NSP/004/041/001 - Specification for the Renovation of Existing LV O/H Lines

1. Purpose

The purpose of this document is to provide a means of detailing the approved techniques and arrangements that should be utilised when either replacing an existing open wire network with ABC conductor or renovating the existing open wire system.

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

Document Reference	Document Title	Version	Published Date
NSP/004/014/001	Specification for the Renovation of Existing LB O/H Lines	4.2	November 2010

2. Scope

This document details the installation requirements associated with the replacement of an existing open wire LV network with ABC conductors or retaining/adding additional conductors onto an existing open wire network.

New LV ABC Networks shall be constructed in accordance with the parent document NSP/004/041 – *"Code of Practice for the Construction of LV ABC Overhead Lines"*.

New overhead line services and new or replacement surface wiring shall be carried out in accordance with this document and NSP/004/043 – *"Specification for Overhead Services, Surface Wiring and Eaves Wall Mains"*

2.1. Table of Contents

3. Technical Specification

3.1. Historical Designs

Historical Industry Designs - specifications used within Northern Powergrid.

Design	Construction period	Types of Cond Used
BEBS L1 (9" Spacing Open Wire)	1962 - 1970	.025" HDBC / 16mm^2 HDBC .05" HDBC / 32mm^2 HDBC .1" HDBC / 70mm^2 HDBC .15" HDBC / 100mm^2 HDBC 50mm^2 Plain Aluminium (Ant) 100mm^2 Plain Aluminium (Wasp)
ENA TS 43-30 (12" Spacing Open Wire Networks)	1970 - 1988	
ENA TS 43-12 ABC Networks	1988 - Present	2 x 35mm^2 ABC 4 x 35mm^2 ABC 4 x 50mm^2 ABC 4 x 70mm^2 ABC 4 x 95mm^2 ABC 4 x 120mm^2 ABC

3.1.1. Historical Design Criteria

Historical LV networks were designed in accordance with the "Electricity (Overhead Line) Regulations 1970 which resulted in the following design criteria:

Loading Conditions:

- 380n/m^2 wind pressure acting on the conductors augmented with 9.5mm diametric ice.
- The minimum factor of safety on the calculated conductor breaking loads were 2.0 for open wire networks and 2.5 for ABC networks.
- MWT' Limits of 4.45kN and 6.0kN were imposed on 32mm^2 and 70mm^2 HDBC open wire lines respectively to enable extensions to be carried out to the older BEBS L1 design specification without the need for out of balance stays.
- The MWT's of the ABC lines were based on the design tables listed in ENA TS 43-12.
- All supports were designed to achieve minimum factors of safety of 2.5.

3.2. Renovation of Existing LV Networks

The prime objective of renovating LV networks must always be to ensure that they comply with all current legislation, have all defective components removed and that any issue likely to affect the continuity of supply has been corrected or removed.

During the period 2019/21 all LV lines in Northern Powergrid were subjected to a detailed condition assessment. The results from these surveys shall be used to determine how the network shall be renovated.

Note - As a general rule the data from the previous pole inspection process has been used to automatically classify the supports or components associated with those supports which need to be replaced.

The necessary renovation work required on each network can be categorised as follows: -

a) Extensive Maintenance

b) Conversion to ABC

3.2.1. Condition Assessment Survey

Despite the fact that the network has been previously inspected as part of the overall Northern Powergrid asset condition survey, all networks shall be subjected to a re-inspection survey prior to actual work commencement, as the condition of the asset may have changed from its original inspection by the time work is due to commence. The inspection shall include the following:

a) The examination of all poles

b) The examination of all stays

c) The examination of all insulators and binders

d) The examination of all services and service spans for ground clearance

e) The examination of cable terminations and auxiliary pole equipment

f) The examination of network conductor condition

g) The identification of any problems of proximity to buildings or trees

h) Confirmation of adequate ground clearance

The level of detail involved in the re-inspection survey will be dependent upon the accuracy of the original survey data and the period of time between the original line survey and work starting.

3.3. Extensive Maintenance

It is envisaged that this category will be applicable where less than 50% of the total number of poles on a section of network require replacement and the following criteria can be complied with:-

Note:-

To avoid confusion the phrase “section of network” shall be deemed to refer to a complete LV feeder supplied up to its normal open point. Additionally, decisions on line rebuild or type of “extensive maintenance” may vary due to other drivers including workload and resource available etc.

a) The section of network utilises copper conductors with adequate CSA for network load and voltage drop requirements and does not have any evidence of previous conductor clashing or repairs. (aluminium network conductors shall be replaced with ABC)

b) The network Neutral conductor is the same CSA as the Phase conductors.

c) The section of network is located a minimum of 3.0m away from the surface of any building. See clause 3.6.1 “Conductors” and 3.6.2 “Clearances & Conductor Design Ratings” for exceptions to this policy.

d) The section of network is located a minimum of 3.0m away from trees capable of supporting a ladder/climber or 0.8m away from trees unable to support a ladder/climber. See clause 3.6.1 “Conductors” and 3.6.2 “Clearances & Conductor Design Ratings” for exceptions to this policy.

e) All other min clearances detailed in NSP/004/011 are compliant.

f) The existing phase to phase spacing is 300mm.

The aim of carrying work out in this category is to return the line to its original design performance by means of replacement of components on a like for like basis (or their modern equivalent). It will normally involve carrying out the minimum amount of work to ensure the network components have a “fit for purpose condition” or health condition of 3 for a minimum life of 10-15 years as all lines will be subjected to a full re-inspection on a 10-year cycle.

Apart from the replacement of a rotten pole this work will typically include the replacement of individual line components e.g., inadequate stays or safety signs, broken or obsolete insulators and ties, and replacing any mechanical connectors with compression connectors. For more details see clause 3.6

Note - As a general rule the data from the previous pole inspection process has been used to automatically classify the supports or components associated with those supports which need to be replaced.

3.4. Conversion to ABC

Where >50% of the total number of poles on a section of network require replacement or any of the above conditions cannot be complied with, then the network shall be converted to ABC.

Additionally, ABC shall be used for the following:

- Construction or extension of all new LV overhead lines
- As a means of providing supplies formally achieved via surface wiring or eaves mains see NSP/004/043.
- In areas identified as high risk by MNT/004/012 "*Guidance on the Risk Assessment of Overhead Lines*"
- Areas identified in NSP/004/011 *"Guidance on Overhead Line Clearances"* as being not suitable for "non effectively insulated conductors"

3.5. Refurbishing LV Networks with ABC Conductor

3.5.1. Conductors, Clearances & Conductor Design Ratings

Replacement conductors shall be as detailed for new construction in NSP/004/041

Main Lines : 4 x 120mm² or 4 x 70mm² (with and without protective conductors on 4 x 120mm²)

Service Lines: 4 x 35mm² or 2 x 35mm²

Additional information has been included in NSP/004/041 to cover for work or extensions to existing 4 x 50 & 4 x 95mm² sizes.

4 x 150mm² may be introduced to satisfy increased network electrical loadings in some circumstances. Because it will be installed to the same mechanical loadings as used for 4 x 120mm² ABC it has negligible impact on the design rating of the existing supports. The only requirement is to confirm that all existing ground clearances will still be compliant with NSP/004/011.

The minimum height of ABC networks above ground level and its clearances to other objects shall be compliant with NSP/004/011.

Historically lines were designed to operate at 50°C. Where possible renovated lines shall provide max operating temperatures and clearances to allow operation at 75°C in accordance with new construction. However, poles shall not be replaced solely to provide an increase in existing operating temperature providing the existing minimum ground clearances at the original max design temperatures still comply with NSP/004/011.

3.5.2. Design Basis of Refurbished Networks

When a line has been renovated to ABC it shall be deemed to have performance levels equivalent to newly constructed lines. See NSP/004/041 for design details. (Where a line undergoes extensive maintenance, it shall be deemed to have performance levels as detailed in clause 3.1.1.)

3.5.3. Wood Poles - General

Existing wood poles may be retained provided they are of minimum classification Medium to ENA TS 43-88 Annex A and that they have been examined and tested in accordance with NSP/004/112 – *" (OHI 12)*

Guidance for the Inspection and Testing of Wood & Steel Poles". (Appendix 12 has been included to assist in the identification of existing pole grades).

Retained poles shall be capable of providing continued service for a minimum of 10 years. Supports that have been identified with minor deterioration but have been confirmed as suitable for continued use shall only be retained when they do not carry additional pole mounted plant. E.g., cable terminations.

Where poles have been inspected and confirmed to be suitable for continued use but do not have a 3m gouge mark to indicate the correct installed sinking depth, they may be retained providing they are situated in locations that can be safely accessed using mobile access platforms or where the pole can be temporarily stayed in four directions. Where this is not the case the pole must be replaced.

Existing poles which are retained shall be fabricated with a new 22 mm diameter hole, 300 mm from the pole top; unused existing holes must be plugged using appropriate size wood plugs as indicated Drawing No. 1091010247. Drawing 1091193302 provides details on converting an existing openwire pole to carry ABC.

The default support requirement for ABC systems shall be wood poles of a minimum classification of Medium Grade as defined in BSEN 14229 and supplied in accordance with material specification NPS/001/001 – "Technical specification for wood poles and associated products for overhead lines".

Wood poles shall by default be treated with creosote preservative, however in accordance with the REACH legislation where wood poles are required for use in the following locations:

- Located in or adjacent to schools or children's play area's
- Located in or adjacent to public parks and gardens
- Poles located in customers gardens
- Located in outdoor recreational and leisure facilities where there is a risk of frequent skin contact

Then the default preservative cannot be utilised and must be substituted with non-creosote based preservative.

Attention shall also be paid to ensure that the optimum position is selected for the new pole and that it is not simply located adjoining the existing pole or in such a position that it results in the new pole being placed out of alignment.

Appendix 1 provides details of arrangement drawings to allow conversion of open wire networks to ABC.

3.5.3.1. Pole Foundations

All foundations and sinking depths shall be as detailed for new construction. See NSP/004/041 clause 3.4.1 for pole sinking depths.

3.5.3.2. Pole Caps

All wood supports shall be either fabricated with a 30° four quartered apex or be fitted with a suitable form of pole cap.

3.5.3.3. Un-stayed Angles on Intermediate Supports

Un-stayed angle supports shall be avoided wherever possible. However, they are permitted providing they comply with the following criteria:

ABC Main – On Medium grade poles the max angle of deviation does not exceed 7°

ABC Main - On Stout grade poles the max angle of deviation does not exceed 19°

Extended Service Span - Medium grade pole with max angle of deviation 30°

In all cases the max pole height is limited to 12m, and the poles must be sunk to a depth of 1.8m and fitted with 2 x ENA TS 43-91 Type 2 (1300 x 250 x 125)mm blocks located 500mm below ground level and attached with a M20 bolts. Where access and ground types are suitable, augured foundations may be used as an alternative to blocked foundations. See drawing 1090431216 for foundation details.

Tubular steel poles of minimum class 'M' may be utilised to provide un-stayed angles in excess of the above limits. Their use should be limited to a last resort due to the onerous cost and protracted installation requirements.

Where existing un-stayed supports, use offset brackets to minimise the angle of deviation on the pole in accordance with Drawing No. 1091193309 they may be retained, providing they are in sound condition.

The brackets shall have the top insulator fixing hole redrilled to allow the attachment of an M20 hook nut (Drawing No. 1000431401, sheet 2).

3.5.3.4. Stayed Supports

Stayed supports shall typically be of medium grade and be designed to be in accordance with the minimum stay spread tables detailed in NSP/004/041 Appendix 9.

3.5.3.5. Section Supports

Section pole arrangements shall be supported on minimum class medium grade poles for all ABC conductor sizes provided the pole is a stayed support. Details of minimum stay angles can be found in Appendix 9.

Arrangement	Drawing Number
Renovation of Open Wire Angle Pole (30° dev) to ABC	1091193303 Sht. 1
Renovation of Open Wire Angle Pole (60° dev) to ABC	1091193303 Sht. 2
Renovation of Open Wire Section Angle (90° dev) to ABC	1091193304
Renovation of Intermediate Angle Support to Typical ABC Tee off	1091193306

Transition supports between existing open wire networks and ABC networks shall be arranged as shown on drawing number 1000431208. Details on the requirements for out of balance stays between the two design systems can be found in appendix 10.

3.5.3.6. Terminal Supports

Terminal arrangements shall be supported on minimum medium grade poles for all ABC conductor sizes. Details of minimum stay angles can be found in appendix 9. Terminal supports shall be arranged in accordance with the following drawing numbers.

Arrangement	Drawing Number
Renovation of Open Wire Terminal Pole to ABC	1091193307
Renovation of Open Wire Terminal Pole to ABC (C/w Cable Box)	1091193308
Renovation of Intermediate Angle Pole with Tee off to ABC	1091193305
Tee off from section support	1000431212

Tee-off poles shall be a minimum grade stout.

3.5.4. Tubular Steel Poles

Steel supports shall be both visually and ultrasonically inspected in accordance with clauses 3.9 – 3.9.5 of NSP/004/112 before they are considered for continued use

All supports with visible holes or thickness measurements of less than those identified in NSP/004/112 shall be replaced.

Where a new steel support is required, it shall be class M in accordance with drawing no. 1091193501 sheet 2. All new M class supports, and previous K and L class supports are supplied with a 30-year protective galvanised coating (year of manufacture stamped on the pole).

Note – When replacing an existing steel pole consideration should be given to replacing it with a wood pole if the design does not require and un-stayed support.

Appendix 1 provides details of arrangement drawings to allow conversion of open wire networks to ABC.

Irrespective of the condition of a steel support, its continued existence on the LV network shall be re-assessed. In many cases the network may have evolved in such a way that the steel support could have its duty replaced by a standard wood support. Due to the higher maintenance costs associated with steel supports, where appropriate they shall be replaced with wood supports.

In order to secure ABC to sound steel supports, the following methods may be adopted:

a) Use of pre-drilled 22mm diameter holes located 300mm from the support top

b) Collars, of appropriate size, to drawing 1091193510 sht2

Note

See clause 3.5.7 for special earthing and bonding requirements for steel supports.

3.5.4.1. Tubular Steel Pole - Numbering

Steel poles shall be numbered by means of metallic plates secures with galvanised cable ties in accordance with NSP/004/109.

3.5.4.2. Tubular Steel Pole - Allowable Angles of deviation

Allowable angles of deviation on historical un-stayed steel supports carrying ABC conductor

Location	4 x 35mm^2 / 50mm^2 ABC	4 x 70 /95/120/150mm^2 ABC
Terminal Positions		
	Type C	Type D
	Type D	Type G
	Type F	Type J
	Type G	Type K
	Type J	Type L
	Type K	Type M
	Type L	
	Type M	
Angle Positions		
Type B	Not recommended	Not recommended
Type C	50°	30°
Type D	80°	50°
Type E	25°	15°
Type F	65°	40°
Type G	90°	70°
Type J	90°	70°
Type K	90°	70°
Type L	90°	70°
Type M	90°	70°

See drawing no 1091193501 sht. 2 for details on the identification of historical steel pole types

3.5.4.3. Tubular Steel Pole Foundations

New tubular steel supports shall be erected on a concrete paving stone located 1675mm below ground level then surrounded with between 100-300mm of concrete depending upon the pole type. See drawing 1091193502 Sht. 1 for details.

Where existing protective casings are of the Bitulac weatherseal type, they shall be removed and cleaned prior to the application of the protective coatings. See MNT/001/004 – *"Technical Specification for Tower, Steel Pole and Substation Plant Painting"* for details. New steel poles are supplied with a suitable protective coating to a height of 2.3m from the base.

3.5.4.4. Pole Caps

Steel pole caps, as shown on drawing no 1091193505 sht 2 must be secured to all steel supports. Except for J & K class supports which have a factory welded 6mm thick plate.

3.5.5. Stays

Existing and replacement stays shall be compliant with the requirements of NSP/004/041 – *"Guidance on the Types and Installation Requirements for Stays*" clause 3.5. Further guidance on stays can be found in NSP/004/104 and Drawing no 1091193326.

Stays shall be inspected as part of a condition survey prior to a network being renovated. Where, as a result of this survey, the existing stays are found to be in sound condition and stay spreads are within the requirements of NSP/004/041 Appendix 9, then they may be retained. Where existing multiple stays require replacing, care should be taken over the replacement requirements as ABC stay loadings are reduced in comparison with open wire configurations.

Where stays are found on existing steel poles, **the pole shall be re-assessed for possible replacement with a wood pole**. If the existing steel pole can accommodate the installation of stays, then potentially it does not need to be a steel pole. Where it is determined that a steel pole is still needs to be retained then assuming the steel pole is of a type/grade that can accommodate the angle or terminal loads being applied, see clause 3.5.4.2 then the stays can be removed. If the steel pole cannot accommodate the loadings without the assistance of stays, then consideration shall be given to the replacement of the legacy steel pole with a modern replacement steel pole. If stays are retained, then this shall be achieved as shown on drawing no. 1091193608 and in general accordance with the provisions detailed above.

Stay insulators shall always be inserted in all stays assemblies (except for steel poles).

Where any stay component is required for replacement e.g., a stay insulator, stay rod or stay wire or a stayed structure is replaced then by default a complete new stay shall always be installed. **We do not replace stay components in a piecemeal fashion.**

3.5.6. Safety Signs, Labels and Notices

All safety signs, labels and notices shall be complaint with NSP/004/041 and guidance document NSP/004/109 - *(OHI 9) Guidance on Anti-Climbing Devices, Safety Signs and Labels Required on Overhead Line Supports".*

3.5.7. Earthing & Bonding

See NSP/004/041 clause 3.11 for general details on earthing requirements for renovated ABC networks and clause 3.11.2 for specific details relating to steel poles.

3.5.8. Erection of Conductors

ABC shall be erected in accordance with the new construction design/erection charts detailed in NSP/004/041 Appendix 3 - 7.

Note. ABC erected on steel poles does not require any reduction in conductor tensions

See NSP/004/041 clause 3.6 and NSP/004/105 – *"Guidance on the Selection, Erection and Sagging of O/H line Conductors"* for more details on the approved techniques for erection of ABC conductors.

3.5.9. Services Connections

See NSP/004/041 clause 3.9.2 and NSP/004/043 "Specification for Overhead Services, Surface Wiring and Eves mains" for more details on service connections.

3.5.10. Services – Hybrid or Copper Concentric

Insulator attachments for existing hybrid services shall be repositioned higher up the pole to allow the conductor tails to be directly terminated into the IPC's connectors on the ABC. This will maximise ground clearances to the service span and reduce the number of overall connections in the service.

All service connections shall be as detailed in NSP/004/043 clause 3.2.1 ensuring that where possible a phase balance is maintained on the ABC main.

3.5.11. Services - Open Wire Construction

Where PVC covered open wire services aerials are encountered, they shall have their hand binds removed, the insulator repositioned higher up the pole and the service re-terminated using limited tension service preformed deadends.

The existing 16 mm^2 PVC insulated service conductor shall be utilised to form the connection between the ABC and the open wire service aerial. The tails shall be connected to the ABC main using single bolt IPC's drawing no. 1000431414 sht1 ensuring that the tapping conductors are secured to the bundle using nylon cable ties and dressed/fixed to the pole using cable cleats.

Where the existing 16 mm^2 open wire tail is of insufficient length to allow direct connection to the IPC, a short length of 16 mm^2 PVC insulated conductor shall be used.

For more detail on the service connections or attachment method at the building side of the service aerial see NSP/004/043.

Where LV networks are converted to ABC construction for ESQCR proximity issues, any bare neutral and Hessian covered aerials shall be replaced as they are not effectively insulated and cannot be terminated onto the ABC main without some additional forms of shrouding or insulation.

Bare aluminium service aerials shall be replaced but PVC covered aerials may be retained.

Where LV networks are converted to ABC due to a general network condition or load related issue, then it is permissible to retain bare neutral open wire services provided they comply with all other aspects detailed in NSP/004/043 and NSP/004/011. Hessian covered services shall always be replaced.

3.5.12. Services - Public Lighting

Where, prior to renovation, the public lighting was supplied using switch wires, the local lighting authority must be informed in order that each light on the network can be separately controlled by photo electric cells if they decide to retain lamps on network poles. See NSP/004/043 for details on the connections to the public lighting service cables.

3.5.13. Mains Cable Terminations

3.5.13.1. Compound Filled

Wherever practical compound filled PILC cable terminations shall be replaced by modern heat shrink terminations. This will normally be accommodated by installing a new length of waveform LV cable up the pole and installing a straight joint at the base of the pole.

However, where the termination is found to be in sound condition and there is no evidence of compound leaks or damaged conductor terminals, the cable box may be retained. In making the

decision to retain an existing termination, an assessment shall be carried out on the ease of maintaining supplies to customers associated with the termination in the event of a possible future failure.

Connections to the cable box shall be made by securing each ABC 'tail' to the appropriate cable box terminals and using bimetal compression lugs in accordance with drawing no 1091193307. Where a box is mounted on an intermediate pole, a short length of ABC conductor of the same CSA as the main line shall be used to form the jumper and be connected to the ABC main using two bolt IPCs to drawing no. 1000431414, sheet 2. Where the overhead network requires separation from the underground network for operational purposes it shall be achieved by disconnecting the lugs from the cable box.

Alternatively, consideration should be given to the modification of the existing jumpers to the ABC network. In many cases it will be prudent to install a set of pole mounted LV fuses in the jumpers to create a permanent section point.

3.5.13.2. Heat Shrink Cable Termination

Heat shrink cable terminations for both PILC or Waveform cable shall be connected to the renovated ABC network generally in accordance with drawing no.1091193308. The jumper connection between the cable termination and the ABC network shall be created by continuing the ABC network directly into the new heat shrink cable terminations. Alternatively, the existing copper PVC Insulated and Sheathed tails from the heat shrink termination shall be jointed onto the ABC tails using Bi-metal connectors to drawing 1091010649. Once completed all joints shall be covered with insulated sleeves.

When the cable termination is on an intermediate pole, a short length of ABC of similar CSA to the main line shall be utilised to form the jumper. This shall then be connected to the underground cable as above and to the ABC main using double bolt IPC's.

If disconnections are required from heat shrink terminations for operational purposes, this shall be achieved by cutting the ABC tails. Reconnection shall be made with non-tension connectors that must be covered with an insulating sleeve.

In locations where it is foreseen that equipment disconnections and reconnections will be required, section fuses should be installed.

3.5.14. Section Fuses

The existing section fuses shall be replaced with new fuse units with lugged connections to drawing no. 1091471530. See drawing no 1000431207 for details on the typical pole assembly drawing.

3.5.15. Connections to Static Balancers & Regulators

See NSP/004/041 clause 3.9.5 for details on connection to static balancers or regulators.

The metalwork of the of the regulator or static balancer shall be bonded to the neutral by means of a short length of 32 mm^2 annealed copper Black PVC (6) covered conductor.

3.6. Refurbishment of Open Wire Networks and the Addition of Conductors

Renovation of existing open wire distribution systems and the erection of additional conductors shall be generally in accordance with ENA TS 43-30. This part of the specification is included to specify the design and constructional requirements where an existing section of network is not converted to ABC or where additional phase conductors are installed.

An existing open wire network will only be retained where all the provisions of clause 3.3 of this specification can be satisfied.

Note:-

Where a network has been refurbished and the existing conductors have been retained the refurbished network shall be deemed to be constructed to the original design criteria detailed in ENA TS 43-30 and Clause 3.1.1 of this specification.

