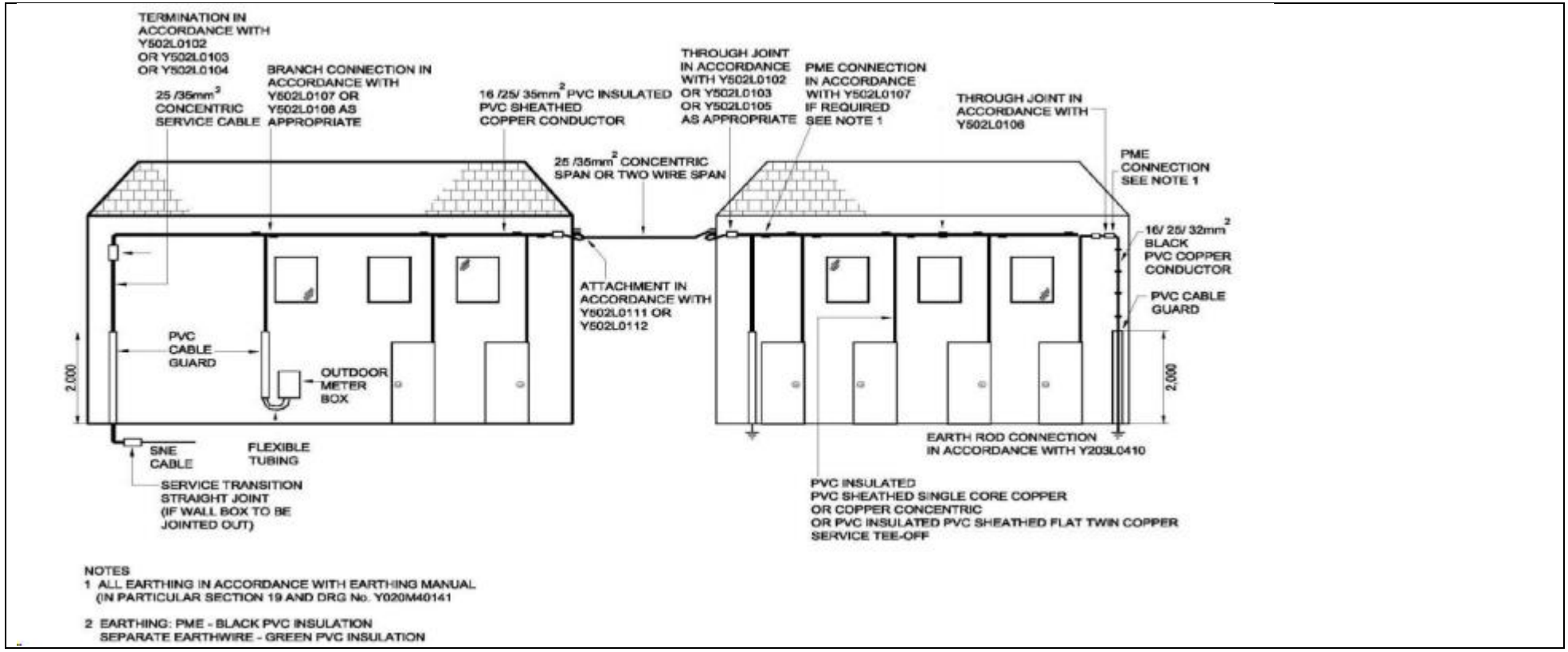
Title – Surface Mounted External Meter Cabinet
Historic Drawing Number – 1121020177 Sheet 1
Reference Number – C729216



