# NSP/004/106 - (OHI 6) Guidance on the Selection and Application of Conductor Joints, Terminations and Binders

## 1. Purpose

The purpose of this document is to provide guidance on the selection and application of conductor joints, terminations and helical fittings for use on the Northern Powergrid overhead line distribution network.

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

| Document Reference | Document Title | Version | Published Date |
|---|---|---|---|
| NSP/004/106 | (OHI 6) Guidance on the selection and application of conductor joints, terminations & binders | 3.1 | Feb 2019 |

## 2. Scope

The information provided in this guidance document is limited to full tension joints and all types of helical fitting for use on overhead lines. Details on Non-tension joints and jumpers have been provided in NSP/004/107 - Guidance on the selection of conductor jumpers and non-tension joints. Specific requirements for tower lines and wood pole lines up to 132kV can be found in the following documents:

- NSP/004/030 - Specification for the Construction and Refurbishment of 33-132kV Steel Tower Lines
- NSP/004/045 - Code of Practice for EHV Wood Pole Lines operating up to 132kV with span lengths up to 220m

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# 3. Technical Specification

## 3.1. Full Tension Joints

Conductor joints are manufactured to comply with NPS/001/016. Generally, a conductor joint must have conductivity characteristics comparable with that of the associated conductor, be capable of carrying the full line current without overheating and short duration maximum fault current of the line without joint failure. In line with the above specifications, mechanically all joints are required to withstand 95% of the UTS of the associated conductor. As a result, certain conductor sizes require the application of 'Hex press' type fittings even though 'Versa Press' fittings may physically fit the conductor size.

Full tension joints shall be provided through the application of one of the following types of compression jointing systems.

a) 'Versa Press'

b) 'Hex Press'

Full Tension Joints

| Conductor Type / Size | Compression System | Selection Chart Drawing Number |
|---|---|---|
| HDBC & Cadmium Copper | Versa press | 1091010102 Sheet 2 |
| 50 -100mm AAAC | Versa press | 1091010102 sheet 3 |
| 50 - 100mm ACSR<br>150mm ACSR (18+1/3.35mm) (Dingo) | Versa press | |
| 70 – 175mm ACSR | Hex press | 1091010653 sheet 1 |
| 175mm AAAC | Hex press | 1091010653 sheet 2 |
| 200mm AAAC | Hex press | 1091010653 sheet 3 |

## 3.2. Armour Splice

Armour Splices are a range of helical fittings which can be applied over the outer strands of a damaged conductor. (See NPS/001/002 for specification information). Once applied they will return the conductor back to its original UTS. They are approved for use on hard drawn bare copper, copper cadmium, AAAC and ACSR conductors, as shown on drawing no 1091010657.

They shall only be used as a repair medium when one third or less of the outer strands have suffered damage.

Damage to the steel core of ACSR conductors must be repaired with the appropriate type of full tension compression joints.

See Section 3.6 for guidance on the application of helical fittings.

## 3.3. Terminations

Where a choice of conductor termination method is available, the preferred arrangement will be to terminate conductors using preformed helical deadends. The tail from the deadend will then be carried through with a lugged connection or extended with a non-tension connector.

Compression terminations will normally only be used in the following situations:

a) Installation of a live line section point where the conductors are live. (See drawing 1091010573 for details on the preferred arrangements for creating live line sections).

b) Large CSA conductors on EHV Lines.

c) ACSR conductors and HV Covered conductors.

d) At jumpers positions in main line routes were a live line disconnect facility is unlikely to be required.

### 3.3.1. LV Line Terminations

| Conductor Type / Size | Type of Fitting | Selection Chart Drawing Number |
|---|---|---|
| **Main Lines** | | |
| Open Wire Construction | Helical Deadend | 1091193155 sheet 1 |
| ABC Conductor – Full Tension 2 Core & 4 Core | Anchor Clamp | 1000431410 sheet 1 |
| **Services** | | |
| Hybrid Concentric | Helical Deadend | 1091193152 sheet1 |
| ABC Conductor – Reduced Tension 2 Core & 4 Core | Anchor Clamp | 1000431410 sheet 1 |
| 16mm Open Wire Service Aerial (Historical) | Helical Deadend | 1091193155 sheet 1 |