3.6.1. Conductors

The condition of the existing conductors shall be inspected for signs of damage or previous conductor clashing. Where conductors are required to be replaced, the network must be converted to ABC

Where the conductors are in good condition and compliant with all conditions detailed in clause 3.3 of this specification, the conductors shall be retained.

When networks are being inspected particular attention shall be paid to networks that contain or show signs of :-

- Where stays on poles have relaxed or contain un-stayed angles supports
- Where networks have been subjected to the long-term installation of temp shrouding.
- Where networks have been the subject of temp repairs or diversions.

All of the above situations are likely to result in poor conductor regulation with the increased potential for conductor clashing and reduced operational performance. Where poor conductor regulation is identified the network conductors shall be unbound and re-sagged back to design tensions

Where additional phase conductors are required to convert a split phase network to a three-phase network, the opportunity shall be taken to replace the existing conductors with ABC.

The following list details allowable conductor types that may be retained on renovated networks

a) 16, 32, 70 or 100mm^2 HD PVC covered copper conductor to BS6485, Type 8 (black)

b) 16, 32, 70 or 100mm^2 HDBC conductor, to BS7884

Note:

PVC insulated conductors to BS6485 type 8 are approved for the following situations

- Protection of BT and Network Rail circuits.
- Proximity protection to buildings, i.e., these conductors meet the requirements of the term "effectively insulated conductors" as detailed in NSP/004/011. Hence, they are suitable for networks located less than 3m from a building but greater than 1m.

3.6.2. Clearances & Conductor Design Ratings

The minimum allowable clearances to ground and other objects on renovated LV networks and the service spans attached to those networks shall be as detailed in the overhead line clearance document NSP/004/011. Additional guidance on service clearances can also be found in NSP/004/043

Particular attention is required with regard to the location of existing networks in proximity to buildings and climbable trees as ESQCR legislation requires the use of insulated conductors in these situations.

All lines shall provide a minimum design clearance of 50°C in line with the original design criteria.

3.6.3. Configuration & Spacing of Conductors

3.6.3.1. Service Lines & Distribution Lines

a) The nominal arrangement of conductors for a three-phase, four-wire service line or distribution line where a switch wire is not required shall be as follows:

Old Phase Colour	New Harmonised Colours for phases	Position on pole relative to pole top
Red	Brown	No 1
Yellow	Black	No 2
Blue	Grey	No 3
Neutral	Neutral	No 4

Where a switch wire is required, this shall occupy position No. 4 and the neutral conductor placed in the fifth position below the switch wire.

b) Conductor spacing shall be 300mm.

c) Continuous earth Wires (CEW)

Where a CEW is required, it shall be mounted on the side of the pole directly opposite the neutral position, Where the network does not already include a PL switchwire, then as an alternative the CEW may be located in the 5th or lowest position on the pole.

CEW shall be not less than 16mm^2 CSA. Earth wires shall be bare except where passing over Network Rail circuits when they shall be insulated.

When positioning conductors, space shall no longer be left for the addition of future additional phase conductors, as reinforcement shall be with ABC.

d) Street Lighting Switch Wire

The use of public lighting switch wires shall be discouraged, but where required they shall be 16 mm^2 HDBC, insulated conductors.

e) Guard wires

Guard wires of 16 mm^2 HDBC shall be erected above the line conductors.

3.6.4. Conductor Erection Sags & Tensions

Bare and insulated open wire conductors shall be erected in accordance with the sag charts shown on drawing no's 1091403404, 1091403405, 1091403506 and 1091403507. See appendix 2 – 5 for details. Additional guidance information on conductor erection techniques can be found in NSP/004/105.

Bare Neutral conductors shall be regulated to match in with the PVC covered conductors.

New conductors shall be pre-stressed before final make off for as long a period as is practicable but preferably not less than 20 minutes. Copper conductors shall be pre-stressed to the instructions given on the appropriate sag table.

Each appendix includes one or more table is dependent upon the requirement for the conductors to be erected at full or reduced tensions. The reduced tension tables shall be used where a section of the network is constructed with open wire conductors and is terminated onto steel poles.

Note:

Appendixes 6 – 9 have been included to provide sag/tension information on historical plain aluminium conductors that require adjustments i.e., where work other than renovation is taking place.

3.6.4.1. Service Lines

a) The PVC-covered phase conductors shall always be positioned above the neutral conductor on open wire services. See NSP/004/043 for more details on services.

Note - In the past it has been common practice in some parts of our network to install the PVC-covered phase conductors below the neutral conductor on open wire services. However, ESQCR Reg 18(4) requires “For low voltage overhead lines equipped with separate phase and neutral cables, the lowest conductor must be the earth or neutral conductor and the phase conductors must be mounted directly above it”. Hence where PVC-covered phase conductors below the neutral conductor on open wire services are found, the service span shall be replaced with a modern concentric service cable.

b) Conductor spacing shall be 150mm.

3.6.5. Services

3.6.5.1. Services –Hybrid or Copper Concentric

No changes required to this type of service provided they comply with NSP/004/043 and NSP/004/011

3.6.5.2. Services - Open Wire Construction

Existing Copper bare or PVC covered service aerials may be retained provided they comply clause 3.6.4.1, NSP/004/043 and NSP/004/011. All neutral service connections must consist of double split bolt connectors or be replaced with compression connectors.

All hessian covered service aerials or bare/covered aluminium service aerials shall be replaced.

3.6.6. Supports

Intermediate and section support sizes (see ENA TS 43-30 Tables 2 -4) are related to loadings imposed on PVC covered conductors, the loading point being considered to be 600mm below the pole top. Stayed supports are designed in accordance with crippling loads imposed by PVC covered conductor loadings (See ENA TS 43-30 Charts 8 -10). The strength of supports are derived from information contained in BS 1990 with respect to red fir poles. The minimum design factor of safety for supports is 2.5 under the design conditions stated in clause 3.1.1 of this specification

3.6.6.1. Wood Poles

Existing wood poles may be retained provided they are of minimum classification Medium to ENA TS 43-88 Annex A and that they have been examined and tested in accordance with NSP/004/112. Retained poles shall be capable of providing continued service for a minimum of 10 years.

Where poles have been inspected and confirmed to be suitable for continued use but do not have 3m gouge marks to indicate the correct installed sinking depth they may be retained providing they are situated in locations that can be safely accessed using mobile access platforms or where the pole can be temporarily stayed in four directions. Where this is not the case the pole must be replaced

All replacement wood poles shall be supplied in accordance with NPS/001/001 – *"Technical Specification for Wood Poles and Associated Products for Overhead Lines"*.

The replacement poles shall be minimum grade Medium as detailed in ENA TS 43-88 Annex A. Poles shall be treated and fabricated in accordance with ENA TS 43-88 and drawing no. 1091193301, sheet 3.

Care shall be taken when selecting replacement poles to take account of the increased pole sinking depths and the potential reduction in ground clearances. Further details on the required sinking depths can be found in NSP/004/041 clause 3.4

3.6.6.2. Steel Poles

For information on retaining or replacing existing steel poles see clause 3.5.4

3.6.7. Insulators and Binders

The condition of all existing insulators and binders shall be inspected and where they are found to be in good condition they shall be retained.

Any replacement insulators shall be supplied in accordance with NPS/001/006 – "*Technical Specification for Insulators for Overhead Lines up to and including 132kV*".

Reel Insulators shall be as detailed in drawing no. 1000439304 sheet 2.

Coach Screw service insulators shall be as detailed in drawing no. 1000439305 sheet 1.

3.6.8. Steelwork

All steelwork shall be supplied in accordance with NPS/001/005 – "*Technical Specification for Overhead Line Steelwork, Conductor Fittings, Insulator Fittings and Stay Fittings*" .

Steelwork is designed to withstand the maximum working tensions tabled in ENA TS 43-30 clause 4.1. All steelwork shall be as specified in ENA TS 43-95.

D-Irons shall be as detailed in drawing no. 1000439512.

Service Brackets shall be to the following 100043 drawing no's 1226, 1404, 9509, 9510, 9511 or 9514 as appropriate to the conductor type and service arrangement.

Any poles containing "Swan Neck" type insulator supports shall have the complete insulator/steelwork assembly replaced with D-Irons and Insulators.

Steel pole steelwork shall be to the following 100043 or 109119 drawing no's

Steel pole collars - 3508 or 3510

Steel pole neutral bars to 3505, 3506 & 3513

Steel pole mounting bar for LV Fuses 3524

3.6.9. Stays

All stays and stay assemblies shall be compliant with clause 3.5.5 of this specification and installed in accordance with NSP/004/104 or NSP/004/041. All stays except those associated with steel poles must include stay insulators.

All stays with permali wood inserts must be replaced with modern type 1 insulators

New or replacement stays shall utilise stay wire to 7/4.00mm grade 1150

3.6.10. Conductor Terminations and Joints

All conductor terminations and joints shall be supplied in accordance with NPS/001/002 or NPS/001/016.

See the following drawings for more details on:

Open Wire Dead ends - 1091193155

Concentric service Dead ends - 1091193152

Intermediate / Angle Ties – 1091193156

3.6.10.1. Mid Span Joints

Mid span joints shall be avoided wherever possible, but where unavoidable, they shall be as detailed on drawing no. 1091010102. Mid span joints shall not be used over motorways, railways or on ABC.

3.6.10.2. Section Fuses

All porcelain type section fuses shall be replaced with new fuse units with lugged connections to drawing no. 1091471530. Where section fuses are installed on supports at heights which are below 4.3m above ground level and section fuses are not installed at the default running condition, then the exposed bare terminals shall be fitted with shrouds to remain compliant with ESQCR regulation 17 (3b)

3.6.11. Fasteners and Washers

All Fasteners and fixings shall be supplied in accordance with NPS/001/011.

3.6.12. Technical Requirements for Open Wire Construction

3.6.12.1. Maximum and Recommended Span Lengths

Conductor or cable size	Recommended Span (m)	Maximum Span (m)
16/25/35mm^2 Concentric cables	20	30
16mm^2 Service Span	20	30
16mm^2 Service Line	50	50
32/70/100mm^2 Distribution Lines	50	60

3.6.12.2. Wind Loading Spans

All wind loading spans are based on the loadings imposed by PVC covered conductors.

Allowable wind loading spans for replacement poles are based on poles being supplied with sizes and available strengths in line with ENA TS 43-88. Consequentially Medium grade poles are suitable for 2, 3, 4 or 5 wire networks with wind spans up to and including 50m.

For spanning in excess of 50m or for information on the maximum windspan capability of existing poles reference shall be made to tables 2 - 4 of ENA TS 43-30.

3.6.12.3. Staying Arrangements and Strut Loading for Angle and Terminal Supports

Stayed supports shall be dressed as shown on drawing no's 1091193326 or 1091193327. For further guidance on allowable staying arrangements see NSP/004/104.

Stay spreads will normally be such that an angle of 35° is provided between stay and pole. (i.e., stay and the vertical). As a general rule, therefore, the stay spread on horizontal ground will be equal to the length of the pole less its sinking depth. In all cases the minimum allowed stay angle shall be 30º.

Typical pole grade / minimum stay spread selection data has been provided for 4 wire Bare and PVC insulated copper networks in appendix 5 & 6. (Note the tabulated data takes no account of additional transverse loadings resulting from service aerials that are additive to the angle loadings).

Alternative conductor arrangements or staying solutions are available by manually checking the strut loads and stay wire capabilities against ENA TS 43-30 table 5 and the appropriate stay charts for the conductor size and number of wire.

Where alternative stay checks are required, users shall utilise the group 2 arrangements as defined in ENA TS 43-30 table 6.

Under exceptional circumstances where no other traditional stayed support can be utilised due to wayleave or access problems, a strut pole arrangement as shown on drawing 1091193331 may be utilised. Strut poles are limited to a maximum angle of deviation of 30°

3.6.13. Relationships with Other Bodies

Where lines to this standard are erected over or alongside the plant of Telecommunications Operators or Network Rail operators, then the provisions of the relevant joint agreements shall apply. Details of the required clearances and any special provisions are available in NSP/004/011.

Additional information with respect to Telecommunication requirements can be found in EB/TP 4 – "*Engineering Recommendation for Telecommunication Providers and Distribution Network Operators joint use of poles*" and PO5/5 – "*Protection of Telecommunication lines from Power Lines*".

The requirements of Waterways Authorities may also be found in Company Code of Practise NSP/004/011.

3.6.14. Safety Signs, Labels and Notices

All poles shall be fitted with safety signs and pole numbers which are compliant with NPS/001/011 and guidance document NSP/004/109.

3.6.15. Earthing

See NSP/004/041 clause 3.11 for more detail on the appropriate earthing policies.

3.6.16. Connections

Connections for open wire networks shall be used according to the material of the conductors, and typical designs are shown on drawings referred to in NSP/004/107.

Before any connection is made, the conductor shall be thoroughly cleaned in order to remove surface oxidation.

Care must be taken to ensure that connectors are properly tightened, and due regard paid in the case of split bolt connectors to conductor relaxation and bedding down of strands. All neutral connections shall consist of double split bolt connectors or compression fittings.

At section positions the tail end of the conductors shall be short on the supply side and long on the remote side to avoid handling a long live tail when making disconnections with the network alive.

3.6.17. Services

Services spans and connections shall be carried out in accordance with NSP/004/043

4. References

4.1. External Documentation

Reference	Title
43-12	Insulated Aerial Bundled Conductor Erection Requirements for LV Overhead Distribution Systems
43-13	Aerial Bundled Conductors Insulated with Cross Linked Polyethylene for low voltage overhead lines.
43-14	Conductor Fittings and Associated Apparatus for use with Low Voltage Insulated Aerial Bare Conductors.
43-30	Low Voltage Overhead Lines On Wood Poles
43-88	Selection and treatment of wood poles and associated timber for overhead lines
43-91	Stay Strands & Stay Fittings for Overhead Lines
43-92	Stay Strands & Stay Fittings for Overhead Lines
43-95	Steelwork for Overhead Lines
EB/TP 4	Engineering Recommendation for Telecommunication Providers and Distribution Network Operators joint use of poles
ESQCR	The Electricity Safety, Quality and continuity Regulations 2002, SI 2665
PO5 /5	Protection of Telecommunication lines from Power Lines

4.2. Internal Documentation

Reference	Title
IMP/010/011	Code of practise for earthing LV Networks and HV Distribution Substations
MNT/001/004	Technical Specification for Tower, Steel Pole and Substation Plant Painting
MNT/004/012	Guidance on the Risk Assessment of Overhead Lines
NPS/001/001	Technical Specification for Wood Poles and Associated Products for Overhead Lines
NPS/001/002	Technical Specification for Helical Products
NPS/001/005	Technical Specification for Steelwork, Conductor/Insulator Fittings and Stay Fittings for Overhead Lines and General Construction Works
NPS/001/006	Technical Specification for Insulators for Overhead Lines up to and including 132kV
NPS/001/007	Technical Specification for Overhead Line Conductors
NPS/001/010	Technical Specification for Notice Plates and Signs for Use on NEDL and YEDL Distribution Systems
NPS/001/011	Technical Specification for Fasteners And Fixings For Wood Pole Overhead Lines and General Construction Works
NPS/001/013	Technical Specification for Stay wire for Overhead Lines
NPS/001/016	Technical Specification for Compression Fittings and Mechanical Conductor Fittings for Overhead Lines
NPS/001/020	Technical Specification for Ground Anchor Systems for Use in Overhead Lines
NSP/001/103	OHI 3 Guidance on the Type and fabrication of O/H line supports (Ref Library)
NSP/004/011	Guidance on Overhead Line Clearances
NSP/004/041	Specification for LV ABC Overhead Lines
NSP/004/043	Specification for Overhead Services, Surface Wiring and ABC Eves Mains
NSP/004/104	Guidance notes on Stay types, make-offs and spreads
NSP/004/105	Guidance notes on conductor erection and dismantling
NSP/004/106	Guidance notes on conductor joints, terminations & binders
NSP/004/107	Guidance notes on conductor jumpers & non-tension connections
NSP/004/109	Guidance notes on anti-climbing devices, signs and notices plates
NSP/004/112	(OHI 12) Guidance for the Inspection and Testing of Wood & Steel Poles

4.3. Amendments from Previous Version

Reference	Description
1.0 Purpose	Reference to historic specifications removed
3.2 Renovation of Existing Networks	References to previous network inspections in 2009/10 updated to 2019/21 additionally references to legacy condition assessment points in Appendix 14 and 15 have been removed.
3.3 Extensive Maintenance	Added option to alter the type of renovation undertaken due to changes in work programs priorities additionally references to the need to comply with clauses 3.6.1 and 3.6.2, conductor type and clearance requirements added. And further references to condition rating values used in legacy inspection processes have been removed.
3.4 Conversion to ABC	the now obsolete ref to NSP/004/012 has been replaced with its replacement reference MNT/004/012. Additionally, all references to the use of "permanent shrouding" have been removed.
3.5.1 Conductors, Clearances & Conductor Design ratings	This clause has been appended with a paragraph detailing the possible future use of 4 x 150mm ABC, where conductors require replacement due to identified electrical loading requirements.
3.5.3 Wood Poles – General	Clarification added when none creosote poles shall be used. Additionally, all legacy references to BS1990 have been replaced with updated references to ENA TS 43-88 as BS1990 has been superseded by BS EN 3288.
3.5.4 Tubular Steel Poles	Further guidance has been added on assessment criteria of existing steel poles and where replacement steel poles are required updated reference to the latest M class poles.
3.5.4.2 Tubular Steel Pole – Allowable Angles of Deviation	The table associated with the clause relating to Tubular Steel Pole – Allowable Angles of Deviation has been updated to reference the later stell pole design variants.
3.5.4.3 Tubular Steel Pole Foundations	Additional references to MNT/001/004 to cover the painting of steel poles
3.5.5 Stays	Additional guidance added with respect to the need to replace the complete stay assembly whenever any individual component within a stay assembly requires replacement or when a stayed structure requires replacement.
3.6.1 Conductors & ESQCR Proximity Issues	Permanent Shrouding Section removed due to permanent conductor shrouding no longer being an approved option. Additionally, a statement has been added that where additional phase conductors are required, rather than adding additional bare or PVC covered wires, the opportunity shall be taken to replace the section of line with ABC.
3.6.2 Clearances & conductor Design Ratings	Further guidance added documenting the need for effectively insulated conductors to be installed where existing networks are located in close proximity to building or climbable trees.
3.6.4.1 Service Lines and 3.6.5 Services	Statement requiring that open wire construction service spans where the live conductor is located below a bare or PVC covered neutral conductor are not compliant with the ESQCR regs and must be replaced with modern concentric service spans when they are identified.
3.6.6.1 Wood Poles	Legacy references to BS1990 replaced with references to ENA TS 43-88
3.6.10.2 Section fuses	New requirement added that where unfused section fuses are installed on supports such that they are positioned below 4.3m above ground level, that the bare exposed terminals must be fitted with insulating shrouds to make them ESQCR compliant.
3.6.13 Relationships with other bodies	Legacy references to EB TP3 and PO5/2 have been updated with the latest versions of those guidance documents
Appendix 1 Index of Drawings	Index updated and noncompliant Northern Powergrid drawing frames removed

5. Definitions

Term	Definition
Anchor Clamp	A fitting, which transfers the tensile forces within the tensioned conductor, cores to the supporting structure.
Design Loading Conditions	These are the augmented ice and wind loadings corresponding to ice 9.5mm diameter, wind 380N/m² , as specified in EATS 43-12
Insulation Piercing Connectors (IPC's)	Connectors that can be applied to insulated conductors without the prior removal of the insulation
Intermediate Support	A support where the ABC system is attached by a suspension clamp. Intermediate supports may have angles of deviation up to 60°.
Main Lines	Lines of 4 core ABC with main cores of 50, 70, 95 or 120mm² conductor
MEN	Multiple Earthed Neutral
PILC	Paper Insulated Lead Covered Cable
PME	Protective Multiple Earthing
Section Support	A support where adjacent spans are attached by means of anchor clamps. Section supports may have angles of deviation and may have provisions for electrically sectionalising the system. Unless there is a specific need for the conductors to be cut, the ABC shall be run unbroken and a loop, approximately 0.5m deep shall be provided.
Service Lines	Lines of 2 or 4 core ABC with core sizes of 35mm^2 conductor
Service Span	The span in which the service conductors are attached to a building at reduced tensions.
Suspension Clamp	A fitting that encloses and supports all ABC cores at an intermediate support.
Terminal Support	A support where the ABC is attached by an anchor clamp and does not continue into an adjacent span.

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	11/04/2024

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	
No	Period: 5	Reason: Update will be dictated by significant changes in working practiced, products or policy
Should this document be displayed on the Northern Powergrid external website?		Yes
		Date
Steven Salkeld	Policy and Standards Engineer	24/06/2024

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	12/04/2024
Aaron Chung	Policy and Standards Engineer	12/04/2024

6.4. Authorisation

Authorisation is granted for publication of this document.