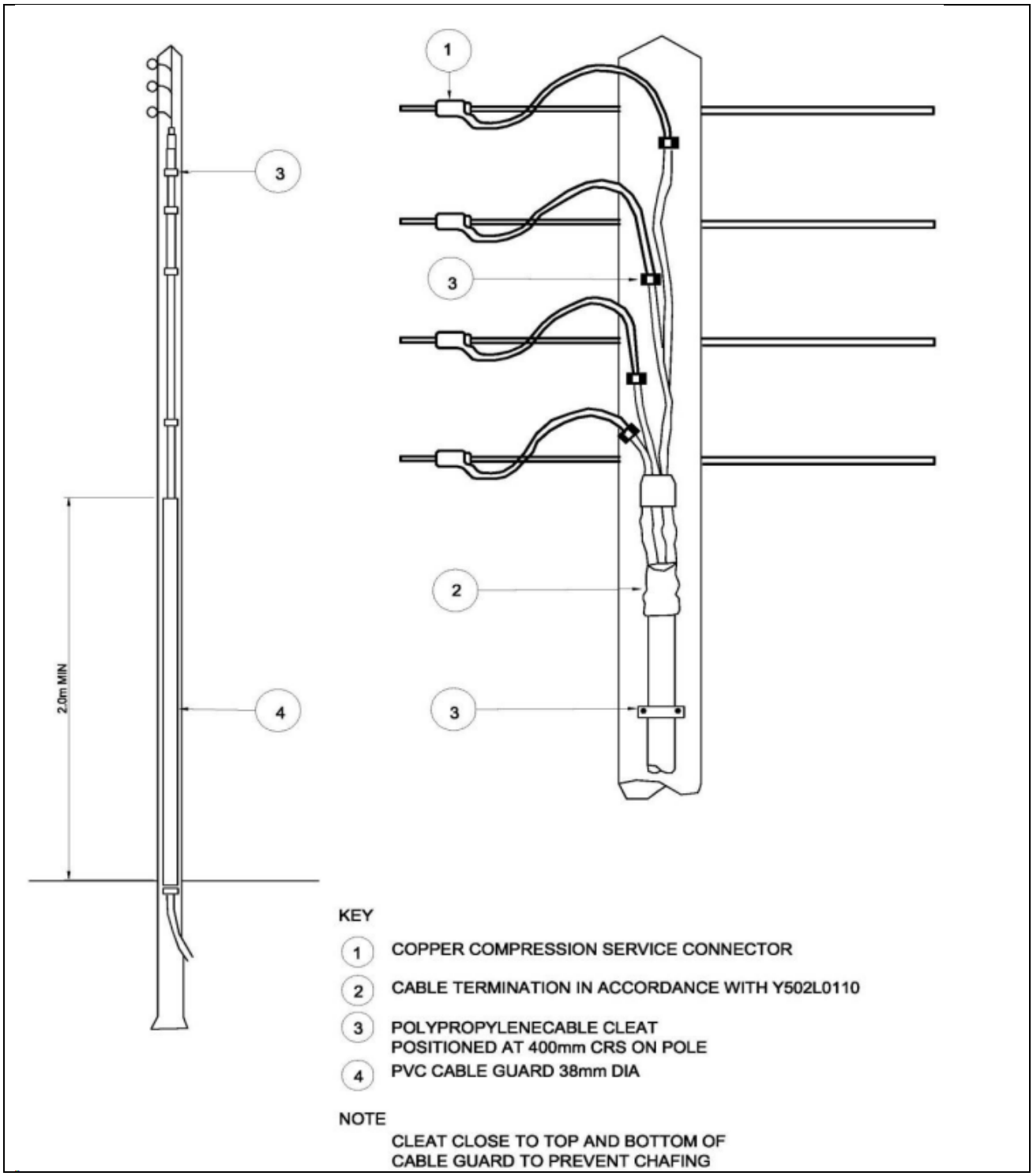
Title – Standard ENATS 21-03 Meter Cabinet with Down-Coming Surface Mounted Service Cable
Historic Drawing Number – 1121020177 Sheet 6
Reference Number – C729217



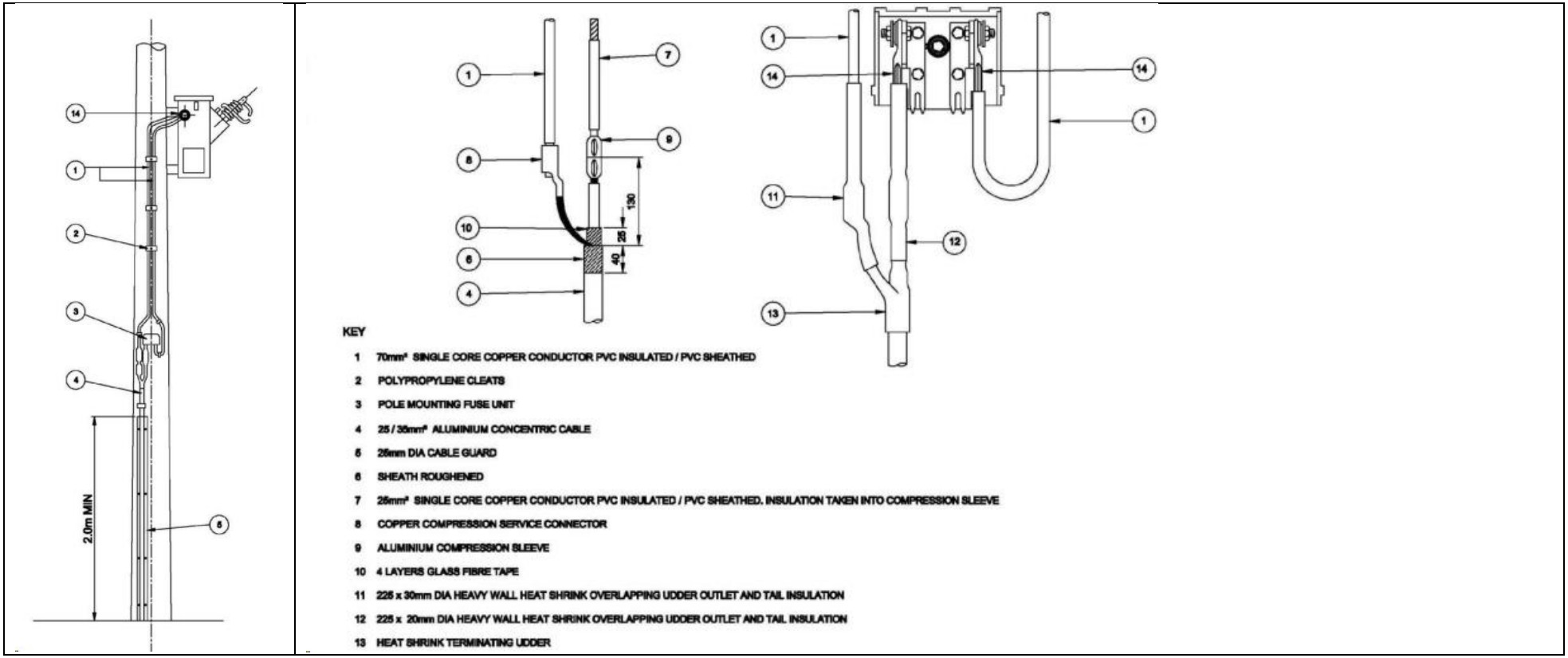
Title – Standard ENATS 21-03 Meter Cabinet with Down-Coming Surface Mounted Service Cable
Historic Drawing Number – 1121020177 Sheet 6
Reference Number – C729217
(Drawing for Historical reference purposes - Future similar arrangements shall be serviced using ABC conductor as an Eaves Main with concentric service)



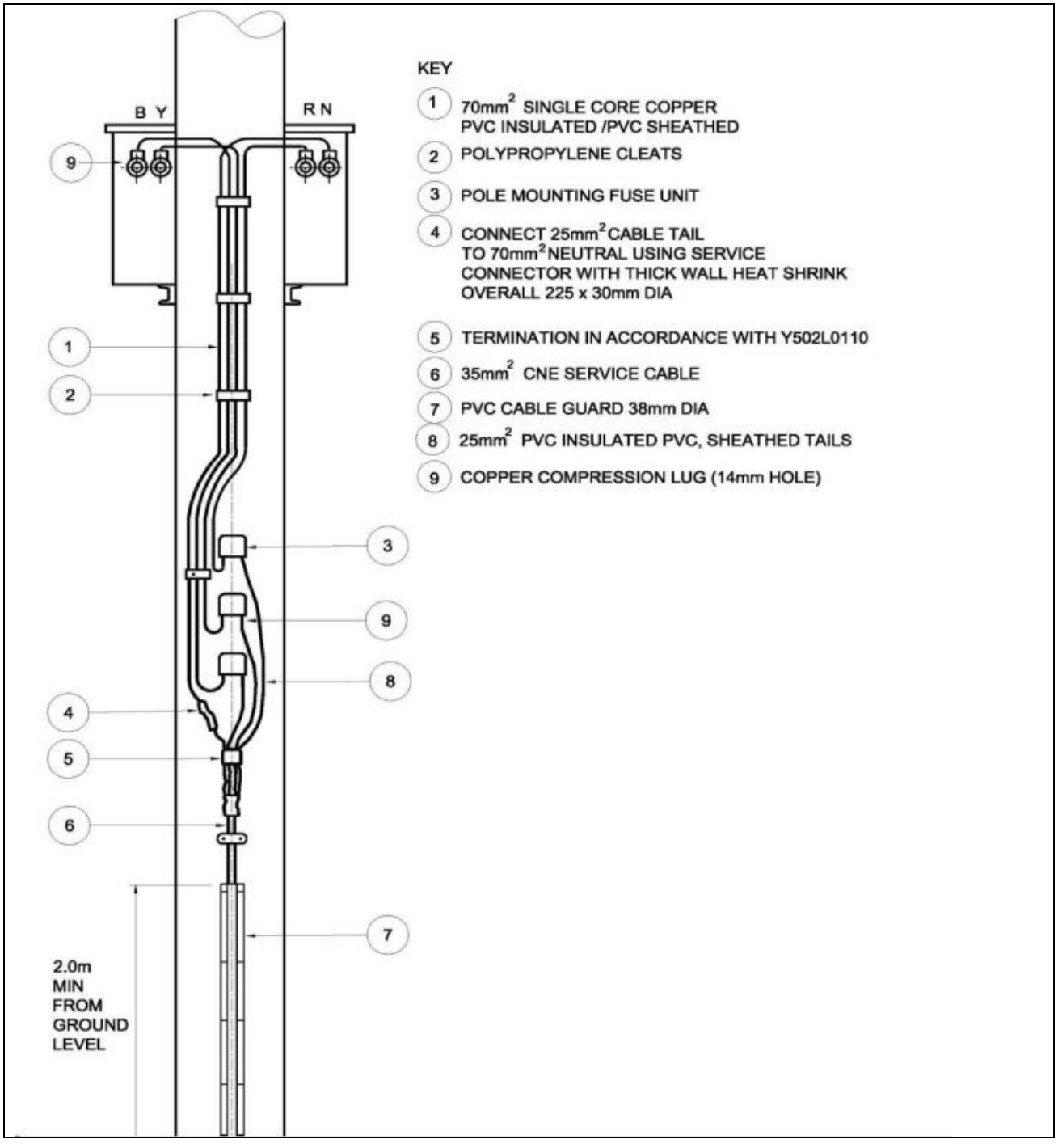
Title – 3 Phase CNE 35mm Service Cable Connection to Line Support
Historic Drawing Number – Y502L0114
Reference Number – C929956