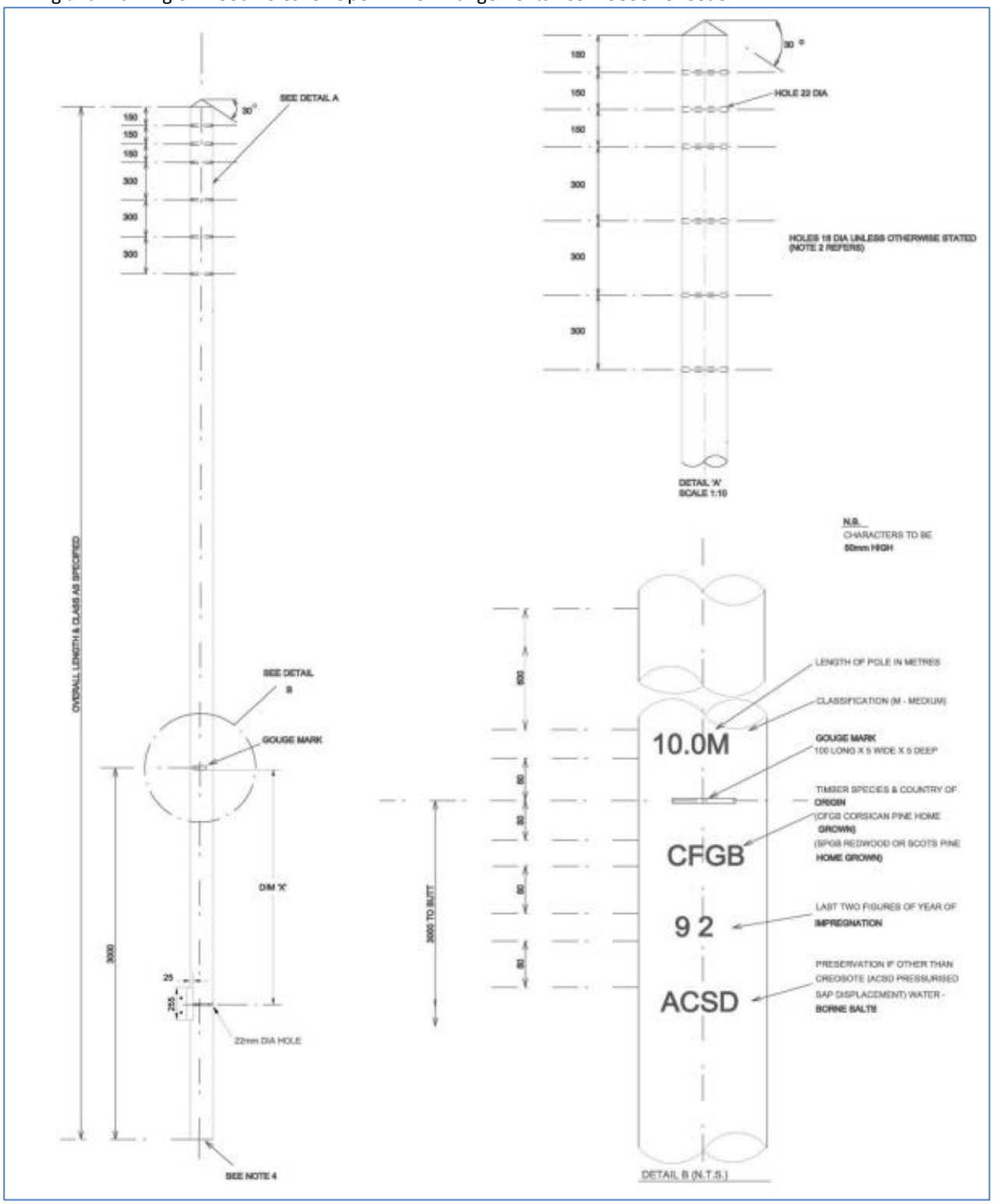
		Date
Paul Black	Head of System Engineering	03/06/2024

Appendix 1 - Index of drawings for conversion of existing open wire networks to ABC construction or renovation of existing open wire arrangements

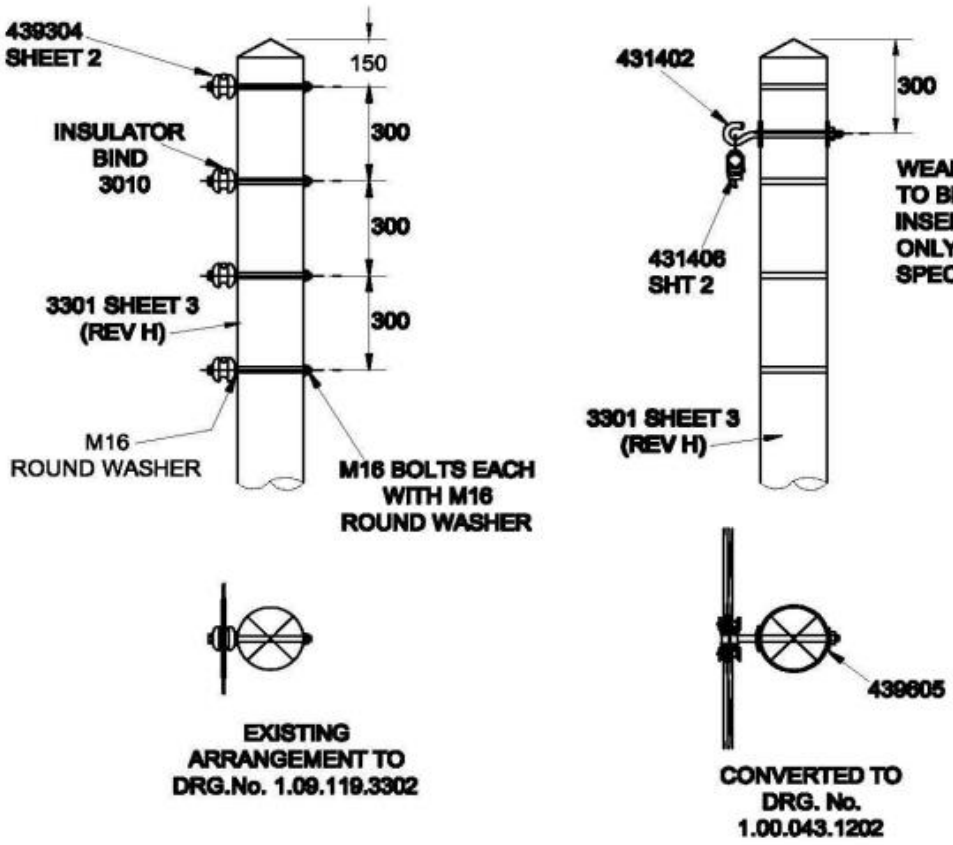
Wood Poles	
Drilling and Marking of Wood Poles for Open Wire Arrangements	1091193301 Sht 3
Renovation of Open Wire Straight Line Pole to ABC Construction	1091193302
Renovation of Open Wire Angle Pole (30° dev) to ABC	1091193303 Sht 1
Renovation of Open Wire Angle Pole (60° dev) to ABC	1091193303 Sht 2
Renovation of Open Wire Section Angle (90° dev) to ABC	1091193304
Renovation of Intermediate Angle Pole with Tee off to ABC	1091193305
Renovation of Intermediate Angle Support to Typical ABC Tee off	1091193306
Renovation of Open Wire Terminal Pole to ABC (C/w Cable Box)	1091193308
Renovation of Open Wire Int. Pole with Offset bracket to ABC	1091193309
Arrangement of 7/4.00mm stay assembly on LV wood Pole	1091193326

Steel Poles	
Steel Pole Details	1091193501 Sht 2
Foundation Requirements for Steel Poles	1091193502 Sht 1
ABC Collars for Steel Poles	1091193510 Sht 2
Cable Cleats for Steel Poles	1091193514 Sht 4
Bonding Connection on J & K Steel Poles	1091193525
Intermediate Support	1091193601 Sht 2
Intermediate Support up to 30° Deviation	1091193603 Sht 2
Section Pole - Straight Line or Angle	1091193605 Sht 1
Terminal Support	1091193606
Typical Service Arrangement on Steel Poles	1091193609
Earthing Connection for Steel Poles	1091193622
Conversion of steel Pole Tops on Undrilled Poles	1091193661
ABC or open wire networks on predrilled Steel Poles	1091193662
Arrangement of 7/4.00mm Stay Assembly on LV Steel Pole	1091193608

Drilling and Marking of Wood Poles for Open Wire Arrangements 1091193301 Sheet 3



Renovation of Open Wire Straight Line Pole to ABC Construction 1091193302



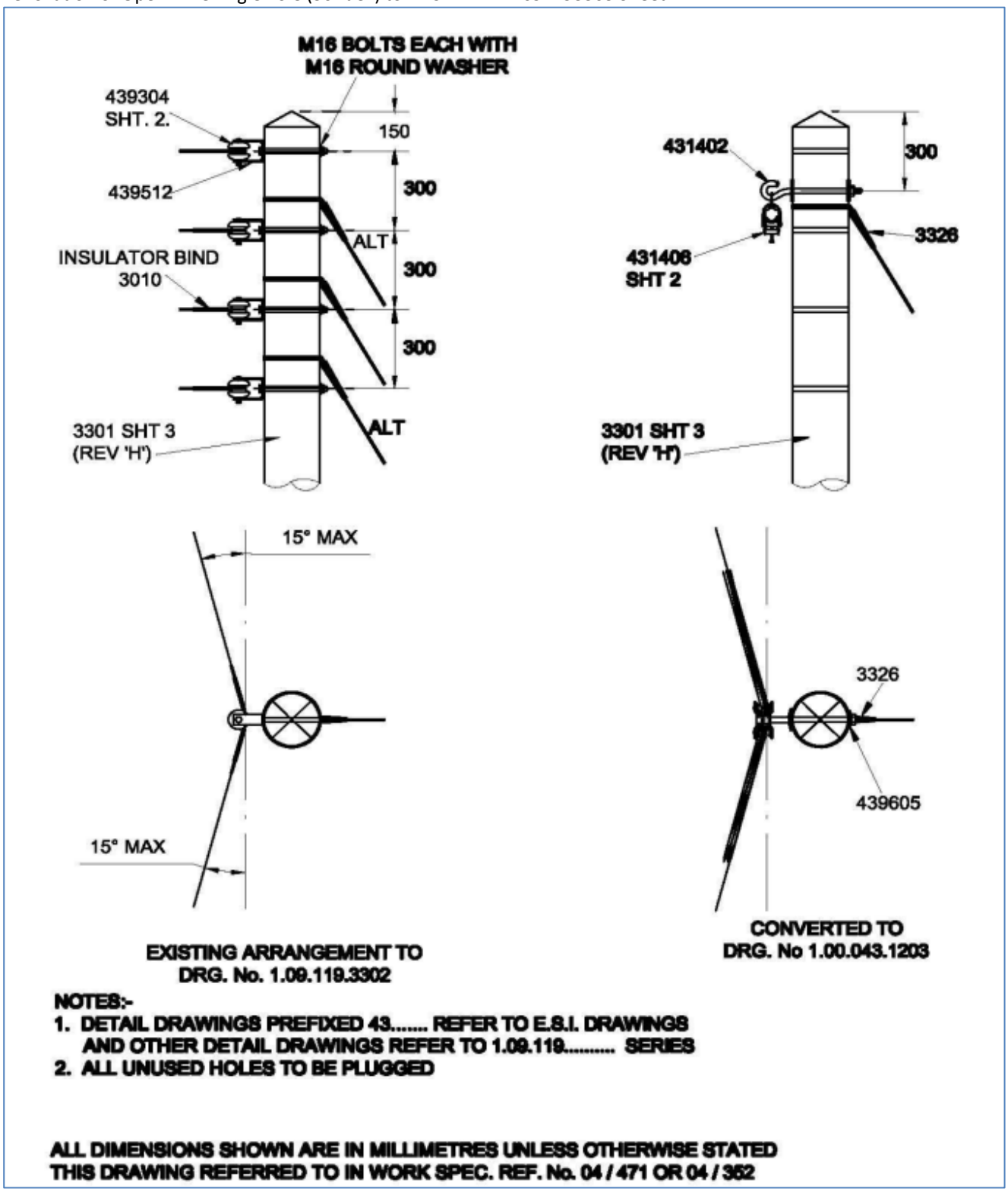
NOTES :-

1. **DETAIL DRAWINGS PREFIXED 43..... REFER TO E.S.I. BASED DRAWINGS AND OTHER DETAIL DRAWINGS REFER TO 1.09.119..... SERIES**
2. **ALL UNUSED HOLES TO BE PLUGGED**

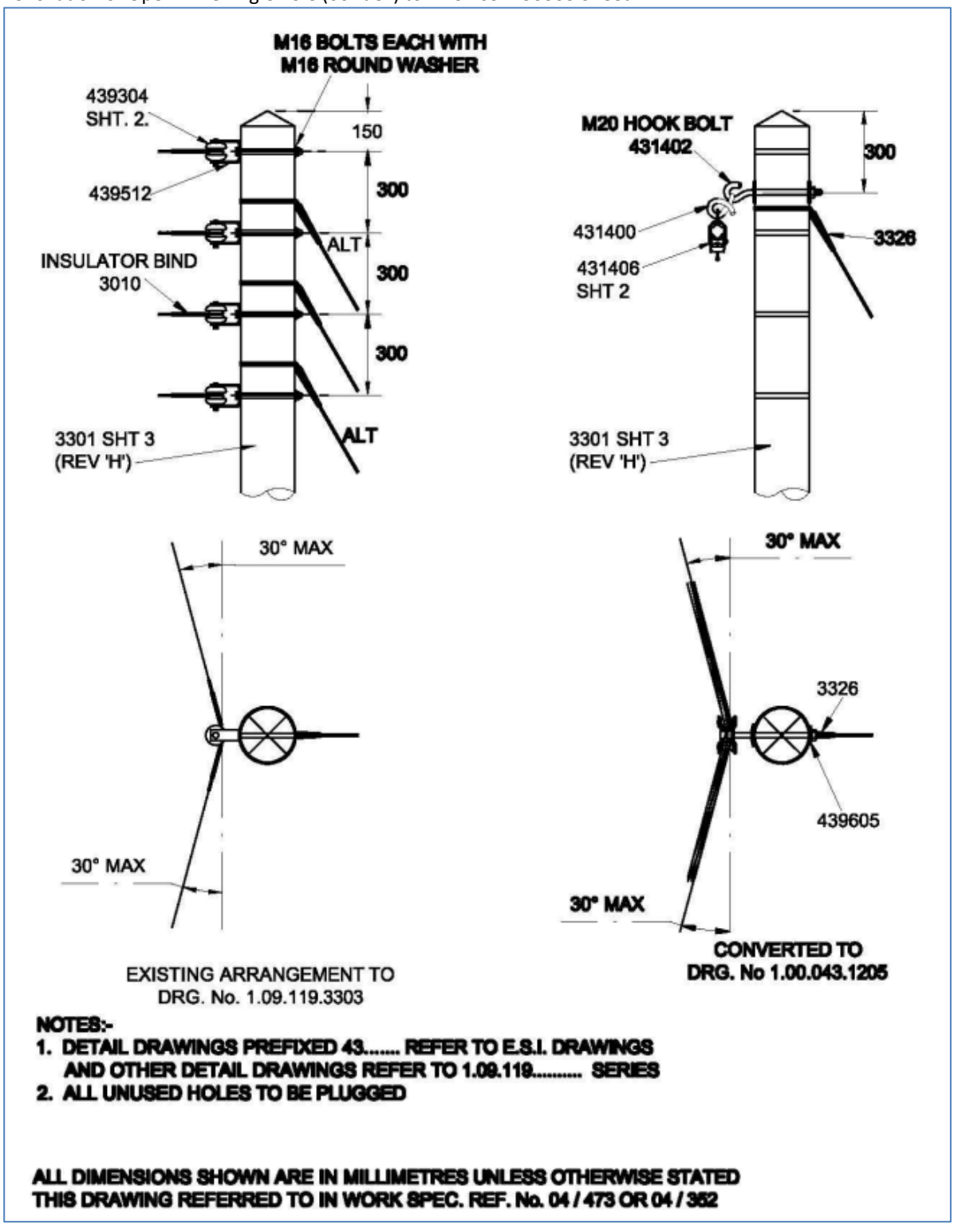
ALL DIMENSIONS SHOWN ARE IN MILLIMETRES UNLESS OTHERWISE STATED

THIS DRAWING REFERRED TO IN WORK SPEC REF. No 04 / 470 OR 04 / 351

Renovation of Open Wire Angle Pole (30° dev) to ABC 1091193303 Sheet 1



Renovation of Open Wire Angle Pole (60° dev) to ABC 1091193303 Sheet 2

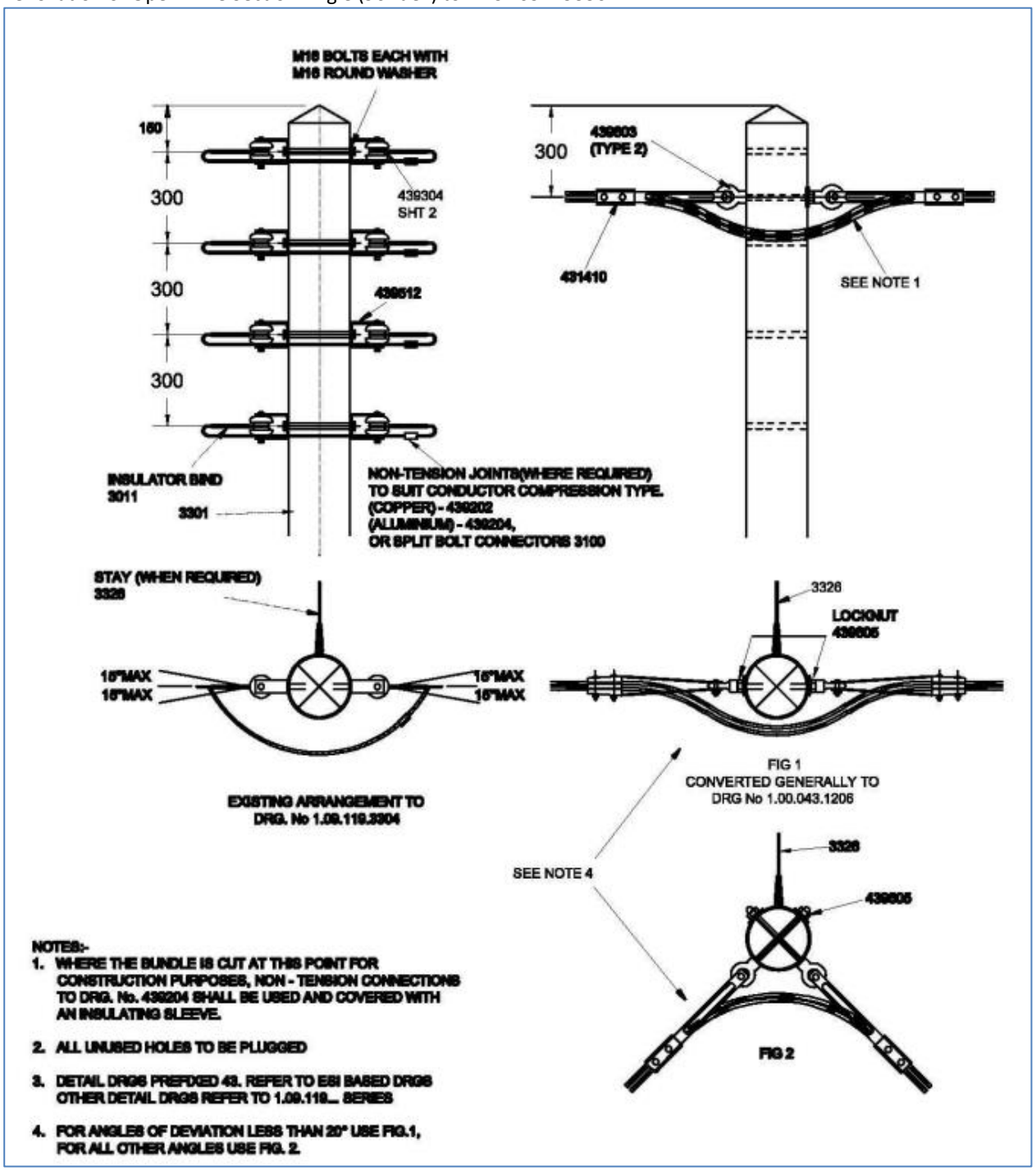


NOTES:-

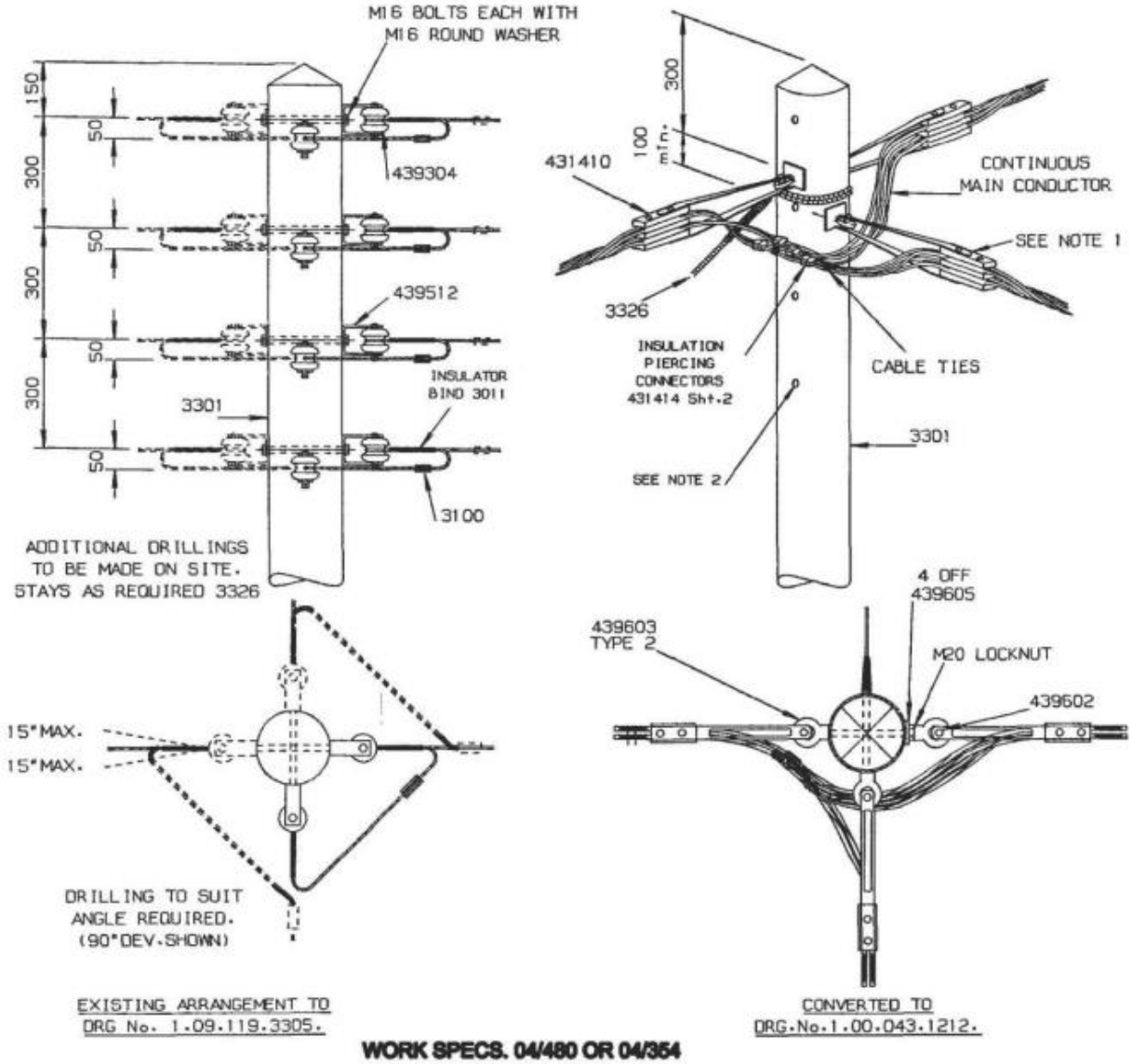
1. **DETAIL DRAWINGS PREFIXED 43..... REFER TO E.S.I. DRAWINGS AND OTHER DETAIL DRAWINGS REFER TO 1.09.119..... SERIES**
2. **ALL UNUSED HOLES TO BE PLUGGED**

ALL DIMENSIONS SHOWN ARE IN MILLIMETRES UNLESS OTHERWISE STATED
THIS DRAWING REFERRED TO IN WORK SPEC. REF. No. 04 / 473 OR 04 / 352

Renovation of Open Wire Section Angle (90° dev) to ABC 1091193304



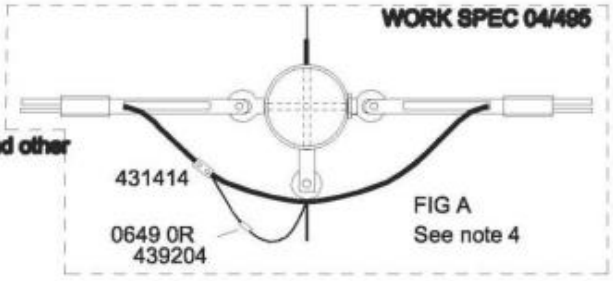
Renovation of Intermediate Angle Pole with Tee off to ABC 1091193305