Title – Overhead Services Aluminium Phase Concentric Service Connection to Pole Mounted Transformer
Historic Drawing Number – Y502L0115
Reference Number – C929964



Title – Three Phase CNE 35mm Service Cable Connections to Pole Mounted Transformer
Historic Drawing Number – Y502L0116
Reference Number – C929942



Appendix 2 - Design Sag & Tension Data for 16mm HDCU PVC Insulated Service Cable

PVC Cu. 16 sq.mm 3/2.65 mm DESIGN SAG AND TENSION 20m BASIC SPAN

Tension (N)	**164.80**	**160.91**	**157.03**	**154.60**	**151.70**	**148.96**	**146.36**	**143.89**	**141.54**	**139.30**	**137.16**	**135.12**	**129.49**	**127.76**
(kgf)	16.80	16.41	16.01	15.76	15.47	15.19	14.92	14.67	14.43	14.20	13.99	13.78	13.20	13.03
(lbf)	37.05	36.17	35.30	34.75	34.10	33.49	32.90	32.35	31.82	31.32	30.84	30.38	29.11	28.72
Temp. (C)	-5.60	.00	6.00	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00	50.00	65.00	70.00
Span (m)	Sag (m)	Sag (m)	Sag (m)	Sag (m)	Sag (m)	Sag (m)	Sag (m)	Sag (m)	Sag (m)	Sag (m)	Sag (m)	Sag (m)	Sag (m)	Sag (m)
2	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01
4	.02	.02	.02	.02	.02	.02	.02	.02	.02	.03	.03	.03	.03	.03
6	.05	.05	.05	.05	.05	.05	.05	.06	.06	.06	.06	.06	.06	.06
8	.09	.09	.09	.09	.09	.09	.10	.10	.10	.10	.10	.10	.11	.11
10	.13	.14	.14	.14	.15	.15	.15	.15	.16	.16	.16	.16	.17	.17
12	.19	.20	.20	.21	.21	.21	.22	.22	.22	.23	.23	.24	.25	.25
14	.26	.27	.28	.28	.29	.29	.30	.30	.31	.31	.32	.32	.33	.34
16	.34	.35	.36	.37	.37	.38	.39	.39	.40	.41	.41	.42	.44	.44
18	.43	.44	.46	.46	.47	.48	.49	.50	.51	.51	.52	.53	.55	.56
20	.54	.55	.56	.57	.58	.59	.60	.61	.62	.63	.64	.65	.68	.69
22	.65	.66	.68	.69	.70	.72	.73	.74	.75	.77	.78	.79	.82	.84
24	.77	.79	.81	.82	.84	.85	.87	.88	.90	.91	.93	.94	.98	.99
26	.91	.93	.95	.96	.98	1.00	1.02	1.04	1.05	1.07	1.09	1.10	1.15	1.17
28	1.05	1.08	1.10	1.12	1.14	1.16	1.18	1.20	1.22	1.24	1.26	1.28	1.34	1.35
30	1.21	1.23	1.26	1.28	1.31	1.33	1.36	1.38	1.40	1.43	1.45	1.47	1.53	1.55

BASIC DESIGN CRITERIA

U.T.S	6590	N	NOMINAL COND DIA	7.7	mm	PRE STRES	N/A Kg
F.O.S	10.138		COND. WT PER M	.18	Kg/M		
						DATE :	02/09/05
M.W.T	650	N	CO. EXP	.000017	/DEG C		
WIND LOAD	380	N/M	MOD. ELAS	124106	N/mm2	DGN NO.	
ICE DIA	9.5	mm	BASIC SPAN	20	M		

Appendix 3 - Design Sag & Tension Data for Single Phase 25mm Hybrid Service Cable (included for existing services)

Hybrid Service cable	25 sq.mm	1Al/27Cu	DESIGN SAG AND TENSION	20m BASIC SPAN

Tension (N)	652.16	596.00	546.52	518.49	487.98	461.60	438.62	418.41	400.52	384.55	370.22	357.28	324.94	307.50
(kgf)	66.50	60.78	55.73	52.87	49.76	47.07	44.73	42.67	40.84	39.21	37.75	36.43	33.14	31.36
(lbf)	146.61	133.99	122.86	116.56	109.70	103.77	98.60	94.06	90.04	86.45	83.23	80.32	73.05	69.13
Temp. (C)	-5.60	.00	6.00	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00	50.00	65.00	75.00
Span (m)	Sag (m)	Sag (m)	Sag (m)	Sag (m)	Sag (m)	Sag (m)	Sag (m)	Sag (m)	Sag (m)	Sag (m)	Sag (m)	Sag (m)	Sag (m)	Sag (m)
2	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.01	.01	.01	.01
4	.01	.01	.01	.01	.02	.02	.02	.02	.02	.02	.02	.02	.02	.02
6	.03	.03	.03	.03	.04	.04	.04	.04	.04	.04	.05	.05	.05	.06
8	.05	.05	.06	.06	.06	.07	.07	.07	.08	.08	.08	.09	.09	.10
10	.07	.08	.09	.09	.10	.10	.11	.11	.12	.12	.13	.13	.15	.16
12	.11	.12	.13	.13	.14	.15	.16	.16	.17	.18	.19	.19	.21	.22
14	.14	.16	.17	.18	.19	.20	.21	.22	.23	.24	.25	.26	.29	.30
16	.19	.21	.22	.24	.25	.27	.28	.29	.31	.32	.33	.34	.38	.40
18	.24	.26	.28	.30	.32	.34	.35	.37	.39	.40	.42	.43	.48	.50
20	.29	.32	.35	.37	.39	.41	.44	.46	.48	.50	.52	.54	.59	.62
22	.35	.39	.42	.45	.47	.50	.53	.55	.58	.60	.62	.65	.71	.75
24	.42	.46	.50	.53	.56	.60	.63	.66	.69	.72	.74	.77	.85	.90
26	.50	.54	.59	.62	.66	.70	.74	.77	.81	.84	.87	.90	.99	1.05
28	.57	.63	.69	.72	.77	.81	.85	.90	.94	.97	1.01	1.05	1.15	1.22
30	.66	.72	.79	.83	.88	.93	.98	1.03	1.07	1.12	1.16	1.20	1.32	1.40

BASIC DESIGN CRITERIA

U.T.S	4000	N	NOMINAL COND DIA	13	mm	PRE STRES	N/A Kg
F.O.S	3.076		COND. WT PER M	.39	Kg/M		
						DATE :	02/09/05
M.W.T	1300	N	CO. EXP	.0000283	/DEG C		
WIND LOAD	380	N/M	MOD. ELAS	31000	N/mm2	DGN NO.	
ICE DIA	9.5	mm	BASIC SPAN	20	M		

Appendix 4 - Design Sag & Tension Data for Single Phase 35mm Hybrid Service Cable

Hybrid Service Cable 35 sq.mm 1Al/25Cu DESIGN SAG AND TENSION 20m BASIC SPAN														
Tension (N)	647.23	607.25	570.84	549.57	525.77	504.57	485.57	468.44	452.89	438.72	425.73	413.78	382.99	365.80
(kgf)	66.00	61.92	58.21	56.04	53.61	51.45	49.52	47.77	46.18	44.74	43.41	42.19	39.05	37.30
(lbf)	145.50	136.52	128.33	123.55	118.20	113.43	109.16	105.31	101.81	98.63	95.71	93.02	86.10	82.24
Temp. (C)	-5.60	.00	6.00	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00	50.00	65.00	75.00
Span (m)	Sag (m)	Sag (m)	Sag (m)	Sag (m)	Sag (m)	Sag (m)	Sag (m)	Sag (m)	Sag (m)	Sag (m)	Sag (m)	Sag (m)	Sag (m)	Sag (m)
2	.00	.00	.00	.00	.00	.00	.01	.01	.01	.01	.01	.01	.01	.01
4	.02	.02	.02	.02	.02	.02	.02	.02	.02	.02	.02	.02	.03	.03
6	.03	.04	.04	.04	.04	.04	.05	.05	.05	.05	.05	.05	.06	.06
8	.06	.07	.07	.07	.08	.08	.08	.09	.09	.09	.09	.10	.10	.11
10	.10	.10	.11	.11	.12	.12	.13	.13	.14	.14	.15	.15	.16	.17
12	.14	.15	.16	.16	.17	.18	.19	.19	.20	.21	.21	.22	.24	.25
14	.19	.20	.21	.22	.23	.24	.25	.26	.27	.28	.29	.30	.32	.33
16	.25	.26	.28	.29	.30	.32	.33	.34	.35	.36	.38	.39	.42	.44
18	.31	.33	.35	.37	.39	.40	.42	.43	.45	.46	.48	.49	.53	.55
20	.39	.41	.44	.46	.48	.50	.51	.53	.55	.57	.59	.60	.65	.68
22	.47	.50	.53	.55	.58	.60	.62	.65	.67	.69	.71	.73	.79	.83
24	.56	.59	.63	.66	.68	.71	.74	.77	.80	.82	.85	.87	.94	.98
26	.65	.70	.74	.77	.80	.84	.87	.90	.93	.96	.99	1.02	1.10	1.16
28	.76	.81	.86	.89	.93	.97	1.01	1.05	1.08	1.12	1.15	1.18	1.28	1.34
30	.87	.93	.99	1.02	1.07	1.12	1.16	1.20	1.24	1.28	1.32	1.36	1.47	1.54