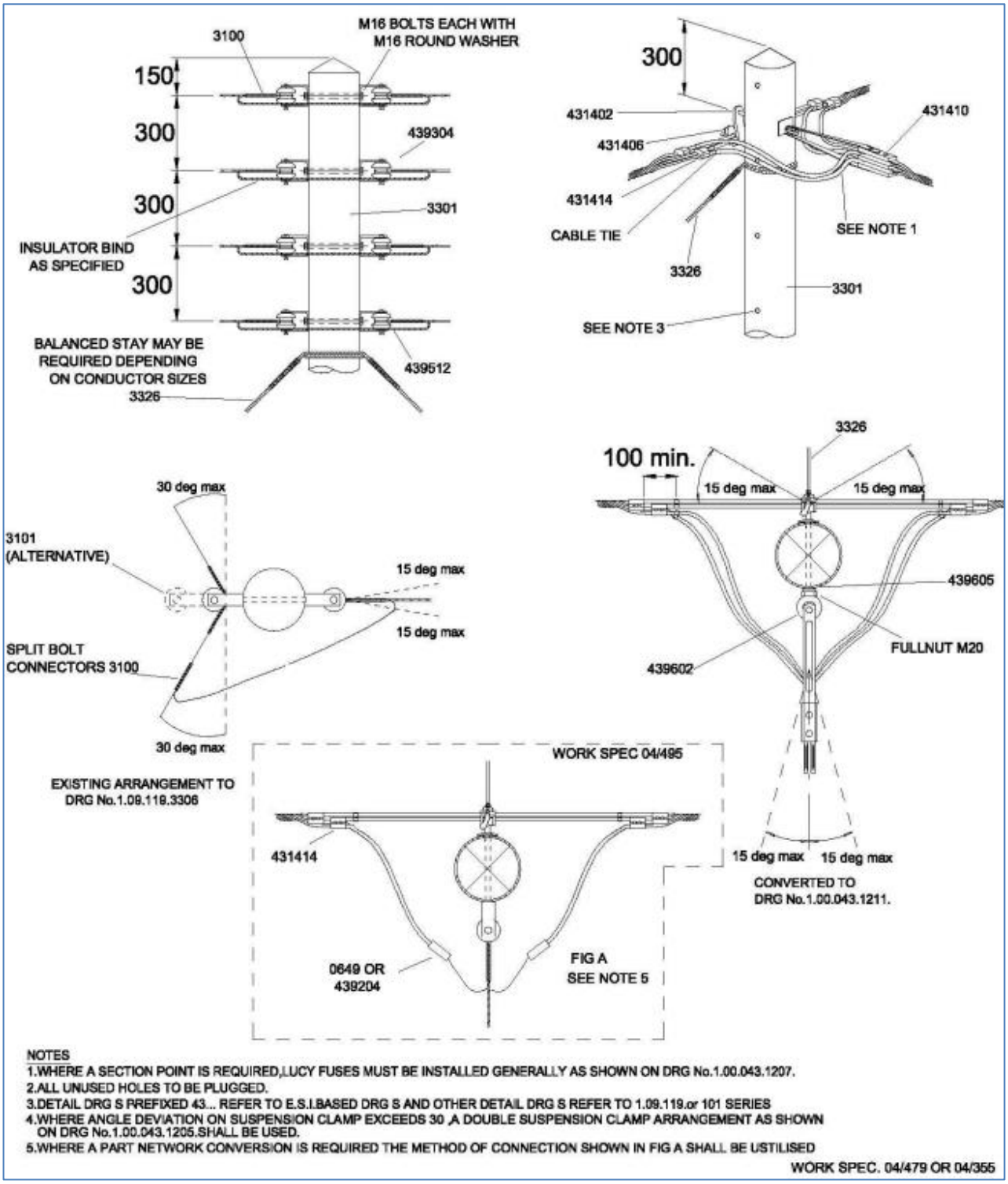
WORK SPECS. 04/480 OR 04/354

NOTES:

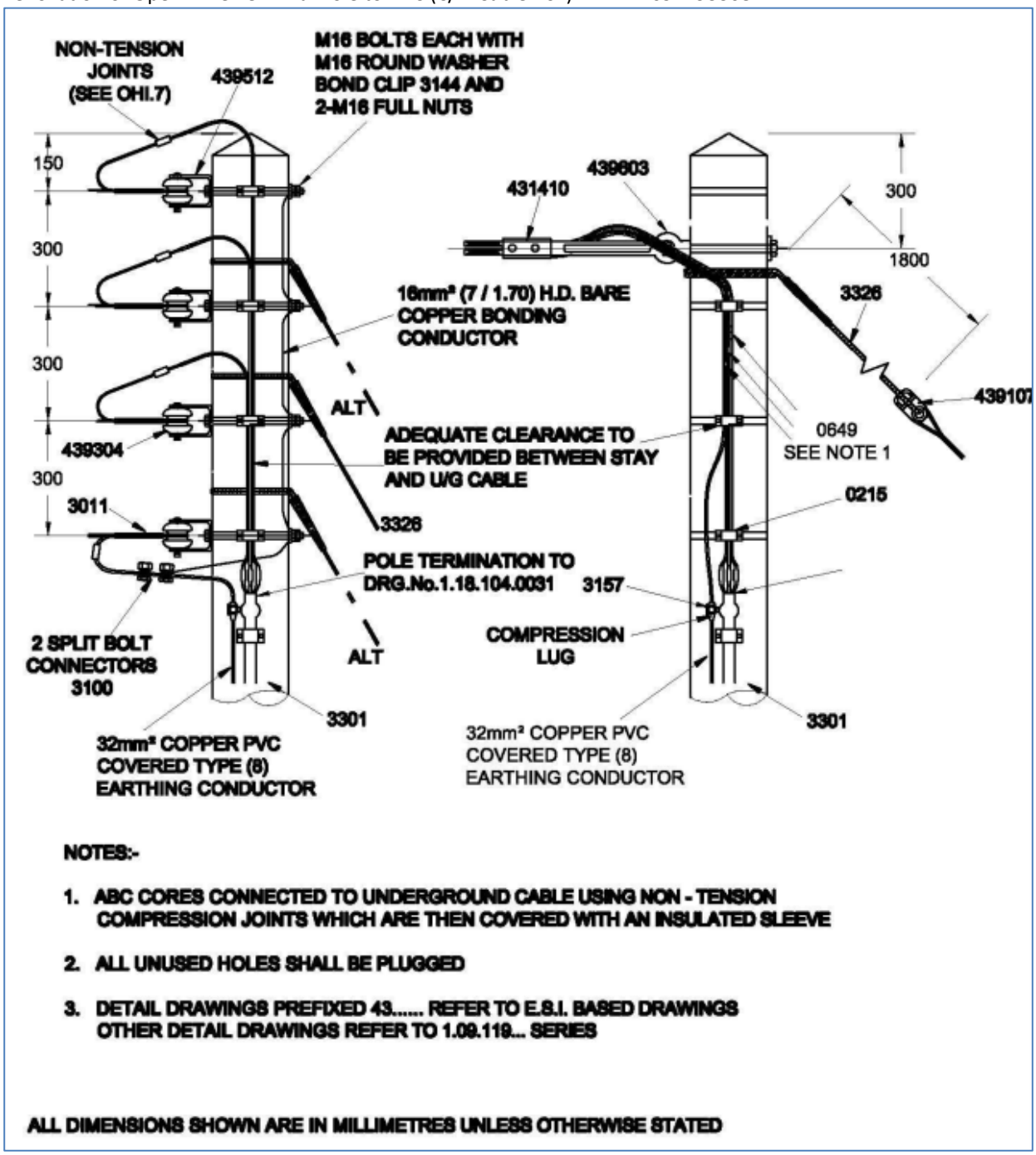
1. Where a section point is required Lucy fuses must be installed generally as shown on DRG No. 1.00.043.1207.
2. All unused holes to be plugged.
3. Detail DRG's prefixed 43... refer to E.S.I. based DRG's and other detail DRG's refer to 1.09.119.or 101 series
4. Where a part network conversion is required the method of connection shown in Fig A shall be utilised.



Renovation of Intermediate Angle Support to Typical ABC Tee off 1091193306



Renovation of Open Wire Terminal Pole to ABC (C/w Cable Box) 1091193308

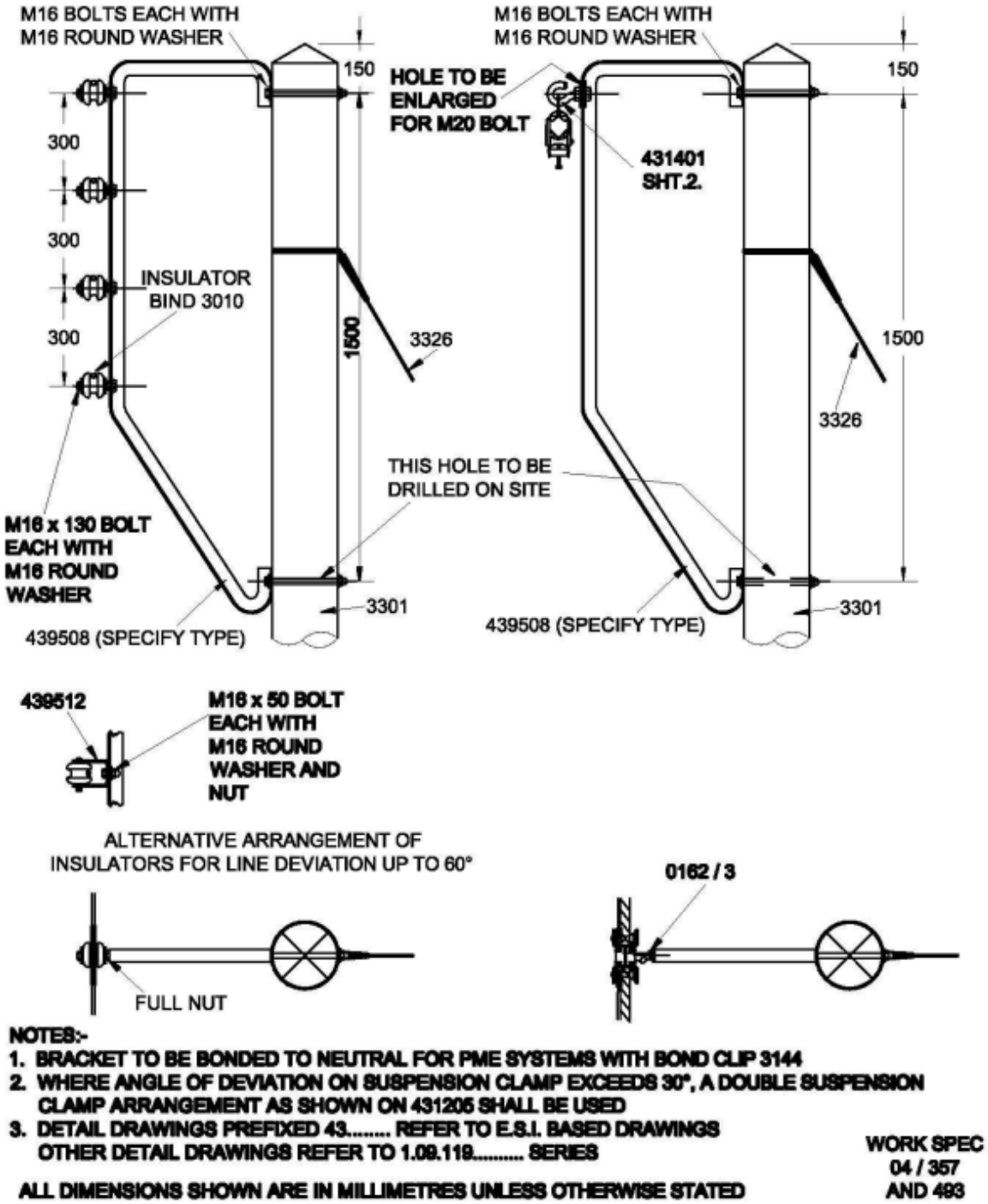


NOTES:-

1. ABC CORES CONNECTED TO UNDERGROUND CABLE USING NON - TENSION COMPRESSION JOINTS WHICH ARE THEN COVERED WITH AN INSULATED SLEEVE
2. ALL UNUSED HOLES SHALL BE PLUGGED
3. DETAIL DRAWINGS PREFIXED 43..... REFER TO E.S.I. BASED DRAWINGS OTHER DETAIL DRAWINGS REFER TO 1.09.119... SERIES

ALL DIMENSIONS SHOWN ARE IN MILLIMETRES UNLESS OTHERWISE STATED

Renovation of Open Wire Int. Pole with Offset bracket to ABC 1091193309



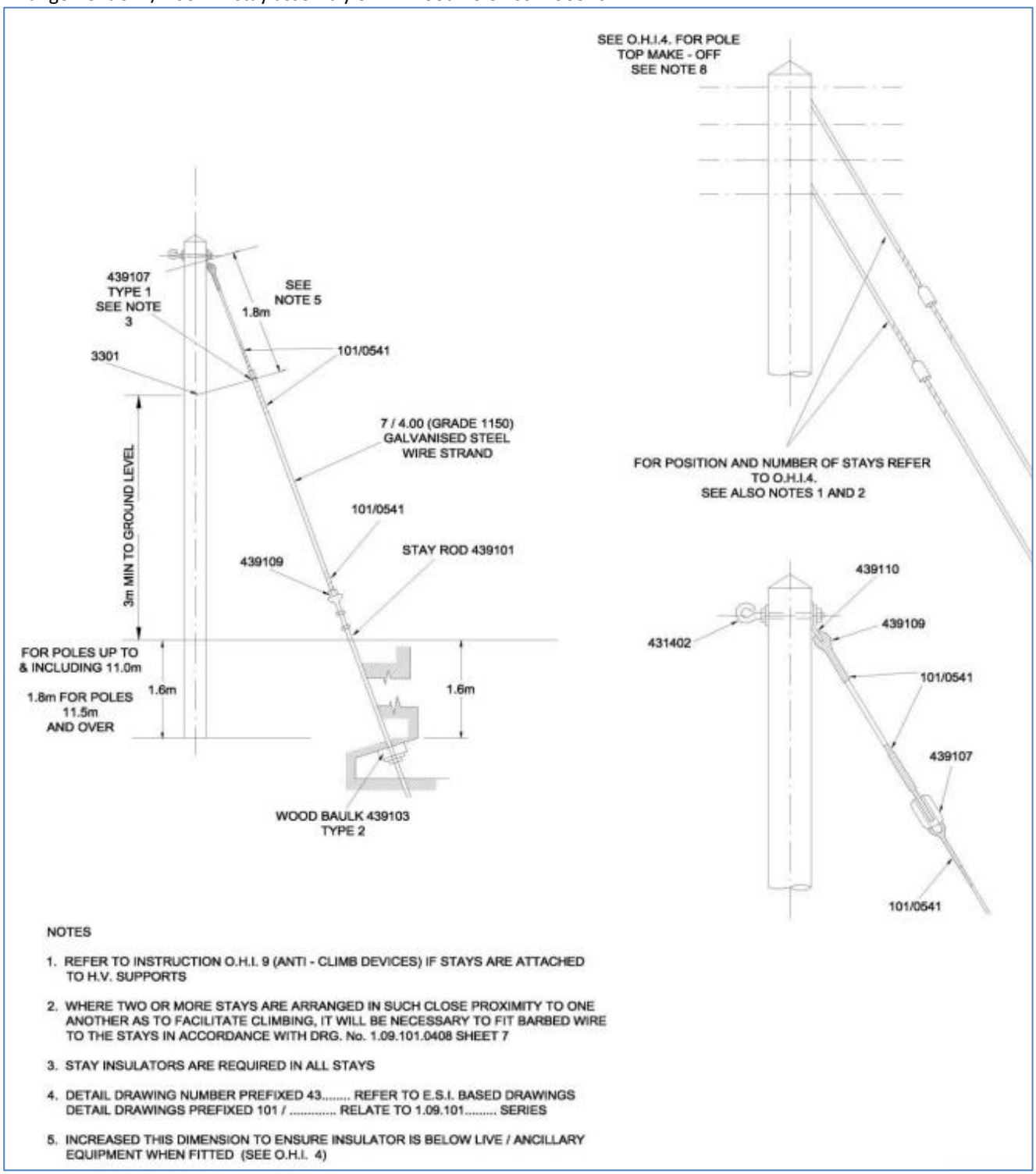
NOTES:-

1. BRACKET TO BE BONDED TO NEUTRAL FOR PME SYSTEMS WITH BOND CLIP 3144
2. WHERE ANGLE OF DEVIATION ON SUSPENSION CLAMP EXCEEDS 30°, A DOUBLE SUSPENSION CLAMP ARRANGEMENT AS SHOWN ON 431205 SHALL BE USED
3. DETAIL DRAWINGS PREFIXED 43..... REFER TO E.S.I. BASED DRAWINGS OTHER DETAIL DRAWINGS REFER TO 1.09.119..... SERIES

ALL DIMENSIONS SHOWN ARE IN MILLIMETRES UNLESS OTHERWISE STATED

WORK SPEC 04 / 357 AND 493

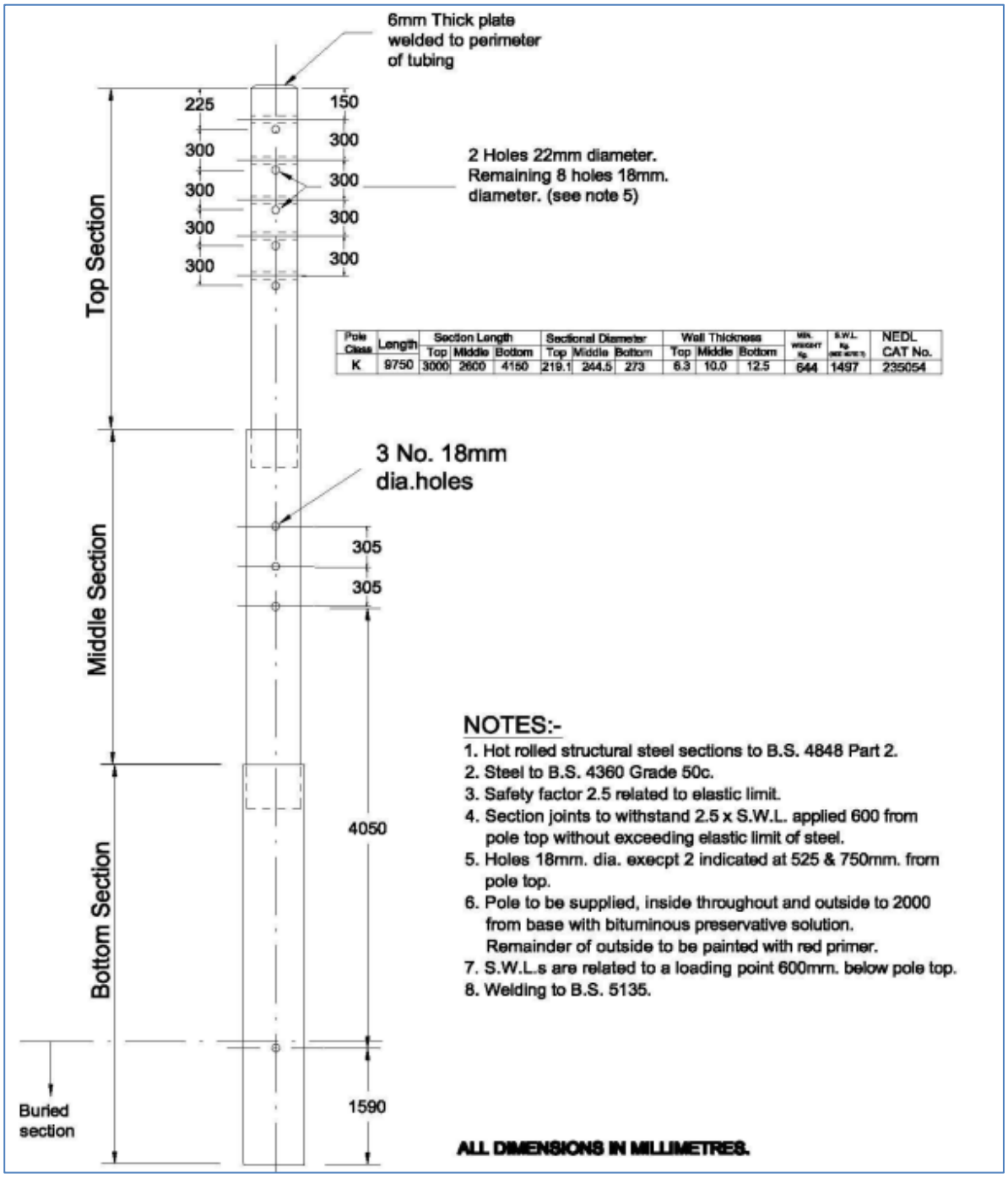
Arrangement of 7/4.00mm stay assembly on LV wood Pole 1091193326



NOTES

1. REFER TO INSTRUCTION O.H.I. 9 (ANTI - CLIMB DEVICES) IF STAYS ARE ATTACHED TO H.V. SUPPORTS
2. WHERE TWO OR MORE STAYS ARE ARRANGED IN SUCH CLOSE PROXIMITY TO ONE ANOTHER AS TO FACILITATE CLIMBING, IT WILL BE NECESSARY TO FIT BARBED WIRE TO THE STAYS IN ACCORDANCE WITH DRG. No. 1.09.101.0408 SHEET 7
3. STAY INSULATORS ARE REQUIRED IN ALL STAYS
4. DETAIL DRAWING NUMBER PREFIXED 43..... REFER TO E.S.I. BASED DRAWINGS DETAIL DRAWINGS PREFIXED 101 / ..... RELATE TO 1.09.101..... SERIES
5. INCREASED THIS DIMENSION TO ENSURE INSULATOR IS BELOW LIVE / ANCILLARY EQUIPMENT WHEN FITTED (SEE O.H.I. 4)

Steel Pole Details 1091193501 Sheet 2



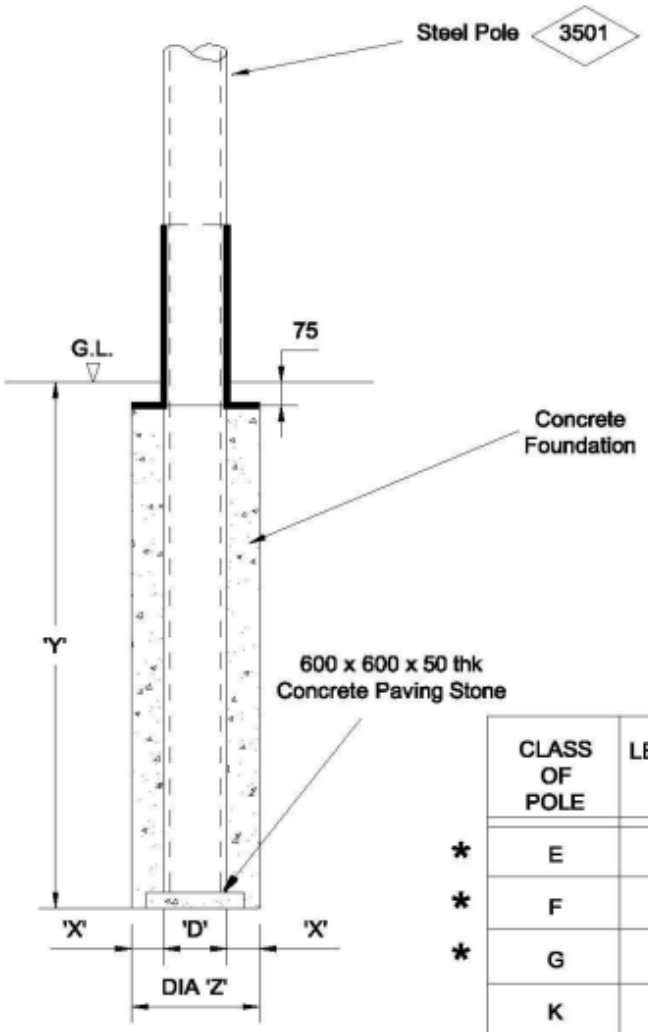
Pole Class	Length	Section Length			Sectional Diameter			Wall Thickness					NEDL CAT No.
		Top	Middle	Bottom	Top	Middle	Bottom	Top	Middle	Bottom			
K	9750	3000	2600	4150	219.1	244.5	273	6.3	10.0	12.5	644	1497	235054

NOTES:-

1. Hot rolled structural steel sections to B.S. 4848 Part 2.
2. Steel to B.S. 4360 Grade 50c.
3. Safety factor 2.5 related to elastic limit.
4. Section joints to withstand 2.5 x S.W.L. applied 600 from pole top without exceeding elastic limit of steel.
5. Holes 18mm. dia. execpt 2 indicated at 525 & 750mm. from pole top.
6. Pole to be supplied, inside throughout and outside to 2000 from base with bituminous preservative solution. Remainder of outside to be painted with red primer.
7. S.W.L.s are related to a loading point 600mm. below pole top.
8. Welding to B.S. 5135.

ALL DIMENSIONS IN MILLIMETRES.

Foundation Requirements for Steel Poles 1091193502 Sheet 1



	CLASS OF POLE	LENGTH m	BASE DIA 'D' mm	DIM 'X' mm	DIM 'Y' mm	DIA. 'Z' mm
*	E	9.75	193.7	100	1675	393.7
*	F	9.75	244.5	150	1675	544.5
*	G	9.75	273	300	1675	875.0
	K	9.75	273	300	1675	873.0
	K	10.75	273	330	1850	933

NOTES:-

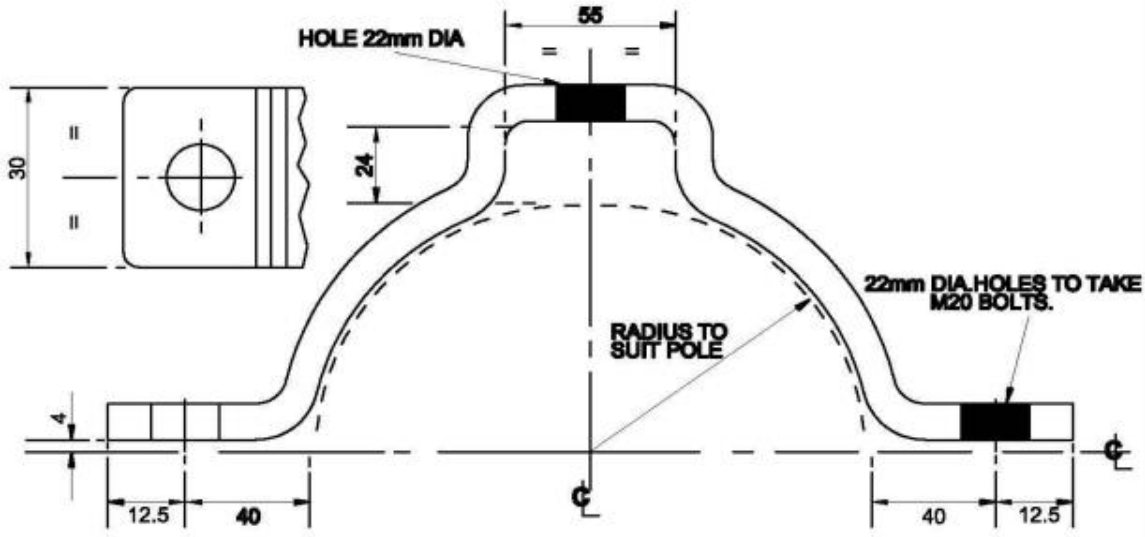
1. Ordinary Portland cement to B.S. 12 shall be used for foundation concrete
2. Nominal maximum size of coarse aggregate 20mm. Mixture to be 1 part cement, 2 parts sand and 4 parts aggregate

* **Foundation Information - Historical Only - current steel poles are K class**

WORK SPEC No 04/440, 444

ABC Collars for Steel Poles 1091193510 Sheet 2

ITEM No	POLE DIA. METRIC mm	IMP.ins.	CAT.Nos.
1	194.0	(7⅝)	249659
2	140.0	(5½)	249663
3	219.1	(8⅝)	249678



TO BE MANUFACTURED ACCURATELY TO DIMENSIONS AND IN MATCHED PAIRS.

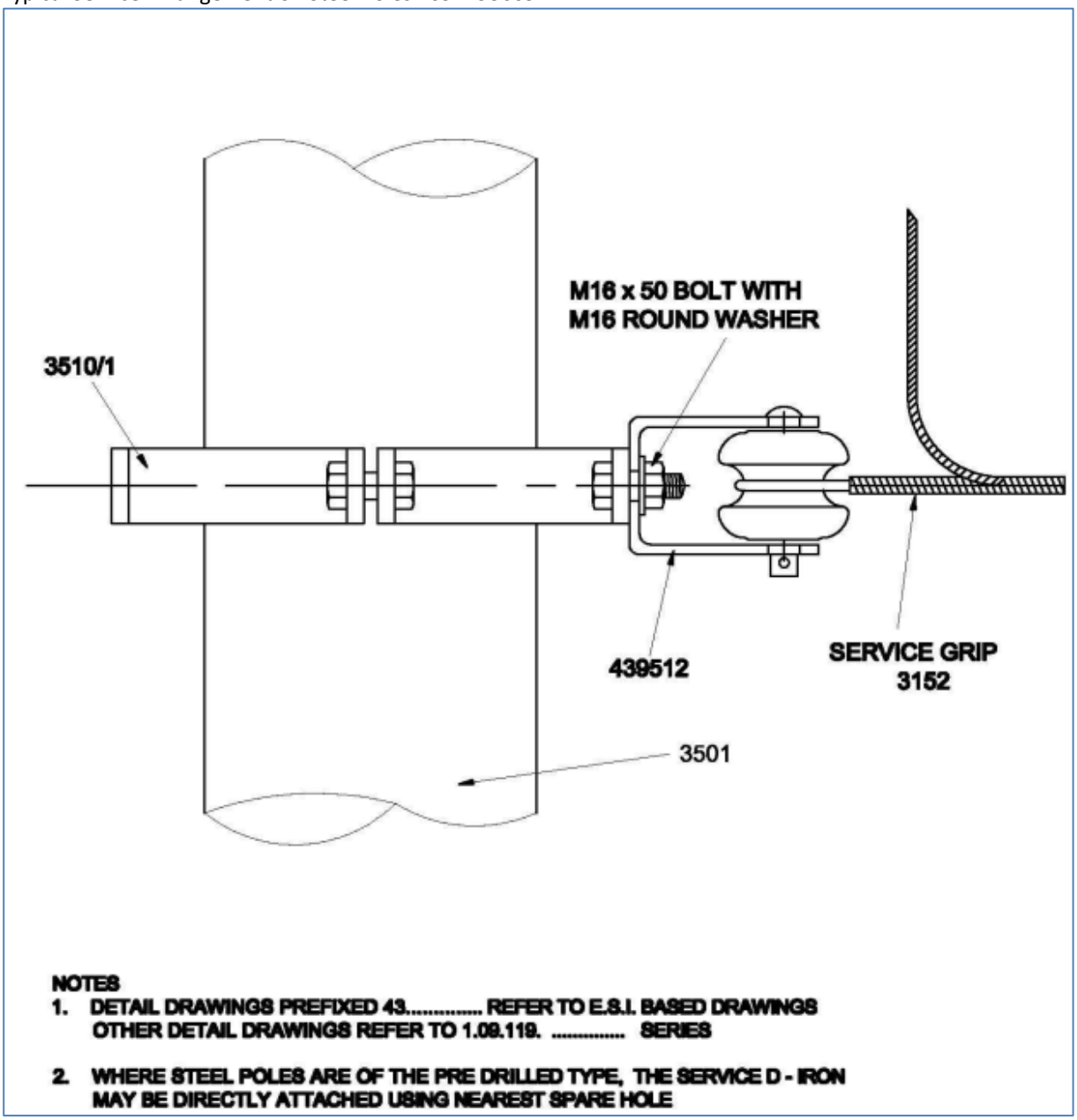
2 OFF THUS PER SET.
MATERIAL:- 60 X 12 FLAT.

NOTES:-

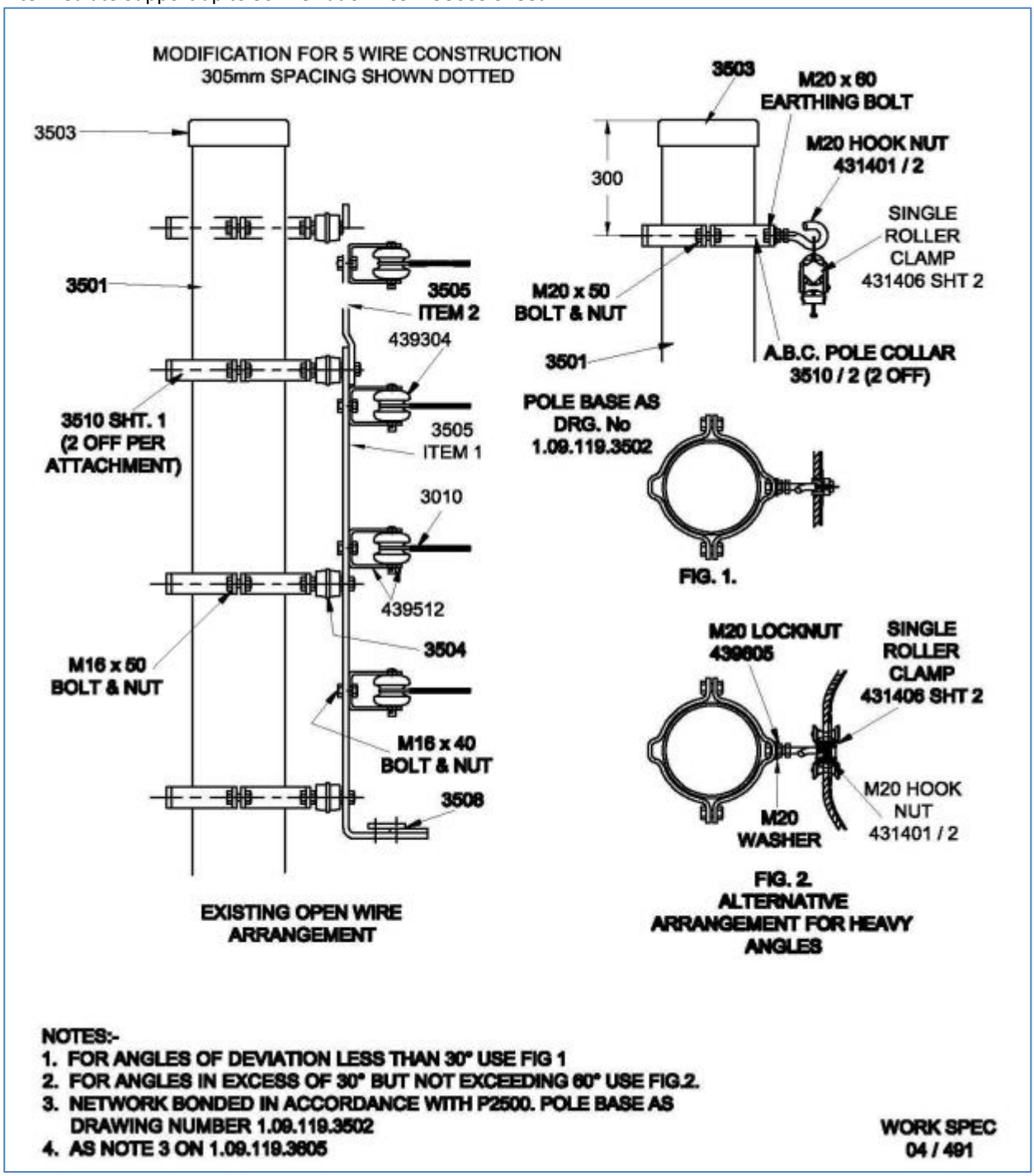
1. STEELWORK TO BE IN ACCORDANCE WITH BS EN 10025, GRADE Fe 430B.
2. SECTIONS TO COMPLY WITH BS 6722.
3. GALVANISING TO MEET THE REQUIREMENTS OF BS 729 AFTER FABRICATION.
4. COMPONENTS TO BE MARKED WITH NORTHERN ELECTRIC STOCK CAT.No.
5. BENDING OF FLATS TO BE CARRIED OUT COLD, THEN STRESS RELIEVED TO 600 C MINIMUM BEFORE GALVANISING OR BENT HOT.

ALL DIMENSIONS SHOWN ARE IN MILLIMETRES UNLESS OTHERWISE STATED.

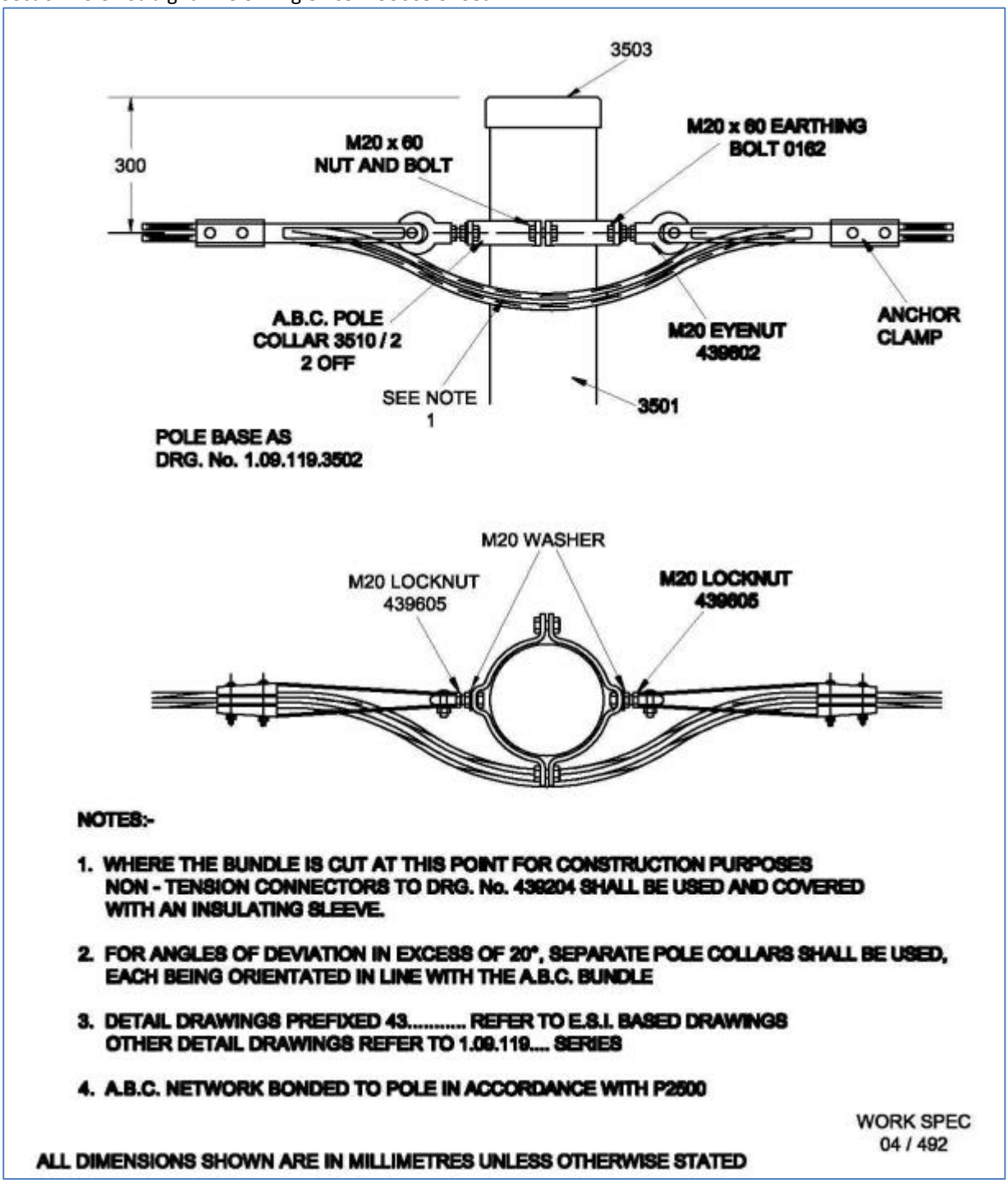
Typical Service Arrangement on Steel Poles 1091193609



Intermediate Support up to 30° Deviation 1091193603 Sheet 2



Section Pole - Straight Line or Angle 1091193605 Sheet 1



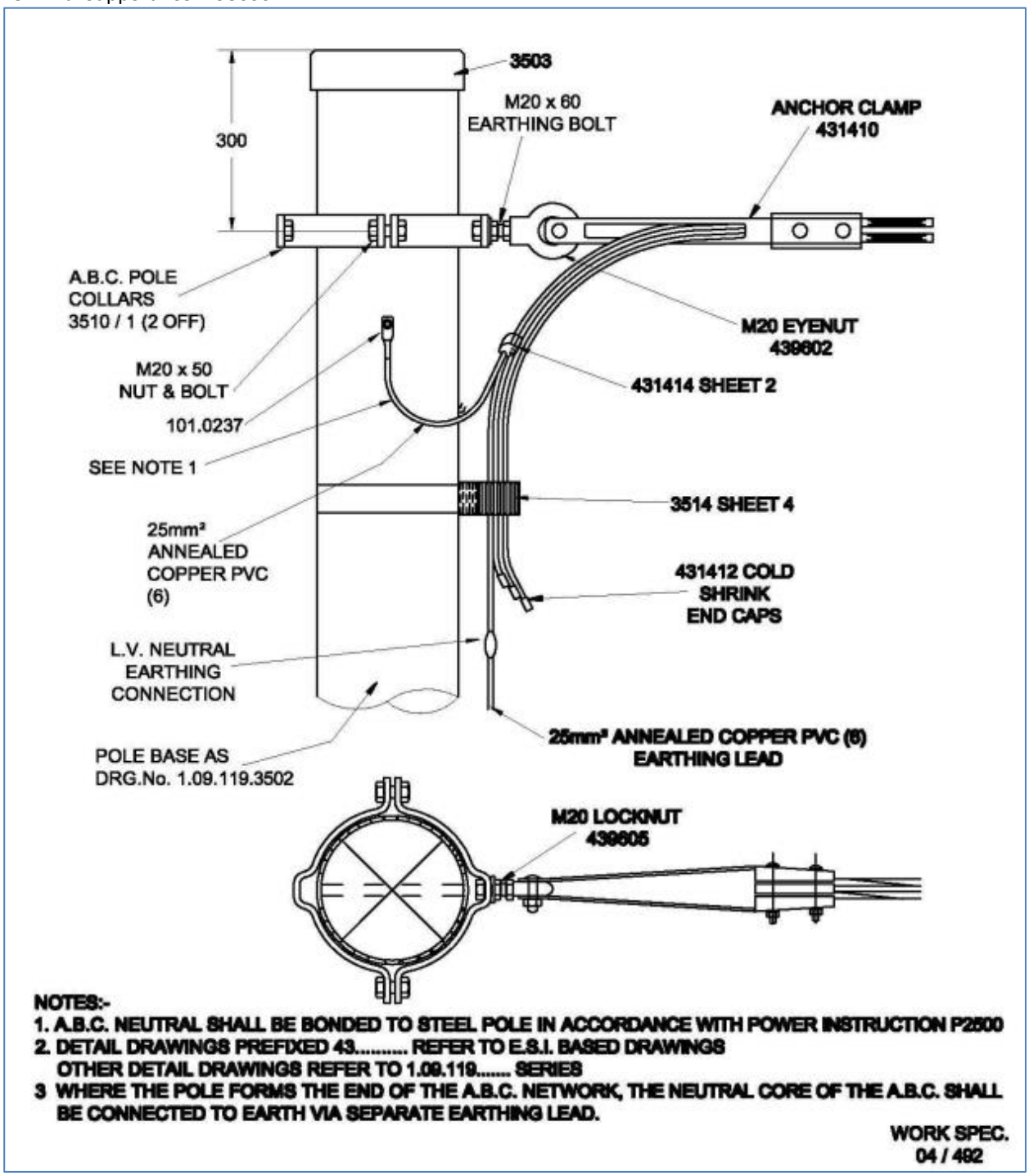
NOTES:-

1. **WHERE THE BUNDLE IS CUT AT THIS POINT FOR CONSTRUCTION PURPOSES NON - TENSION CONNECTORS TO DRG. No. 439204 SHALL BE USED AND COVERED WITH AN INSULATING SLEEVE.**
2. **FOR ANGLES OF DEVIATION IN EXCESS OF 20°, SEPARATE POLE COLLARS SHALL BE USED, EACH BEING ORIENTATED IN LINE WITH THE A.B.C. BUNDLE**
3. **DETAIL DRAWINGS PREFIXED 43..... REFER TO E.S.I. BASED DRAWINGS OTHER DETAIL DRAWINGS REFER TO 1.09.119.... SERIES**
4. **A.B.C. NETWORK BONDED TO POLE IN ACCORDANCE WITH P2500**