BASIC DESIGN CRITERIA							
U.T.S	5000	N	NOMINAL COND DIA	14.4	mm	PRE STRES	N/A Kg
F.O.S	3.846		COND. WT PER M	.51	Kg/M		
						DATE :	02/09/05
M.W.T	1300	N	CO. EXP	.0000283	/DEG C		
WIND LOAD	380	N/M	MOD. ELAS	31000	N/mm2	DGN NO.	
ICE DIA	9.5	mm	BASIC SPAN	20	M		

Appendix 5 - Design Sag & Tension Data for Three Core 25mm Hybrid Service Cable (included for existing services)

Hybrid service cable 3 Core 25 sq.mm 3Al/45Cu DESIGN SAG AND TENSION 20m BASIC SPAN														
Tension (N)	651.98	635.04	618.22	607.70	595.23	583.48	572.37	561.85	551.87	542.40	533.37	524.78	501.22	487.14
(kgf)	66.48	64.76	63.04	61.97	60.70	59.50	58.37	57.29	56.28	55.31	54.39	53.51	51.11	49.67
(lbf)	146.57	142.76	138.98	136.62	133.81	131.17	128.67	126.31	124.07	121.94	119.91	117.97	112.68	109.51
Temp. (C)	-5.60	.00	6.00	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00	50.00	65.00	75.00
Span (m)	Sag (m)	Sag (m)	Sag (m)	Sag (m)	Sag (m)	Sag (m)	Sag (m)	Sag (m)	Sag (m)	Sag (m)	Sag (m)	Sag (m)	Sag (m)	Sag (m)
2	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01
4	.03	.03	.03	.03	.03	.03	.03	.03	.03	.03	.03	.03	.03	.03
6	.06	.06	.06	.06	.06	.07	.07	.07	.07	.07	.07	.07	.08	.08
8	.10	.11	.11	.11	.11	.12	.12	.12	.12	.12	.13	.13	.13	.14
10	.16	.17	.17	.17	.18	.18	.18	.19	.19	.19	.20	.20	.21	.22
12	.23	.24	.25	.25	.26	.26	.27	.27	.28	.28	.28	.29	.30	.31
14	.32	.33	.33	.34	.35	.35	.36	.37	.37	.38	.39	.39	.41	.42
16	.41	.42	.44	.44	.45	.46	.47	.48	.49	.50	.51	.51	.54	.55
18	.52	.54	.55	.56	.57	.59	.60	.61	.62	.63	.64	.65	.68	.70
20	.65	.66	.68	.69	.71	.72	.74	.75	.76	.78	.79	.80	.84	.87
22	.78	.80	.83	.84	.86	.87	.89	.91	.92	.94	.96	.97	1.02	1.05
24	.93	.96	.98	1.00	1.02	1.04	1.06	1.08	1.10	1.12	1.14	1.16	1.21	1.25
26	1.09	1.12	1.15	1.17	1.20	1.22	1.25	1.27	1.29	1.31	1.34	1.36	1.42	1.46
28	1.27	1.30	1.34	1.36	1.39	1.42	1.44	1.47	1.50	1.52	1.55	1.57	1.65	1.70
30	1.46	1.49	1.53	1.56	1.59	1.63	1.66	1.69	1.72	1.75	1.78	1.81	1.89	1.95

BASIC DESIGN CRITERIA

U.T.S	4000	N	NOMINAL COND DIA	24.1	mm	PRE STRES	N/A Kg
F.O.S	3.076		COND. WT PER M	.86	Kg/M		
						DATE :	02/09/05
M.W.T	1300	N	CO. EXP	.0000283	/DEG C		
WIND LOAD	380	N/M	MOD. ELAS	31000	N/mm2	DGN NO.	
ICE DIA	9.5	mm	BASIC SPAN	20	M		