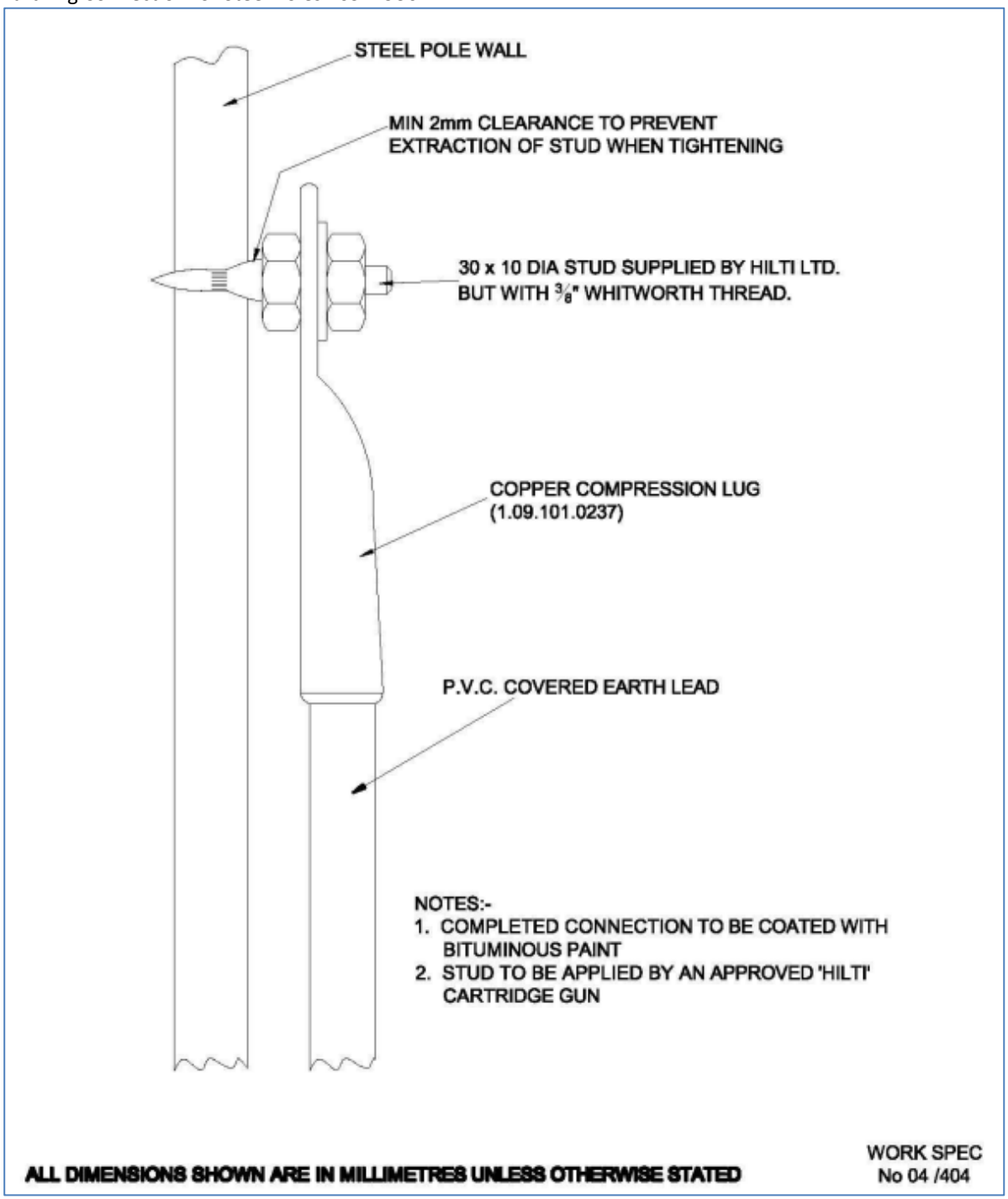
WORK SPEC
04 / 492

ALL DIMENSIONS SHOWN ARE IN MILLIMETRES UNLESS OTHERWISE STATED

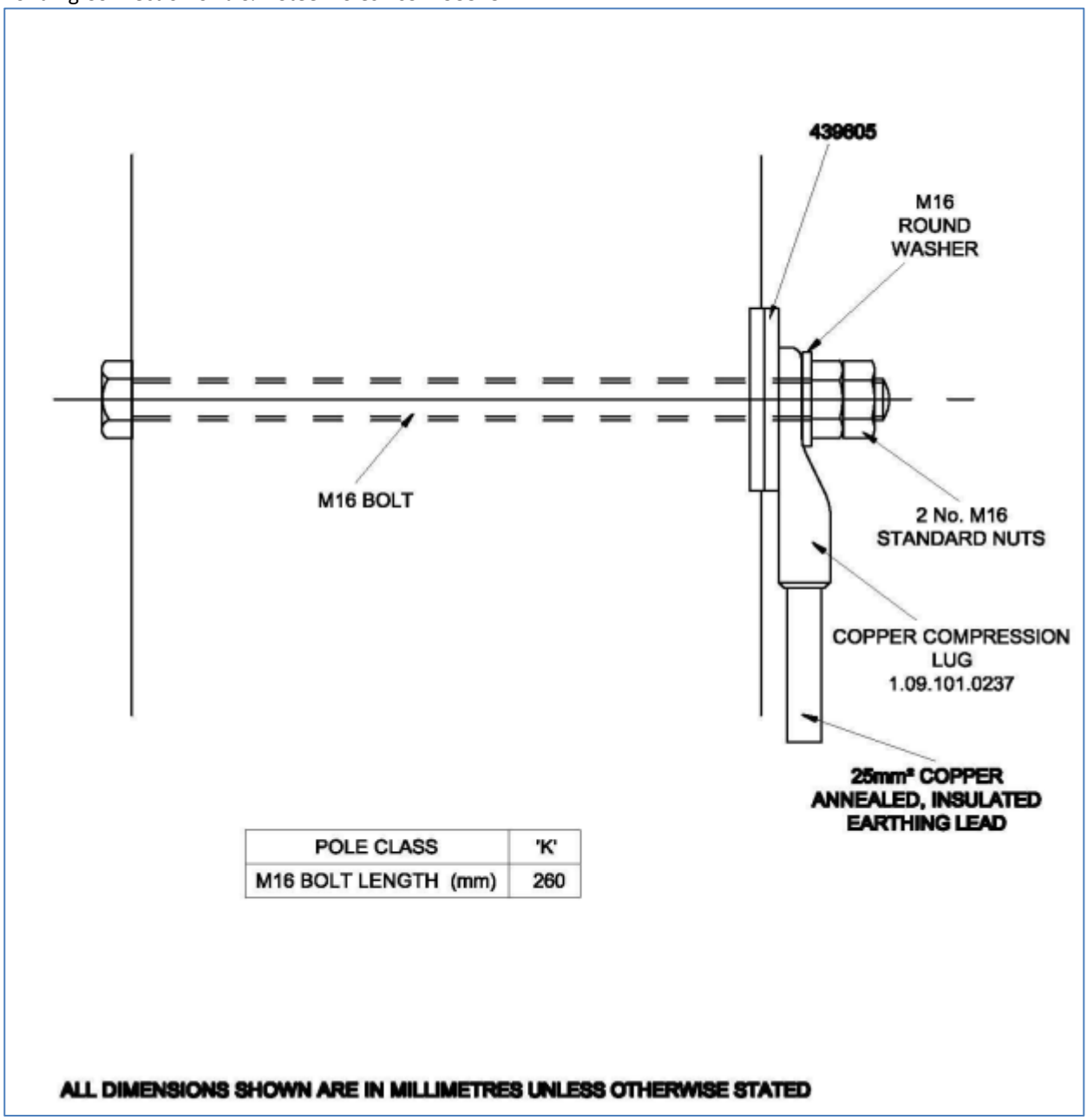
Terminal Support 1091193606



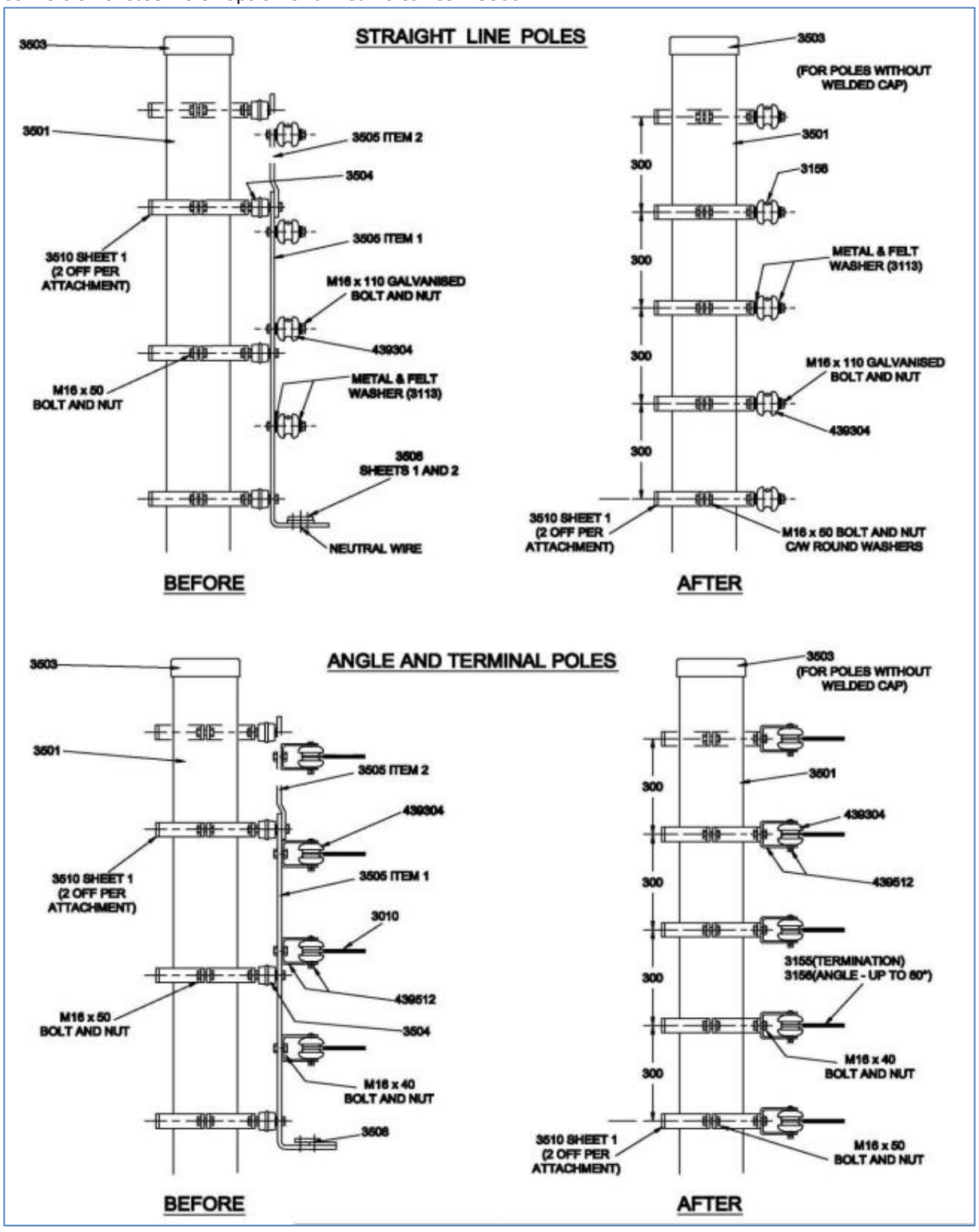
Earthing Connection for Steel Poles 1091193622



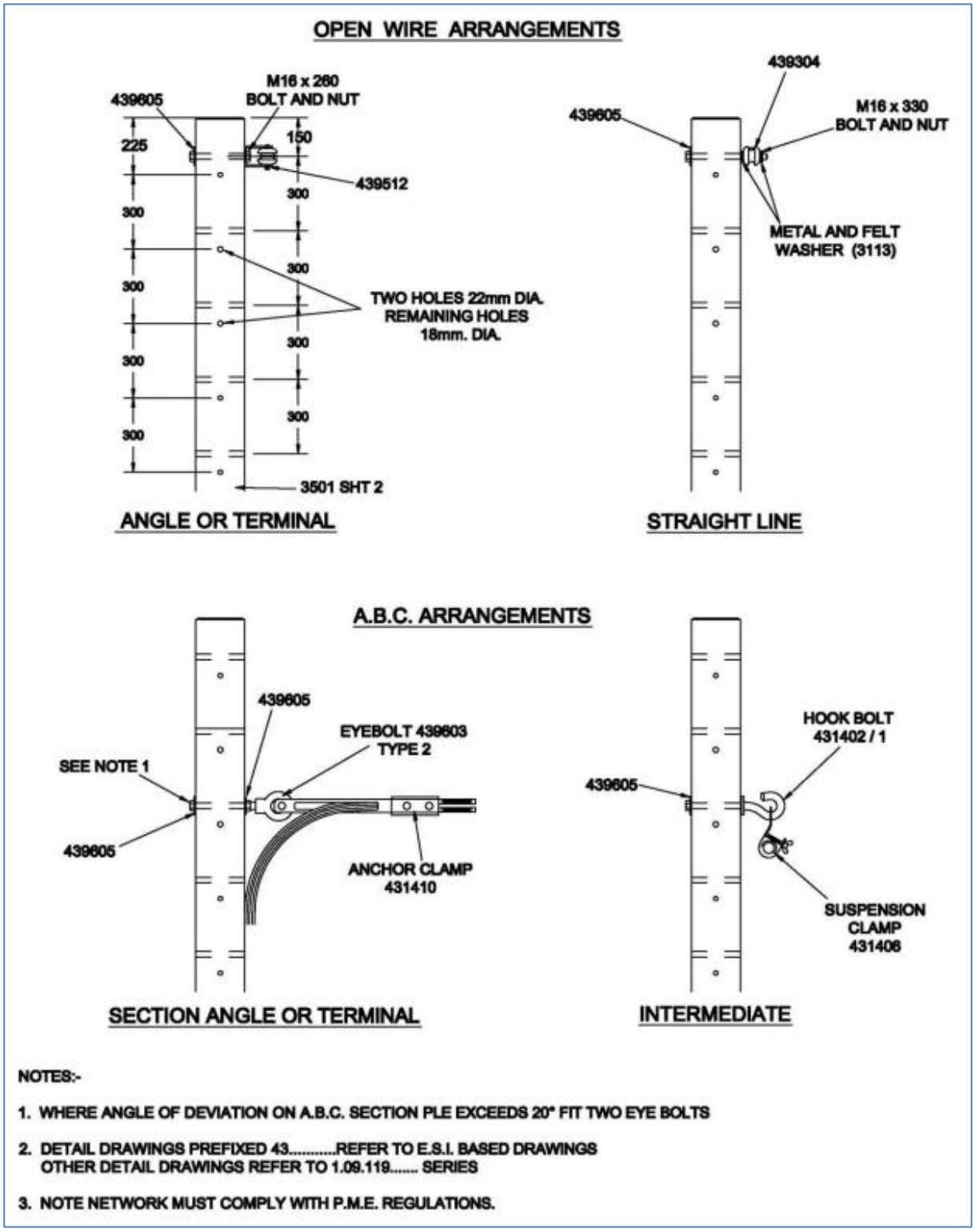
Bonding Connection on J & K Steel Poles 1091193525



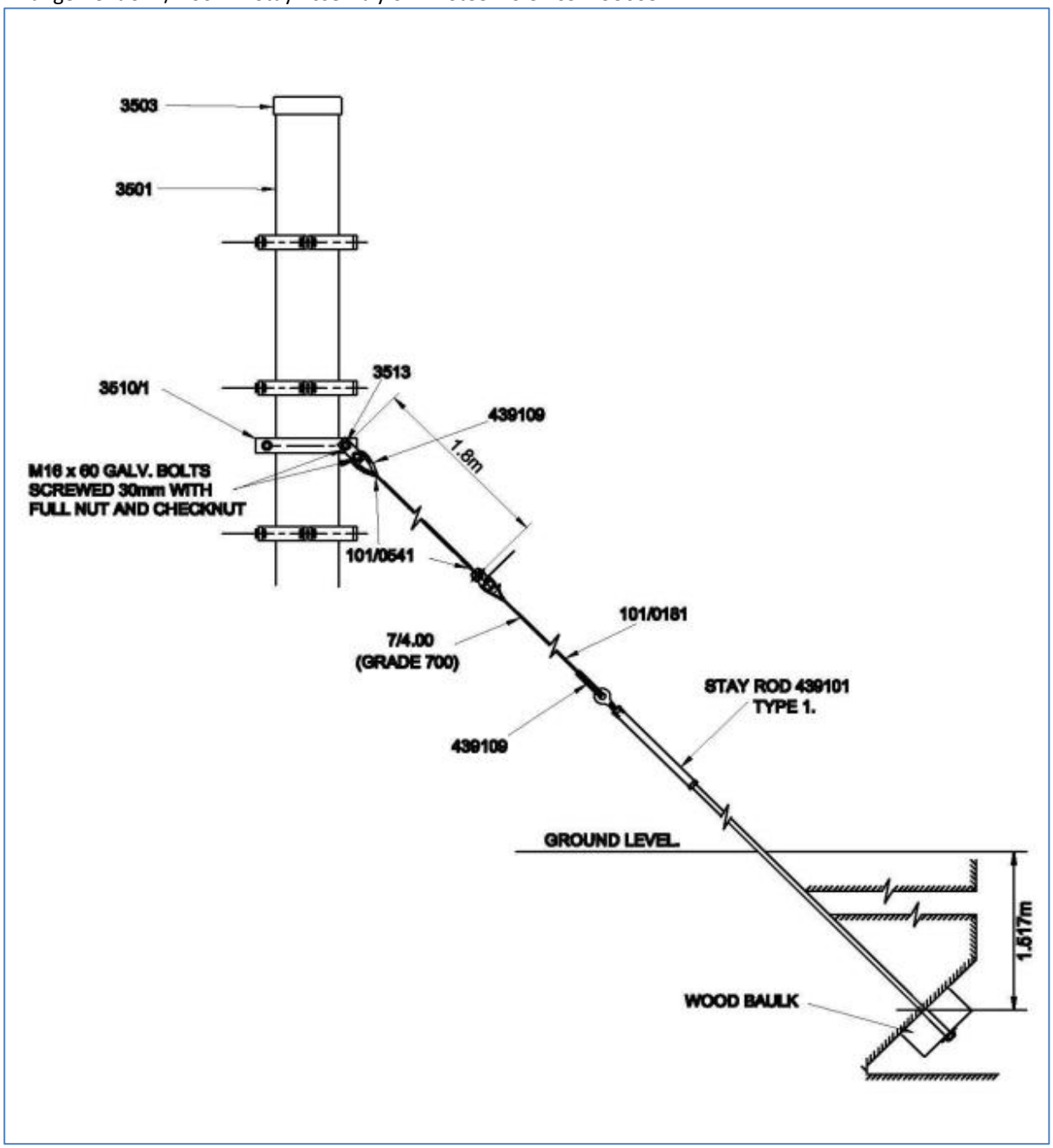
Conversion of steel Pole Tops on Undrilled Poles 1091193661



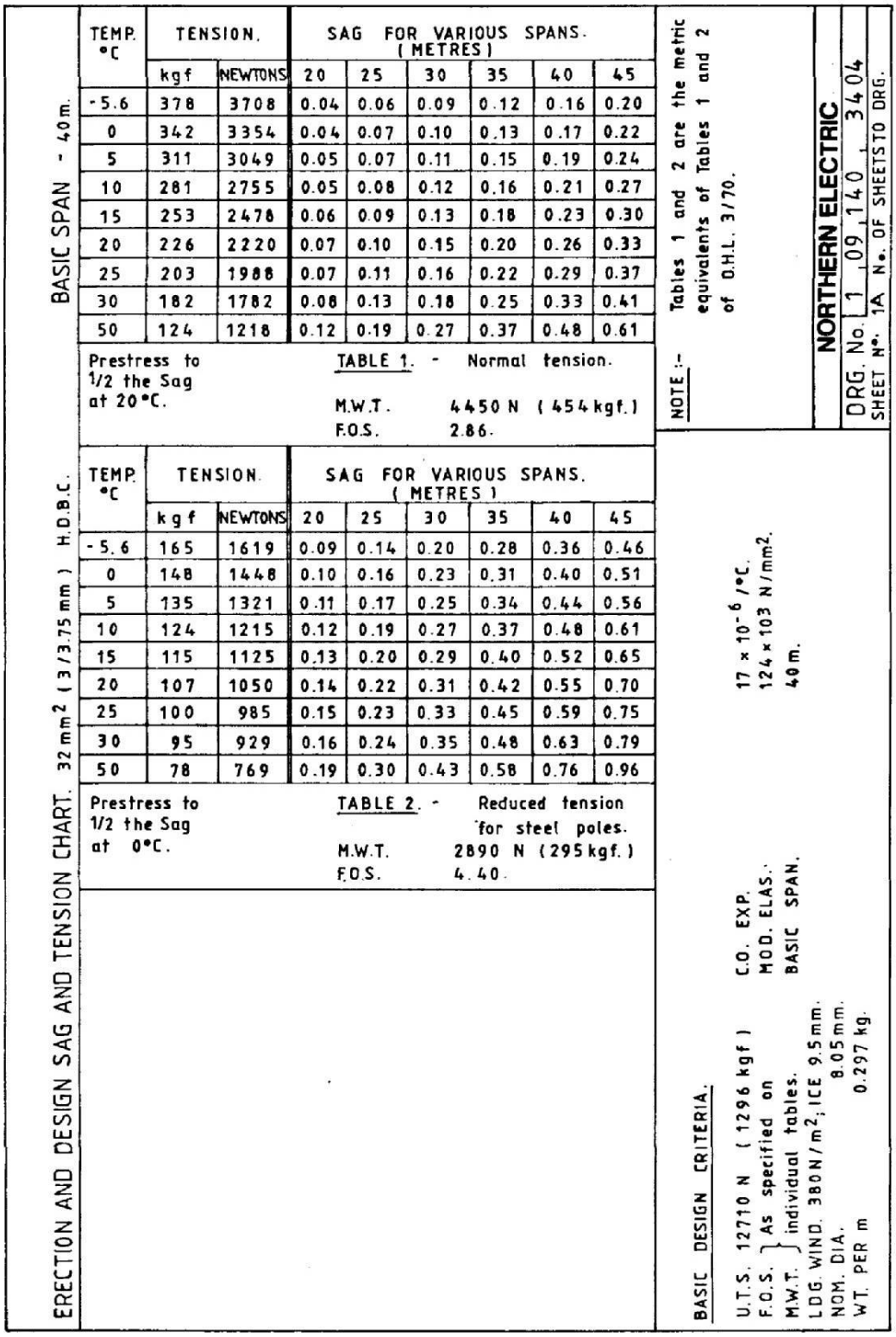
ABC or open wire networks on predrilled Steel Poles 1091193662



Arrangement of 7/4.00mm Stay Assembly on LV Steel Pole 1091193608



Appendix 2 – Openwire Network Conductor erection charts



ERECTION AND DESIGN SAG AND TENSION CHART. 32 mm² (3/3.75 mm) H.D.B.C.

BASIC SPAN - 40 m.

TEMP. °C	TENSION. kgf	TENSION. NEWTONS	SAG FOR VARIOUS SPANS. (METRES) 20	25	30	35	40	45
-5.6	378	3708	0.04	0.06	0.09	0.12	0.16	0.20
0	342	3354	0.04	0.07	0.10	0.13	0.17	0.22
5	311	3049	0.05	0.07	0.11	0.15	0.19	0.24
10	281	2755	0.05	0.08	0.12	0.16	0.21	0.27
15	253	2478	0.06	0.09	0.13	0.18	0.23	0.30
20	226	2220	0.07	0.10	0.15	0.20	0.26	0.33
25	203	1988	0.07	0.11	0.16	0.22	0.29	0.37
30	182	1782	0.08	0.13	0.18	0.25	0.33	0.41
50	124	1218	0.12	0.19	0.27	0.37	0.48	0.61

Prestress to 1/2 the Sag at 20 °C.

TABLE 1. - Normal tension.

M.W.T. 4450 N (454 kgf.)

F.O.S. 2.86.

TEMP. °C	TENSION. kgf	TENSION. NEWTONS	SAG FOR VARIOUS SPANS. (METRES) 20	25	30	35	40	45
-5.6	165	1619	0.09	0.14	0.20	0.28	0.36	0.46
0	148	1448	0.10	0.16	0.23	0.31	0.40	0.51
5	135	1321	0.11	0.17	0.25	0.34	0.44	0.56
10	124	1215	0.12	0.19	0.27	0.37	0.48	0.61
15	115	1125	0.13	0.20	0.29	0.40	0.52	0.65
20	107	1050	0.14	0.22	0.31	0.42	0.55	0.70
25	100	985	0.15	0.23	0.33	0.45	0.59	0.75
30	95	929	0.16	0.24	0.35	0.48	0.63	0.79
50	78	769	0.19	0.30	0.43	0.58	0.76	0.96

Prestress to 1/2 the Sag at 0 °C.

TABLE 2. - Reduced tension for steel poles.

M.W.T. 2890 N (295 kgf.)

F.O.S. 4.40.

NOTE :- Tables 1 and 2 are the metric equivalents of Tables 1 and 2 of O.H.L. 3/70.