Appendix 6 - Design Sag & Tension Data for Three Core 35mm Hybrid Service Cable

Hybrid service Cable	3 Core 35 sq.mm	3Al/61Cu	DESIGN SAG AND TENSION	20m BASIC SPAN										
Tension (N)	640.07	625.46	610.84	601.62	590.65	580.25	570.36	560.94	551.97	543.41	535.22	527.38	505.76	492.71
(kgf)	65.27	63.78	62.29	61.35	60.23	59.17	58.16	57.20	56.29	55.41	54.58	53.78	51.57	50.24
(lbf)	143.89	140.61	137.32	135.25	132.78	130.44	128.22	126.11	124.09	122.16	120.32	118.56	113.70	110.77
Temp. (C)	-5.60	.00	6.00	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00	50.00	65.00	75.00
Span (m)	Sag (m)	Sag (m)	Sag (m)	Sag (m)	Sag (m)	Sag (m)	Sag (m)	Sag (m)	Sag (m)	Sag (m)	Sag (m)	Sag (m)	Sag (m)	Sag (m)
2	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01
4	.03	.03	.03	.03	.03	.03	.03	.03	.03	.03	.03	.03	.04	.04
6	.06	.06	.07	.07	.07	.07	.07	.07	.07	.07	.08	.08	.08	.08
8	.11	.11	.12	.12	.12	.12	.13	.13	.13	.13	.13	.14	.14	.14
10	.17	.18	.18	.19	.19	.19	.20	.20	.20	.21	.21	.21	.22	.23
12	.25	.26	.26	.27	.27	.28	.28	.29	.29	.30	.30	.30	.32	.33
14	.34	.35	.36	.36	.37	.38	.38	.39	.40	.40	.41	.41	.43	.44
16	.45	.46	.47	.47	.48	.49	.50	.51	.52	.53	.53	.54	.56	.58
18	.56	.58	.59	.60	.61	.62	.63	.64	.65	.67	.68	.69	.71	.73
20	.70	.71	.73	.74	.76	.77	.78	.80	.81	.82	.83	.85	.88	.91
22	.84	.86	.88	.90	.91	.93	.95	.96	.98	.99	1.01	1.02	1.07	1.10
24	1.00	1.03	1.05	1.07	1.09	1.11	1.13	1.15	1.16	1.18	1.20	1.22	1.27	1.30
26	1.18	1.21	1.23	1.25	1.28	1.30	1.32	1.34	1.37	1.39	1.41	1.43	1.49	1.53
28	1.37	1.40	1.43	1.45	1.48	1.51	1.53	1.56	1.58	1.61	1.63	1.66	1.73	1.77
30	1.57	1.61	1.64	1.67	1.70	1.73	1.76	1.79	1.82	1.85	1.88	1.90	1.99	2.04

BASIC DESIGN CRITERIA

U.T.S	5000	N	NOMINAL COND DIA	26.2	mm	PRE STRES	N/A Kg
F.O.S	3.846		COND. WT PER M	.91	Kg/M		
						DATE :	02/09/05
M.W.T	1300	N	CO. EXP	.0000283	/DEG C		
WIND LOAD	380	N/M	MOD. ELAS	31000	N/mm2	DGN NO.	
ICE DIA	9.5	mm	BASIC SPAN	20	M		

Appendix 7 - Design Sag & Tension Data for 2 Core 35mm ABC - Service Span

2 Core 35 sq.mm ABC — DESIGN SAG AND TENSION — 20m BASIC SPAN

Tension (N)	266.85	256.40	248.03	240.41	233.45	227.05	221.14	215.67	210.58	205.83	201.39	197.22	186.09	179.64
(kgf)	27.21	26.15	25.29	24.52	23.81	23.15	22.55	21.99	21.47	20.99	20.54	20.11	18.98	18.32
(lbf)	59.99	57.64	55.76	54.05	52.48	51.04	49.71	48.48	47.34	46.27	45.27	44.34	41.84	40.38
Temp. (C)	-5.60	.00	5.00	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00	50.00	65.00	75.00

Span (m)	Sag (m)	Sag (m)	Sag (m)	Sag (m)	Sag (m)	Sag (m)	Sag (m)	Sag (m)	Sag (m)	Sag (m)	Sag (m)	Sag (m)	Sag (m)	Sag (m)
2	.00	.00	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01
4	.02	.02	.02	.02	.02	.02	.02	.02	.02	.02	.03	.03	.03	.03
6	.04	.04	.05	.05	.05	.05	.05	.05	.05	.06	.06	.06	.06	.06
8	.08	.08	.08	.08	.09	.09	.09	.09	.10	.10	.10	.10	.11	.11
10	.12	.12	.13	.13	.14	.14	.14	.15	.15	.15	.16	.16	.17	.18
12	.17	.18	.19	.19	.20	.20	.21	.21	.22	.22	.23	.23	.25	.26
14	.23	.24	.25	.26	.27	.28	.28	.29	.30	.30	.31	.32	.34	.35
16	.31	.32	.33	.34	.35	.36	.37	.38	.39	.40	.41	.41	.44	.45
18	.39	.40	.42	.43	.44	.45	.47	.48	.49	.50	.51	.52	.55	.57
20	.48	.50	.51	.53	.55	.56	.58	.59	.61	.62	.63	.65	.69	.71
22	.58	.60	.62	.64	.66	.68	.70	.72	.73	.75	.77	.78	.83	.86
24	.69	.72	.74	.76	.79	.81	.83	.85	.87	.89	.91	.93	.99	1.02
26	.81	.84	.87	.90	.92	.95	.97	1.00	1.02	1.05	1.07	1.09	1.16	1.20
28	.94	.97	1.01	1.04	1.07	1.10	1.13	1.16	1.19	1.21	1.24	1.27	1.34	1.39
30	1.07	1.12	1.16	1.19	1.23	1.26	1.30	1.33	1.36	1.39	1.42	1.45	1.54	1.60