NORTHERN ELECTRIC

DRG. No. 1 09 140 3404

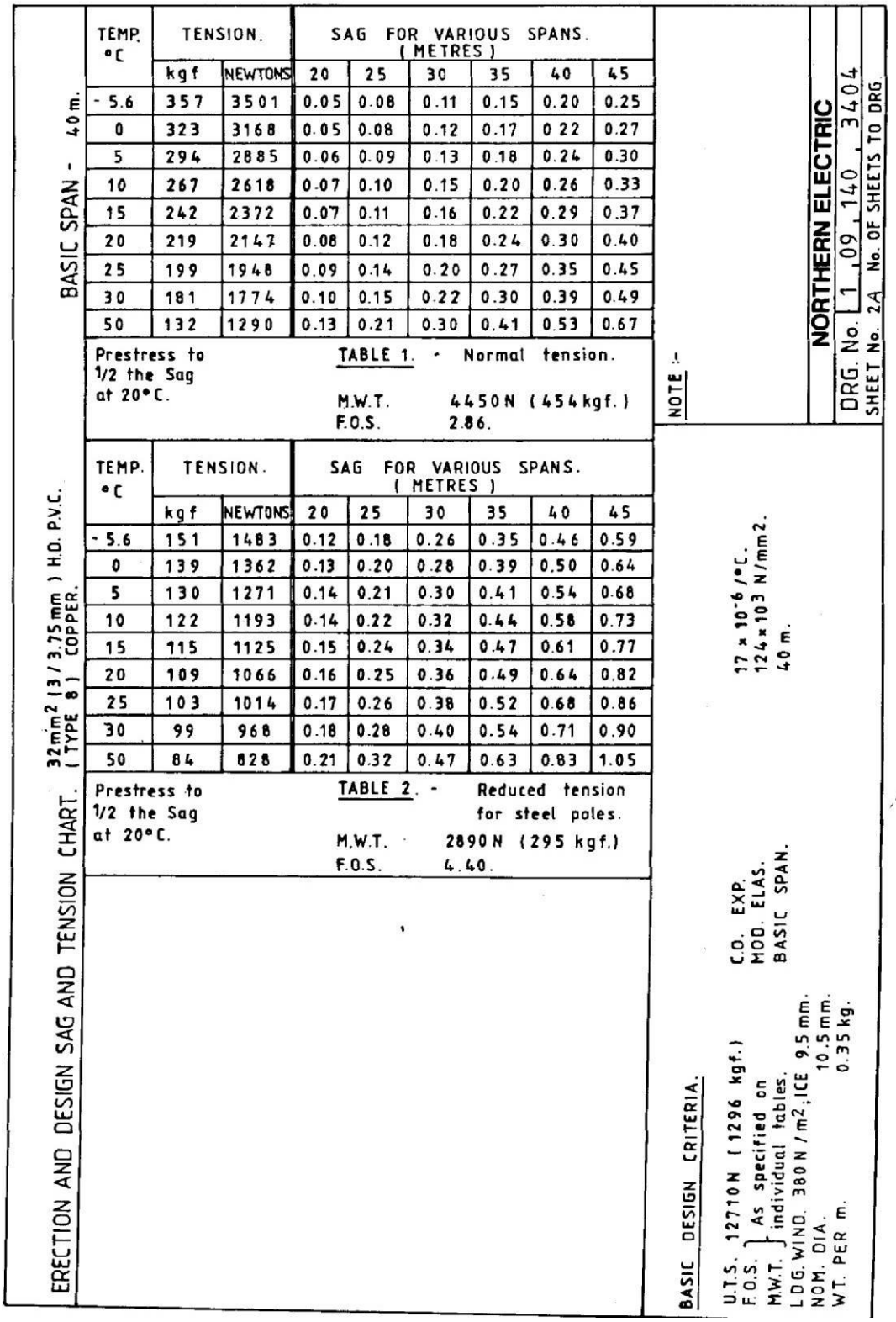
SHEET N°. 1A No. OF SHEETS TO DRG.

BASIC DESIGN CRITERIA.

U.T.S. 12710 N (1296 kgf)
F.O.S. } As specified on
M.W.T. } individual tables.
LDG WIND. 380 N/m²; ICE 9.5 mm.
NOM. DIA. 8.05 mm.
WT. PER m 0.297 kg.

C.O. EXP. 17 × 10⁻⁶ /°C.
MOD. ELAS. 124 × 103 N/mm².
BASIC SPAN. 40 m.

Appendix 3 - Openwire Network Conductor erection charts



ERECTION AND DESIGN SAG AND TENSION CHART. 32mm² (3 / 3.75mm) H.D. P.V.C. (TYPE 8) COPPER.

BASIC SPAN - 40 m.

TEMP. °C	TENSION. kgf	TENSION. NEWTONS	SAG FOR VARIOUS SPANS. (METRES) 20	25	30	35	40	45
- 5.6	357	3501	0.05	0.08	0.11	0.15	0.20	0.25
0	323	3168	0.05	0.08	0.12	0.17	0.22	0.27
5	294	2885	0.06	0.09	0.13	0.18	0.24	0.30
10	267	2618	0.07	0.10	0.15	0.20	0.26	0.33
15	242	2372	0.07	0.11	0.16	0.22	0.29	0.37
20	219	2147	0.08	0.12	0.18	0.24	0.30	0.40
25	199	1948	0.09	0.14	0.20	0.27	0.35	0.45
30	181	1774	0.10	0.15	0.22	0.30	0.39	0.49
50	132	1290	0.13	0.21	0.30	0.41	0.53	0.67

Prestress to 1/2 the Sag at 20°C.

TABLE 1. - Normal tension.

M.W.T. 4450N (454kgf.)
F.O.S. 2.86.

TEMP. °C	TENSION. kgf	TENSION. NEWTONS	SAG FOR VARIOUS SPANS. (METRES) 20	25	30	35	40	45
- 5.6	151	1483	0.12	0.18	0.26	0.35	0.46	0.59
0	139	1362	0.13	0.20	0.28	0.39	0.50	0.64
5	130	1271	0.14	0.21	0.30	0.41	0.54	0.68
10	122	1193	0.14	0.22	0.32	0.44	0.58	0.73
15	115	1125	0.15	0.24	0.34	0.47	0.61	0.77
20	109	1066	0.16	0.25	0.36	0.49	0.64	0.82
25	103	1014	0.17	0.26	0.38	0.52	0.68	0.86
30	99	968	0.18	0.28	0.40	0.54	0.71	0.90
50	84	828	0.21	0.32	0.47	0.63	0.83	1.05

Prestress to 1/2 the Sag at 20°C.

TABLE 2. - Reduced tension for steel poles.

M.W.T. 2890N (295 kgf.)
F.O.S. 4.40.

NOTE :-

NORTHERN ELECTRIC
DRG. No. 1 09 140 3404
SHEET No. 2A No. OF SHEETS TO DRG

17 x 10⁻⁶ /°C.
124 x 103 N/mm2.
40 m.

C.O. EXP.
MOD. ELAS.
BASIC SPAN.

BASIC DESIGN CRITERIA.

U.T.S. 12710N (1296 kgf.)
F.O.S. } As specified on
M.W.T. } individual tables.
LDG. WIND. 380 N / m2, ICE 9.5 mm.
NOM. DIA. 10.5 mm.
WT. PER m. 0.35 kg.

Appendix 4- Openwire Network Conductor erection charts

ERECTION AND DESIGN SAG AND TENSION CHART. 70mm² (7/3.55mm) H.D.B.C.

BASIC SPAN - 40m.

TEMP °C.	TENSION. kgf	TENSION. NEWTONS	SAG FOR VARIOUS SPANS. (METRES) 20	25	30	35	40	45
- 5.6	499	4898	0.06	0.10	0.14	0.19	0.25	0.31
0	441	4328	0.07	0.11	0.16	0.22	0.28	0.36
5	395	3876	0.08	0.12	0.18	0.24	0.31	0.40
10	355	3482	0.09	0.14	0.20	0.27	0.35	0.44
15	321	3146	0.10	0.15	0.22	0.30	0.39	0.49
20	292	2862	0.11	0.17	0.24	0.33	0.43	0.54
25	268	2623	0.12	0.18	0.26	0.36	0.46	0.59
30	247	2423	0.13	0.20	0.28	0.38	0.50	0.64
50	192	1881	0.16	0.25	0.36	0.50	0.65	0.82

Prestress to 1/2 the Sag at 20°C.

TABLE 1. - Normal Tension.

M.W.T. 6000 N (612 kgf.)
F.O.S. 4.48.

TEMP °C	TENSION. kgf	TENSION. NEWTONS	SAG FOR VARIOUS SPAN. (METRES) 20	25	30	35	40	45
- 5.6	173	1697	0.18	0.28	0.40	0.55	0.72	0.91
0	165	1618	0.19	0.29	0.42	0.58	0.75	0.95
5	159	1555	0.20	0.31	0.44	0.60	0.78	0.99
10	153	1498	0.20	0.32	0.46	0.62	0.81	1.03
15	148	1447	0.21	0.33	0.47	0.64	0.84	1.07
20	143	1401	0.22	0.34	0.49	0.67	0.87	1.10
25	138	1358	0.22	0.35	0.50	0.69	0.90	1.14
30	135	1319	0.23	0.36	0.52	0.71	0.92	1.17
50	121	1190	0.26	0.40	0.58	0.78	1.02	1.30

Prestress to 1/2 the Sag at 15°C.

TABLE 2. - Reduced tension for for steel poles.

M.W.T. 2890 N (295 kgf.)
F.O.S. 9.30.

NOTE. Tables 1 and 2 are the metric equivalents of Tables 1 and 2 of O.H.L.3/70.

NORTHERN ELECTRIC

DRG. No. 1 09 140 3405

SHEET No. 1A No. OF SHEETS TO DRG.

BASIC DESIGN CRITERIA.

U.T.S. 26880N (2741 kgf.)
F.O.S. } As specified on
M.W.T. } individual tables.
LDG. WIND 380 N/m²; ICE 9.5mm.
NOM. DIA. 10.65 mm.
WT. PER m. 0.621 kg.

C.O. EXP. 17 × 10⁻⁶ /°C.
MOD. ELAS. 124×10³ N/mm².
BASIC SPAN. 40m.

Appendix 5 Openwire Network Conductor erection charts

ERECTION AND DESIGN SAG AND TENSION CHART. 70mm² (7/3.55mm) H.D. P.V.C. (TYPE 8) COPPER.

BASIC SPAN - 40 m.

TEMP. °C	TENSION. kgf	TENSION. NEWTONS	SAG FOR VARIOUS SPANS. (METRES) 20	25	30	35	40	45
- 5.6	474	4651	0.07	0.11	0.16	0.22	0.29	0.37
0	423	4146	0.08	0.13	0.17	0.25	0.33	0.41
5	383	3752	0.09	0.14	0.20	0.28	0.36	0.46
10	348	3412	0.10	0.16	0.22	0.30	0.40	0.50
15	318	3122	0.11	0.17	0.24	0.33	0.43	0.55
20	293	2874	0.12	0.18	0.27	0.36	0.47	0.60
25	272	2664	0.13	0.20	0.29	0.39	0.51	0.64
30	254	2486	0.14	0.21	0.31	0.42	0.55	0.69
50	202	1984	0.17	0.27	0.38	0.52	0.68	0.86

Prestress to 1/2 the Sag at 20°C.

TABLE 1. - Normal tension.

M.W.T. 6000 N (612 kgf.)
F.O.S. 4.48.

TEMP. °C	TENSION. kgf	TENSION. NEWTONS	SAG FOR VARIOUS SPANS. (METRES) 20	25	30	35	40	45
- 5.6	167	1638	0.21	0.32	0.47	0.63	0.83	1.05
0	161	1578	0.21	0.34	0.48	0.66	0.86	1.09
5	156	1529	0.22	0.35	0.50	0.68	0.89	1.12
10	151	1484	0.23	0.36	0.51	0.70	0.91	1.16
15	147	1443	0.23	0.37	0.53	0.72	0.94	1.19
20	143	1405	0.24	0.38	0.54	0.74	0.96	1.22
25	140	1370	0.25	0.39	0.56	0.76	0.99	1.25
30	136	1337	0.25	0.40	0.57	0.78	1.01	1.28
50	125	1225	0.28	0.43	0.62	0.85	1.11	1.40

Prestress to 1/2 the Sag at 10°C.

TABLE 2. - Reduced tension for steel poles.

M.W.T. 2890N (295 kgf.)
F.O.S. 9.30.

NORTHERN ELECTRIC.
DRG. No. 1,09,140,3405
SHEET No. 2A No. OF SHEETS TO DRG.

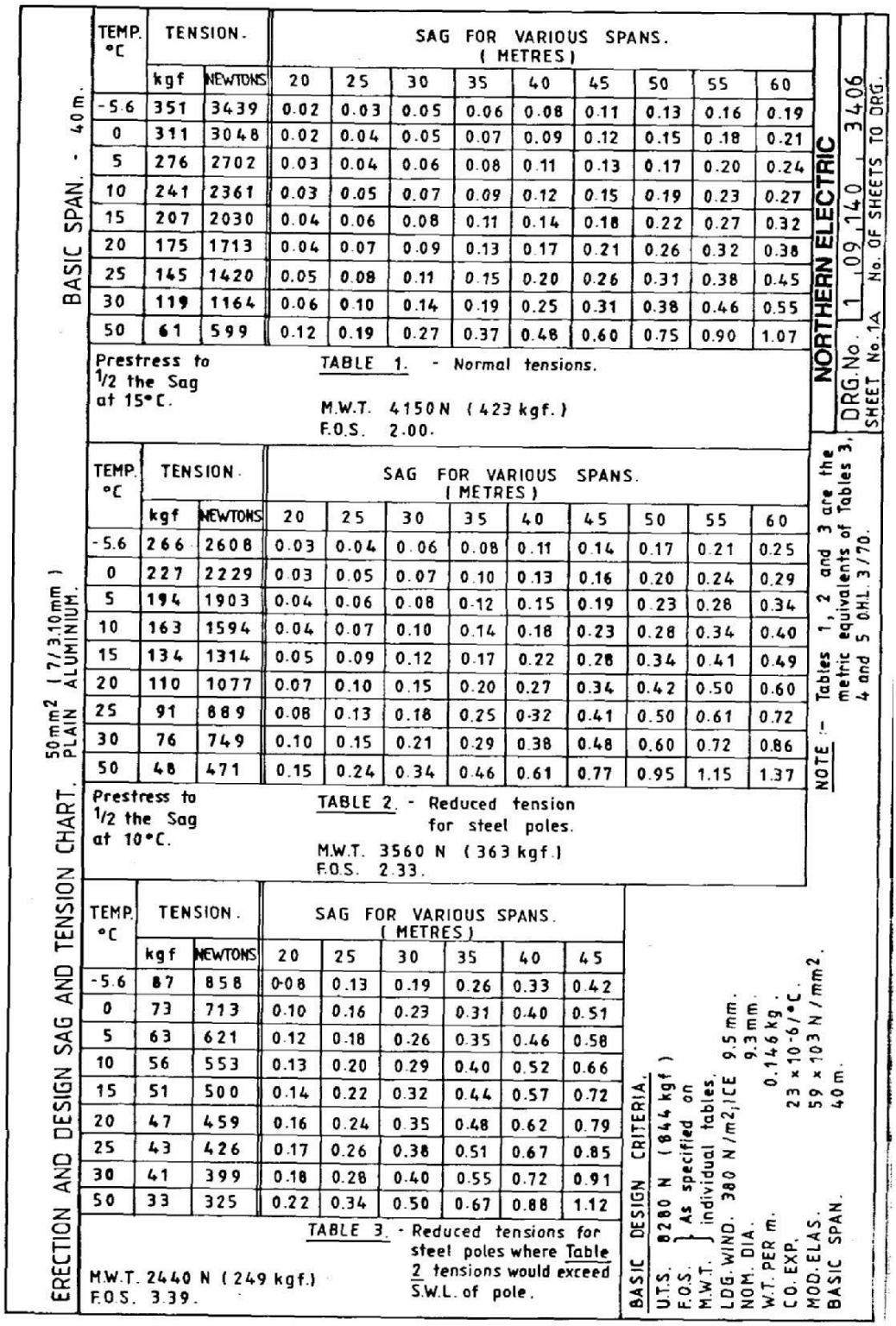
17×10^{-6} /°C.
124×10^3 N/mm².
40 m.

C.O. EXP.
MOD. ELAS.
BASIC SPAN.

BASIC DESIGN CRITERIA.

U.T.S. 26880N (2741 kgf.)
F.O.S. } As specified on
M.W.T. } individual tables.
LDG WIND. 380 N/m², ICE 9.5mm.
NOM. DIA. 13.5mm.
WT. PER m. 0.691kg.

Appendix 6 Openwire Network Conductor erection charts



ERECTION AND DESIGN SAG AND TENSION CHART. 50mm² (7/3.10mm) PLAIN ALUMINIUM.

BASIC SPAN. - 40 m.

TEMP. °C	TENSION. kgf	TENSION. NEWTONS	SAG FOR VARIOUS SPANS. (METRES) 20	25	30	35	40	45	50	55	60
-5.6	351	3439	0.02	0.03	0.05	0.06	0.08	0.11	0.13	0.16	0.19
0	311	3048	0.02	0.04	0.05	0.07	0.09	0.12	0.15	0.18	0.21
5	276	2702	0.03	0.04	0.06	0.08	0.11	0.13	0.17	0.20	0.24
10	241	2361	0.03	0.05	0.07	0.09	0.12	0.15	0.19	0.23	0.27
15	207	2030	0.04	0.06	0.08	0.11	0.14	0.18	0.22	0.27	0.32
20	175	1713	0.04	0.07	0.09	0.13	0.17	0.21	0.26	0.32	0.38
25	145	1420	0.05	0.08	0.11	0.15	0.20	0.26	0.31	0.38	0.45
30	119	1164	0.06	0.10	0.14	0.19	0.25	0.31	0.38	0.46	0.55
50	61	599	0.12	0.19	0.27	0.37	0.48	0.60	0.75	0.90	1.07

Prestress to 1/2 the Sag at 15°C.

TABLE 1. - Normal tensions.

M.W.T. 4150 N (423 kgf.)
F.O.S. 2.00.

TEMP. °C	TENSION. kgf	TENSION. NEWTONS	SAG FOR VARIOUS SPANS. (METRES) 20	25	30	35	40	45	50	55	60
-5.6	266	2608	0.03	0.04	0.06	0.08	0.11	0.14	0.17	0.21	0.25
0	227	2229	0.03	0.05	0.07	0.10	0.13	0.16	0.20	0.24	0.29
5	194	1903	0.04	0.06	0.08	0.12	0.15	0.19	0.23	0.28	0.34
10	163	1594	0.04	0.07	0.10	0.14	0.18	0.23	0.28	0.34	0.40
15	134	1314	0.05	0.09	0.12	0.17	0.22	0.28	0.34	0.41	0.49
20	110	1077	0.07	0.10	0.15	0.20	0.27	0.34	0.42	0.50	0.60
25	91	889	0.08	0.13	0.18	0.25	0.32	0.41	0.50	0.61	0.72
30	76	749	0.10	0.15	0.21	0.29	0.38	0.48	0.60	0.72	0.86
50	48	471	0.15	0.24	0.34	0.46	0.61	0.77	0.95	1.15	1.37

Prestress to 1/2 the Sag at 10°C.

TABLE 2. - Reduced tension for steel poles.

M.W.T. 3560 N (363 kgf.)
F.O.S. 2.33.

TEMP. °C	TENSION. kgf	TENSION. NEWTONS	SAG FOR VARIOUS SPANS. (METRES) 20	25	30	35	40	45
-5.6	87	858	0.08	0.13	0.19	0.26	0.33	0.42
0	73	713	0.10	0.16	0.23	0.31	0.40	0.51
5	63	621	0.12	0.18	0.26	0.35	0.46	0.58
10	56	553	0.13	0.20	0.29	0.40	0.52	0.66
15	51	500	0.14	0.22	0.32	0.44	0.57	0.72
20	47	459	0.16	0.24	0.35	0.48	0.62	0.79
25	43	426	0.17	0.26	0.38	0.51	0.67	0.85
30	41	399	0.18	0.28	0.40	0.55	0.72	0.91
50	33	325	0.22	0.34	0.50	0.67	0.88	1.12

TABLE 3. - Reduced tensions for steel poles where Table 2 tensions would exceed S.W.L. of pole.

M.W.T. 2440 N (249 kgf.)
F.O.S. 3.39.

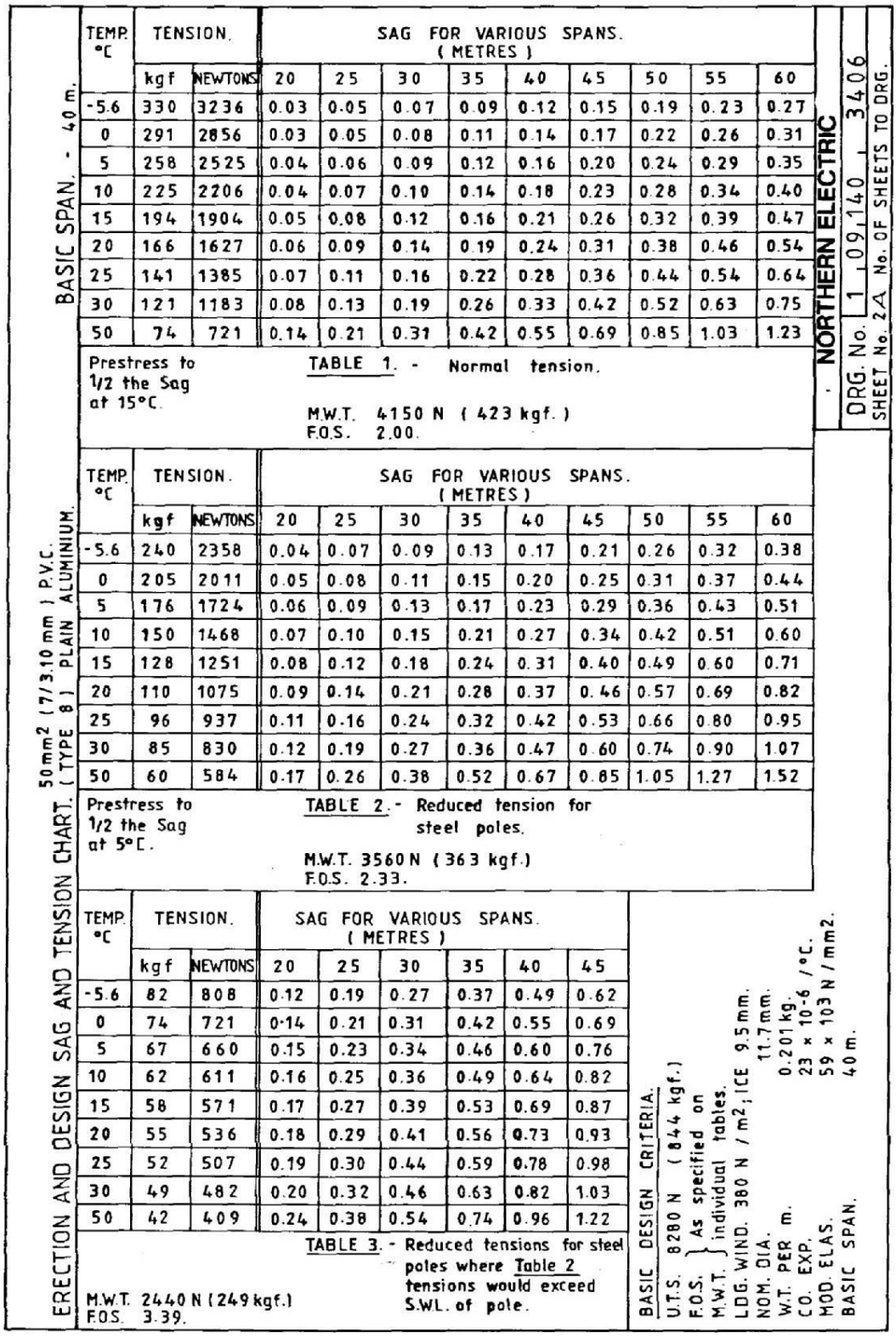
BASIC DESIGN CRITERIA.