BASIC DESIGN CRITERIA

U.T.S	11300	N	NOMINAL COND DIA	21.9	mm	PRE STRES	N/A Kg
F.O.S	8.692		COND. WT PER M	.26	Kg/M		
						DATE :	02/09/05
M.W.T	1300	N	CO. EXP	.000023	/DEG C		
WIND LOAD	380	N/M	MOD. ELAS	59000	N/mm2	DGN NO.	
ICE DIA	9.5	mm	BASIC SPAN	20	M		

Appendix 8 - Design Sag & Tension Data for 4 Core 35mm ABC - Service Span

4 Core 35sq.mm ABC — DESIGN SAG AND TENSION — 20m BASIC SPAN

Tension (N)	412.47	402.50	394.17	386.34	378.95	371.97	365.36	359.09	353.12	347.45	342.03	336.86	322.65	314.12
(kgf)	42.06	41.04	40.19	39.40	38.64	37.93	37.26	36.62	36.01	35.43	34.88	34.35	32.90	32.03
(lbf)	92.73	90.48	88.61	86.85	85.19	83.62	82.14	80.73	79.39	78.11	76.89	75.73	72.54	70.62
Temp. (C)	-5.60	.00	5.00	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00	50.00	65.00	75.00

Span (m)	Sag (m)	Sag (m)	Sag (m)	Sag (m)	Sag (m)	Sag (m)	Sag (m)	Sag (m)	Sag (m)	Sag (m)	Sag (m)	Sag (m)	Sag (m)	Sag (m)
2	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01
4	.02	.03	.03	.03	.03	.03	.03	.03	.03	.03	.03	.03	.03	.03
6	.06	.06	.06	.06	.06	.06	.06	.06	.06	.07	.07	.07	.07	.07
8	.10	.10	.10	.11	.11	.11	.11	.11	.12	.12	.12	.12	.13	.13
10	.15	.16	.16	.16	.17	.17	.17	.18	.18	.18	.19	.19	.20	.20
12	.22	.23	.23	.24	.24	.25	.25	.26	.26	.26	.27	.27	.28	.29
14	.30	.31	.32	.32	.33	.34	.34	.35	.35	.36	.37	.37	.39	.40
16	.40	.41	.41	.42	.43	.44	.45	.45	.46	.47	.48	.48	.51	.52
18	.50	.51	.52	.53	.54	.56	.57	.58	.58	.59	.60	.61	.64	.66
20	.62	.63	.65	.66	.67	.69	.70	.71	.72	.73	.75	.76	.79	.81
22	.75	.77	.78	.80	.81	.83	.84	.86	.87	.89	.90	.92	.96	.98
24	.89	.91	.93	.95	.97	.99	1.00	1.02	1.04	1.06	1.07	1.09	1.14	1.17
26	1.04	1.07	1.09	1.12	1.14	1.16	1.18	1.20	1.22	1.24	1.26	1.28	1.34	1.37
28	1.21	1.24	1.27	1.29	1.32	1.34	1.37	1.39	1.42	1.44	1.46	1.48	1.55	1.59
30	1.39	1.43	1.46	1.48	1.51	1.54	1.57	1.60	1.62	1.65	1.68	1.70	1.78	1.83

BASIC DESIGN CRITERIA

U.T.S	22400	N	NOMINAL COND DIA	26.2	mm	PRE STRES	N/A Kg
F.O.S	17.23		COND. WT PER M	.52	Kg/M		
						DATE :	02/09/05
M.W.T	1300	N	CO. EXP	.000023	/DEG C		
WIND LOAD	380	N/M	MOD. ELAS	59000	N/mm2	DGN NO.	
ICE DIA	9.5	mm	BASIC SPAN	20	M		

Appendix 9 - Erection Data For 4 Core ABC Attached To Buildings - Slack Spans @ reduced tensions

SPAN METRES	35mm - SAG (m)	50mm - SAG (m)	70mm - SAG (m)	95mm - SAG (m)
10.0	0.16	0.19	0.24	0.26
12.5	0.26	0.30	0.38	0.41
15.0	0.37	0.43	0.54	0.58
17.5	0.50	0.58	0.74	0.80
20.0	0.66	0.76	0.97	1.04
22.5	0.83	0.96	1.23	1.32
25.0	1.03	1.19	1.51	1.62
27.5	1.24	1.44	1.83	1.96
30.0	1.48	1.71	2.18	2.34

NOTE:

Sags are based on design conditions applied to various sizes of ABC producing a tension not exceeding 1.3 kN.

The figures have been collated based on a 20m Basic Span @ 15°C