U.T.S. 8280 N (844 kgf)
F.O.S. } As specified on
M.W.T. } individual tables.
LDG. WIND. 380 N/m²/ICE 9.5 mm.
NOM. DIA. 9.3 mm.
W.T. PER m. 0.146 kg.
CO. EXP. 23 x 10-6/°C.
MOD. ELAS. 59 x 10³ N/mm².
BASIC SPAN. 40 m.

NOTE :- Tables 1, 2 and 3 are the metric equivalents of Tables 3, 4 and 5 OHL 3/70.

NORTHERN ELECTRIC
DRG. No. 1 09 140 3406
SHEET No. 1A No. OF SHEETS TO DRG.

Appendix 7 Openwire Network Conductor erection charts



ERECTION AND DESIGN SAG AND TENSION CHART.
50 mm² (7/3.10 mm) P.V.C. (TYPE 8) PLAIN ALUMINIUM.
BASIC SPAN. - 40 m.

NORTHERN ELECTRIC
DRG. No. 1,09,140,3406
SHEET No. 2A No. OF SHEETS TO DRG.

TEMP. °C	TENSION. kgf	TENSION. NEWTONS	SAG FOR VARIOUS SPANS. (METRES) 20	25	30	35	40	45	50	55	60
-5.6	330	3236	0.03	0.05	0.07	0.09	0.12	0.15	0.19	0.23	0.27
0	291	2856	0.03	0.05	0.08	0.11	0.14	0.17	0.22	0.26	0.31
5	258	2525	0.04	0.06	0.09	0.12	0.16	0.20	0.24	0.29	0.35
10	225	2206	0.04	0.07	0.10	0.14	0.18	0.23	0.28	0.34	0.40
15	194	1904	0.05	0.08	0.12	0.16	0.21	0.26	0.32	0.39	0.47
20	166	1627	0.06	0.09	0.14	0.19	0.24	0.31	0.38	0.46	0.54
25	141	1385	0.07	0.11	0.16	0.22	0.28	0.36	0.44	0.54	0.64
30	121	1183	0.08	0.13	0.19	0.26	0.33	0.42	0.52	0.63	0.75
50	74	721	0.14	0.21	0.31	0.42	0.55	0.69	0.85	1.03	1.23

Prestress to 1/2 the Sag at 15°C.

TABLE 1. - Normal tension.

M.W.T. 4150 N (423 kgf.)
F.O.S. 2.00.

TEMP. °C	TENSION. kgf	TENSION. NEWTONS	SAG FOR VARIOUS SPANS. (METRES) 20	25	30	35	40	45	50	55	60
-5.6	240	2358	0.04	0.07	0.09	0.13	0.17	0.21	0.26	0.32	0.38
0	205	2011	0.05	0.08	0.11	0.15	0.20	0.25	0.31	0.37	0.44
5	176	1724	0.06	0.09	0.13	0.17	0.23	0.29	0.36	0.43	0.51
10	150	1468	0.07	0.10	0.15	0.21	0.27	0.34	0.42	0.51	0.60
15	128	1251	0.08	0.12	0.18	0.24	0.31	0.40	0.49	0.60	0.71
20	110	1075	0.09	0.14	0.21	0.28	0.37	0.46	0.57	0.69	0.82
25	96	937	0.11	0.16	0.24	0.32	0.42	0.53	0.66	0.80	0.95
30	85	830	0.12	0.19	0.27	0.36	0.47	0.60	0.74	0.90	1.07
50	60	584	0.17	0.26	0.38	0.52	0.67	0.85	1.05	1.27	1.52

Prestress to 1/2 the Sag at 5°C.

TABLE 2. - Reduced tension for steel poles.

M.W.T. 3560 N (363 kgf.)
F.O.S. 2.33.

TEMP. °C	TENSION. kgf	TENSION. NEWTONS	SAG FOR VARIOUS SPANS. (METRES) 20	25	30	35	40	45
-5.6	82	808	0.12	0.19	0.27	0.37	0.49	0.62
0	74	721	0.14	0.21	0.31	0.42	0.55	0.69
5	67	660	0.15	0.23	0.34	0.46	0.60	0.76
10	62	611	0.16	0.25	0.36	0.49	0.64	0.82
15	58	571	0.17	0.27	0.39	0.53	0.69	0.87
20	55	536	0.18	0.29	0.41	0.56	0.73	0.93
25	52	507	0.19	0.30	0.44	0.59	0.78	0.98
30	49	482	0.20	0.32	0.46	0.63	0.82	1.03
50	42	409	0.24	0.38	0.54	0.74	0.96	1.22

TABLE 3. - Reduced tensions for steel poles where Table 2 tensions would exceed S.W.L. of pole.

M.W.T. 2440 N (249 kgf.)
F.O.S. 3.39.

BASIC DESIGN CRITERIA.
U.T.S. 8280 N (844 kgf.)
F.O.S. } As specified on
M.W.T. } individual tables.
LDG. WIND. 380 N / m²; ICE 9.5 mm.
NOM. DIA. 11.7 mm.
W.T. PER m. 0.201 kg.
CO. EXP. 23 × 10⁻⁶ / °C.
MOD. ELAS. 59 × 10³ N / mm².
BASIC SPAN. 40 m.

Appendix 8 Openwire Network Conductor erection charts

ERECTION AND DESIGN SAG AND TENSION CHART. 100 mm² (7/4.39 mm) PLAIN ALUMINIUM. BASIC SPAN. - 40 m.

TEMP. °C	TENSION. kgf	TENSION. NEWTONS	SAG FOR VARIOUS SPANS. (METRES) 20	25	30	35	40	45	50	55	60
-5.6	506	4962	0.03	0.04	0.06	0.09	0.12	0.15	0.18	0.22	0.26
0	429	4210	0.03	0.05	0.08	0.10	0.14	0.17	0.21	0.26	0.31
5	364	3567	0.04	0.06	0.09	0.12	0.16	0.20	0·25	0.30	0.36
10	303	2967	0.05	0.08	0.11	0.15	0.19	0.24	0.30	0.36	0.43
15	248	2435	0.06	0.09	0.13	0.18	0.23	0.30	0.37	0.44	0.53
20	203	1995	0.07	0·11	0·16	0.22	0.29	0.36	0.45	0.54	0.64
25	169	1658	0.09	0.13	0.19	0.26	0.34	0.44	0.54	0.65	0.77
30	144	1410	0.10	0.16	0.23	0.31	0.40	0.51	0.63	0.77	0.91
50	93	912	0.16	0.24	0.35	0.48	0.63	0.79	0.98	1.18	1.41

Prestress to 1/2 the Sag at 10°C.

TABLE 1. - Normal tension.

M.W.T. 6000 N (612 kgf.)
F.O.S. 2.67.

TEMP. °C	TENSION. kgf	TENSION. NEWTONS	SAG FOR VARIOUS SPANS. (METRES) 20	25	30	35	40	45	50	55	60
-5.6	216	2113	0.07	0.11	0.15	0.21	0.27	0.34	0.42	0.51	0.61
0	174	1709	0.08	0.13	0.19	0.26	0.33	0.42	0.52	0.63	0.75
5	148	1448	0.10	0.15	0.22	0.30	0.39	0.50	0.62	0.75	0.89
10	128	1257	0.11	0.18	0.26	0.35	0.45	0.57	0.71	0.86	1.02
15	114	1116	0.13	0.20	0.29	0.39	0.51	0.65	0.80	0.97	1.15
20	103	1009	0.14	0.22	0·32	0.43	0.57	0·72	0.88	1.07	1.27
25	94	924	0.15	0.24	0·35	0.47	0.62	0.78	0.97	1.17	1.39
30	87	857	0.17	0.26	0.37	0.51	0.67	0.84	1.04	1.26	1.50
50	69	681	0·21	0.33	0.47	0.64	0.84	1.06	1.31	1.59	1.85

Prestress to 1/2 the Sag at 0°C.

TABLE 2. - Reduced tension for steel pole.

M.W.T. 4000 N (408 kgf.)
F.O.S. 4.00.

TEMP. °C	TENSION. kgf	TENSION. NEWTONS	SAG FOR VARIOUS SPANS. (METRES) 20	25	30	35	40	45
-5.6	92	902	0.16	0.25	0.36	0.48	0.63	0.80
0	85	832	0.17	0.27	0.39	0.53	0.69	0.87
5	80	780	0.18	0.29	0.41	0.56	0.73	0.93
10	75	737	0·19	0.30	0.44	0.59	0.78	0·98
15	71	700	0.20	0.32	0.46	0.62	0.82	1.03
20	68	667	0.21	0.33	0.48	0.66	0.86	1.08
25	65	639	0.22	0.35	0.50	0.68	0.89	1.13
30	63	614	0.23	0.36	0.52	0.71	0.93	1.18
50	55	536	0.27	0.42	0.60	0.82	1.07	1.35

TABLE 3. - Reduced tensions for steel poles where Table 2 tensions would exceed S.W.L. of pole.

M.W.T. 2670 N (273 kgf.)
F.O.S. 6.00.

BASIC DESIGN CRITERIA.
U.T.S. 16000 N (1631 kgf.)
F.O.S. } As specified on
M.W.T. } individual tables.
LDG. WIND 380 N / m², ICE 9.5 mm.
NOM. DIA. 13.17 mm.
W.T. PER m. 0.291 kg.
CO. EXP. 23 × 10⁻⁶ / °C
MOD. ELAS. 59 × 10³ N / mm².
BASIC SPAN. 40 m.

NOTE :- Tables 1, 2 and 3 are the metric equivalents of Tables 3, 4 and 5 of O.H.L. 3/70.

NORTHERN ELECTRIC
DRG. No. 1 ,09,140 , 3407
SHEET No.1A No. OF SHEETS TO DRG.

Appendix 9 Openwire Network Conductor erection charts

ERECTION AND DESIGN SAG AND TENSION CHART. 100mm² (7/4.39 mm) P.V.C. (TYPE 8) PLAIN ALUMINIUM.

BASIC SPAN. - 40 m.

TEMP. °C	TENSION. kgf	TENSION. NEWTONS	SAG FOR VARIOUS SPANS. (METRES) 20	25	30	35	40	45	50	55	60
-5.6	478	4691	0.04	0.06	0.08	0.12	0.15	0.19	0.24	0.29	0.34
0	406	3979	0.04	0.07	0.10	0.14	0.18	0.23	0.28	0.34	0.40
5	345	3386	0.05	0.08	0.12	0.16	0.21	0.26	0.33	0.40	0.47
10	291	2853	0.06	0.10	0.14	0.19	0.25	0.31	0.39	0.47	0.56
15	244	2399	0.07	0.12	0.17	0.23	0.30	0.37	0.46	0.56	0.66
20	207	2035	0.09	0.14	0.20	0.27	0.35	0.44	0.54	0.66	0.78
25	179	1753	0.10	0.16	0.23	0.31	0.40	0.51	0.63	0.76	0.91
30	157	1539	0.12	0.18	0.26	0.35	0.46	0.58	0.72	0.87	1.04
50	109	1065	0.17	0.26	0.37	0.51	0.67	0.84	1.04	1.26	1.50

Prestress to 1/2 the Sag at 10°C.

TABLE 1. - Normal tension.

M.W.T. 6000 N (612 kgf.)
F.O.S. 2.67.

NORTHERN ELECTRIC
DRG No. 1 09 140 3407
SHEET No. 2A No. OF SHEETS TO DRG.

TEMP. °C	TENSION. kgf	TENSION. NEWTONS	SAG FOR VARIOUS SPANS. (METRES) 20	25	30	35	40	45	50	55	60
-5.6	197	1927	0.09	0.14	0.21	0.28	0.37	0.47	0.57	0.69	0.83
0	168	1645	0.11	0.17	0.24	0.33	0.43	0.54	0.67	0.81	0.97
5	149	1457	0.12	0.19	0.27	0.37	0.49	0.62	0.76	0.92	1.09
10	134	1312	0.14	0.21	0.30	0.41	0.54	0.68	0.84	1.02	1.22
15	122	1198	0.15	0.23	0.33	0.45	0.59	0.75	0.92	1.12	1.33
20	113	1106	0.16	0.25	0.36	0.49	0.64	0.81	1.00	1.21	1.44
25	105	1031	0.17	0.27	0.39	0.53	0.69	0.87	1.07	1.30	1.55
30	99	968	0.18	0.29	0.41	0.56	0.73	0.93	1.14	1.38	1.65
50	81	795	0.22	0.35	0.50	0.68	0.89	1.13	1.39	1.69	2.01

Prestress to 1/2 the Sag at - 5.6°C.

TABLE 2. - Reduced tension for steel poles.

M.W.T. 4000 (408 kgf.)
F.O.S. 4.00.

TEMP. °C	TENSION. kgf	TENSION. NEWTONS	SAG FOR VARIOUS SPANS. (METRES) 20	25	30	35	40	45
-5.6	95	928	0.19	0.30	0.43	0.58	0.76	0.97
0	89	875	0.20	0.32	0.46	0.62	0.81	1.02
5	85	834	0.21	0.33	0.48	0.65	0.85	1.07
10	81	799	0.22	0.35	0.50	0.68	0.89	1.12
15	78	767	0.23	0.36	0.52	0.71	0.92	1.17
20	75	739	0.24	0.37	0.54	0.73	0.96	1.21
25	73	714	0.25	0.39	0.56	0.76	0.99	1.26
30	70	691	0.26	0.40	0.58	0.79	1.03	1.30
50	63	616	0.29	0.45	0.65	0.88	1.15	1.46

TABLE 3. - Reduced tensions for steel poles where Table 2 tensions would exceed S.W.L. of pole.

M.W.T. 2670 N (273 kgf.)
F.O.S. 6.00.

BASIC DESIGN CRITERIA.

U.T.S.	16000 N (1631 kgf)
F.O.S. } M.W.T. }	As specified on individual tables.
L.D.G. WIND.	380 N/m²; ICE 9.5 mm.
NOM. DIA.	16 mm.
W.T. PER m.	0.361 kg.
C.O. EXP.	23 × 10⁻⁶/°C.
MOD. ELAS.	59 × 10³ N/mm².
BASIC SPAN.	40 m.

Appendix 10 - Minimum Stay Spreads For Angle Poles

4 x 32 mm^2 HDBC

Dev	<15°	20°	25°	30°	35°	40°	45°	50°	55°	60°
Pole Height (m)	Minimum stay spread (m)									
9.0	1@4.0	1@4.0	1@4.0	1@4.9	2@4.0	2@4.0	2@4.0	2@4.0	2@4.0	2@4.4
9.5	1@4.3	1@4.3	1@4.7	1@5.4	2@4.3	2@4.3	2@4.3	2@4.3	2@4.3	2@4.7
10.0	1@4.6	1@4.6	1@4.6	2@4.6	2@4.6	2@4.6	2@4.6	2@4.6	2@4.6	2@5.0
10.5	1@4.9	1@5.3	1@4.9	2@4.9	2@4.9	2@4.9	2@4.9	2@4.9	2@4.9	2@5.3
11.0	1@5.2	1@6.3	1@5.2	1@6.3	2@5.2	2@5.2	2@5.2	2@5.2	2@5.2	2@5.6
12.0	1@5.8	1@6.7	1@5.8	2@5.8	2@5.8	2@5.8	2@5.8	2@6.0	2@6.5	2@7.0

4 x 70 mm^2 HDBC

Dev	<15°	20°	25°	30°	35°	40°	45°	50°	55°	60°
Pole Height (m)	Minimum stay spread (m)									
9.0	1@4.0	1@4.0	1@4.0	1@4.7	2@4.0	2@4.0	2@4.0	2@4.0	2@4.0	2@4.4
9.5	1@4.3	1@4.3	1@4.9	2@4.3	2@4.3	2@4.3	2@4.3	2@4.3	2@4.3	2@4.7
10.0	1@4.6	1@4.8	1@5.8	2@4.6	2@4.6	2@4.6	2@4.6	2@4.6	2@4.6	2@5.0
10.5	1@4.9	1@5.7	1@4.9	2@4.9	2@4.9	2@4.9	2@4.9	2@4.9	2@4.9	2@5.3
11.0	1@5.4	1@5.2	1@5.2	2@5.2	2@5.2	2@5.2	2@5.2	2@5.2	2@5.2	2@5.6
12.0	1@7.2	1@5.8	2@5.8	2@5.8	2@5.8	2@5.8	2@5.8	2@6.2	2@6.7	2@7.2

4 x 100 mm^2 HDBC

Dev	<15°	20°	25°	30°	35°	40°	45°	50°	55°	60°
Pole Height (m)	Minimum stay spread (m)									
9.0	1@4.0	1@4.0	1@4.2	1@5.1	2@4.0	2@4.0	2@4.0	2@4.0	2@4.0	2@4.4
9.5	1@4.3	1@4.3	1@5.0	2@4.3	2@4.3	2@4.3	2@4.3	2@4.3	2@4.3	2@4.7
10.0	1@4.6	1@5.0	1@4.8	2@4.6	2@4.6	2@4.6	2@4.6	2@4.6	2@4.6	2@5.0
10.5	1@4.9	1@4.9	1@5.1	2@4.9	2@4.9	2@4.9	2@4.9	2@4.9	2@4.9	2@5.3
11.0	1@5.8	1@5.2	1@5.4	2@5.2	2@5.2	2@5.2	2@5.2	2@5.2	2@5.2	2@5.6
12.0	1@5.8	1@5.8	1@6.0	2@5.8	2@5.8	2@5.8	2@5.8	2@6.2	2@7.0	2@7.2

	Medium Grade
	Stout Grade

Notes

- The chart created to provide the best combination of pole grade / number of stays and minimum spread
- Alternative solutions are available by manually checking the strut loads and stay wire capabilities against ENA TS 43-30. Table 5 and the appropriate stay charts for the conductor size and number of wire.
- Based on 7/4.00mm grade 700 stay wire (Group 2 as defined in ENA TS 43-30 Table 6)
- Attachment point of stays at 600mm from pole top.
- Pole grade selected to keep stay spread below 35°
- Terminal loads shall be taken as equal to 60°

Appendix 11 - Minimum Stay Spreads For Angle Poles

4 x 32 mm^2 PVC Covered Copper

Dev	<15°	20°	25°	30°	35°	40°	45°	50°	55°	60°
Pole Height (m)	Minimum stay spread (m)									
9.0	1@4.0	1@4.0	1@4.0	1@4.0	1@4.2	2@4.0	2@4.0	2@4.0	2@4.0	2@4.0
9.5	1@4.3	1@4.3	1@4.3	1@4.3	1@4.5	2@4.3	2@4.3	2@4.3	2@4.3	2@4.3
10.0	1@4.6	1@4.6	1@4.6	1@4.8	2@4.6	2@4.6	2@4.6	2@4.6	2@4.6	2@4.6
10.5	1@4.9	1@4.9	1@4.9	1@5.5	2@4.9	2@4.9	2@4.9	2@4.9	2@4.9	2@4.9
11.0	1@5.2	1@5.2	1@5.6	2@5.2	2@5.2	2@5.2	2@5.2	2@5.2	2@5.2	2@5.2
12.0	1@5.8	1@6.2	1@5.8	2@5.8	2@5.8	2@5.8	2@5.8	2@5.8	2@5.8	2@5.8

4 x 70 mm^2 PVC Covered Copper

Dev	<15°	20°	25°	30°	35°	40°	45°	50°	55°	60°
Pole Height (m)	Minimum stay spread (m)									
9.0	1@4.0	1@4.0	1@4.2	1@5.1	2@4.0	2@4.0	2@4.0	2@4.0	2@4.0	2@4.4
9.5	1@4.3	1@4.3	1@5.0	2@4.3	2@4.3	2@4.3	2@4.3	2@4.3	2@4.2	2@4.7
10.0	1@4.6	1@5.0	2@4.6	2@4.6	2@4.6	2@4.6	2@4.6	2@4.6	2@4.6	2@5.0
10.5	1@4.9	1@5.9	2@4.9	2@4.9	2@4.9	2@4.9	2@4.9	2@4.9	2@4.9	2@5.3
11.0	1@5.2	1@5.2	1@5.2	1@5.2	1@5.2	1@5.2	1@5.2	1@5.2	1@5.2	2@5.6
12.0	1@7.5.8	1@5.8	1@6.0	2@5.8	2@5.8	2@5.8	2@5.8	2@6.2	2@6.7	2@7.2

4 x 100 mm^2 PVC Covered Copper

Dev	<15°	20°	25°	30°	35°	40°	45°	50°	55°	60°
Pole Height (m)	Minimum stay spread (m)									
9.0	1@4.0	1@4.0	1@4.4	2@4.0	2@4.0	2@4.0	2@4.0	2@4.0	2@4.0	2@4.4
9.5	1@4.3	1@4.3	1@5.2	1@4.5	2@4.3	2@4.3	2@4.3	2@4.3	2@4.3	2@4.7
10.0	1@4.6	1@5.2	1@4.8	2@4.6	2@4.6	2@4.6	2@4.6	2@4.6	2@4.6	2@5.0
10.5	1@4.9	1@4.9	1@5.1	2@4.9	2@4.9	2@4.9	2@4.9	2@4.9	2@4.9	2@5.3
11.0	1@6.1	1@5.2	2@5.2	2@5.2	2@5.2	2@5.2	2@5.2	2@5.2	2@5.2	2@5.6
12.0	1@5.8	1@5.8	2@5.8	2@5.8	2@5.8	2@5.8	2@6.0	2@6.5	2@7.0	2@7.5

	Medium Grade
	Stout Grade

Notes

- The chart created to provide the best combination of pole grade / number of stays and minimum spread
- Alternative solutions are available by manually checking the strut loads and stay wire capabilities against ENA TS 43-30. Table 5 and the appropriate stay charts for the conductor size and number of wire.
- Based on 7/4.00mm grade 700 stay wire (Group 2 as defined in ENA TS 43-30 Table 6)
- Attachment point of stays at 600mm from pole top.
- Pole grade selected to keep stay spread below 35°
- Terminal loads shall be taken as equal to 60°

Appendix 12 - Historical Pole Type Classification Table

Length of Pole			Light			Medium			Medium Stout			Stout		
Approx. Conv. In (M)	Feet	Range of Pole Sink Depths (M)	Dia. at top (mm)		Min Dia 5ft from Butt (mm)	Dia. At top (mm)		Min Dia 5ft from Butt (mm)	Dia. at top (mm)		Min Dia 5ft from Butt (mm)	Dia. at top (mm)		Min Dia 5ft from Butt (mm)
			Min	Max		Min	Max		Min	Max		Min	Max	
8.5	28	1.5 - 1.8	127	152	178	146	178	216	158	203	241	190	241	266
9.0	30	1.5 - 1.8	127	152	184	152	184	222	158	209	247	190	241	273
10.0	32	1.5 - 1.8	127	158	184	152	184	229	165	209	254	190	247	279
10.5	34	1.5 - 1.8	127	158	184	152	184	235	165	209	260	190	247	285
11.0	36	1.5 - 1.8	127	165	184	152	184	241	165	216	266	190	247	292
11.5	38	1.8	127	165	184	152	184	248	171	228	273	190	247	298
12.0	40	1.8	127	165	203	152	184	248	171	228	273	190	247	305
13.0	42	1.8	-	-	-	159	197	260	178	228	285	190	247	317
14.0	45	2.1	133	171	222	165	203	273	178	228	298	197	254	330

Notes :

1. This table is only to be used where poles are not already classified with pole scarfings.