### 3.3.2. HV Line (11 – 33kV) Terminations

| Conductor Type / Size | Type of Fitting | Selection Chart Drawing Number |
|---|---|---|
| All conductor types (see CC below) | Helical Deadend | 1091010425 |
| Or | | |
| All Conductor Types (see CC below) | Compression Dead End | 1091010102 sheet 9 |
| Covered Conductor | Compression dead end | 1091010667 sheet 1 |

### 3.3.3. EHV Wood Pole Line (33kV – 132kV) Terminations

| Conductor Type / Size | Type of Fitting | Selection Chart Drawing Number |
|---|---|---|
| All conductor types | Helical Deadend | 1091010425 |
| Or | | |
| 100mm AAAC (Oak), 100mm HDBC, 125mm HDBC | Compression Dead End | 1091010102 sheet 9 |
| 175mm AAAC (Elm), 200mm AAAC (Poplar) | | 1091010653 sheet 2 |
| 70mm ACSR (Horse), 150mm ACSR (Wolf), 175mm ACSR (Lynx) | Compression Dead End | 1091010653 sheet 1 |

### 3.3.4. Tower Line Terminations

| Conductor Type / Size | Type of Fitting | Selection Chart Drawing Number |
|---|---|---|
| 100mm AAAC (Oak), 100mm HDBC, 125mm HDBC | Compression Dead End | 1091010102 sheet 9 |
| 175mm AAAC (Elm), 200mm AAAC (Poplar) | Compression Dead End | 1091010653 sheet 2, 3 |
| 70mm ACSR (Horse), 150mm ACSR (Wolf), 175mm ACSR (Lynx) | Compression Dead End | 1091010653 sheet 1 |

### 3.3.5. Intermediate or Angle Binder/Ties

Helical preformed fittings are essentially basically groups of conductive rods formed into a helix shape giving the appearance of a stretched spring. The inner diameter of the helix is slightly smaller than that of the conductor or stand to which the fitting will be applied giving the effect of a high gripping force without causing potentially damaging stress to the conductor or strand. Helical preformed fittings can also be used to attach stays to poles. See NPS/001/002 for specification details

### 3.3.6. LV Line Intermediate and Angle Fittings

| Conductor Type / Size | Type of Fitting | Selection Chart Drawing Number |
|---|---|---|
| **Main Lines** | | |
| Open Wire Construction (intermediate/angle) | Helical Fitting | 1091193156 sheet 1 |
| ABC Conductor – Full Tension 2 Core & 4 Core | Roller suspension clamps | 1000431406 sheet 2 |
| **Services Lines** | | |
| ABC Conductor – Reduced Tension 2 Core & 4 Core | Roller suspension clamps | 1000431406 sheet 2 |

### 3.3.7. HV Line (11 – 33kV) Intermediate and Angle Fittings

Selection of fittings:

For ease of identification of the strand or conductor range accommodated by an individual preformed fitting a colour code paint mark is applied to the fittings.

a) Use top ties on all line types to secure conductors to pin insulators at in-line situations in normal environments.

b) Use side ties on all line types to secure conductors to pin insulators at angle poles in both normal and high altitudes.

c) Use double top ties to secure large conductor types to pin insulators at in-line situations in high altitude environments or where difficulty is encountered when securing large conductors e.g. down steep inclines.

d) Use twin grip uplift ties to secure small conductor types to pin insulators where lines are constructed down steep inclines or where small levels of uplift exist in normal environments only.

| Conductor Type / Size | Type of Fitting | Selection Chart Drawing Number |
|---|---|---|
| (Intermediate Top Ties) - All conductor types including covered conductor | Helical Top Tie | 1091010660 |
| (Double Top Ties) - All conductor types excluding covered conductor | Helical Double Top Ties | TBA |
| Twin grip Uplift Ties (Limited to lines with CSA of <=50mm AAAC or 32mm HDBC) | Helical Uplift Tie | 1091010142 |
| Intermediate Ties – Covered conductor | Helical Top Tie | 1091010660 |
| | | |
| **Conductor Type / Size** | **Type of Fitting** | **Selection chart drawing number** |
| (Angle Ties) – All conductor types including covered conductor | Helical Side Tie | 1091010662 |

Notes

1) Where ties are required pilot pin insulators, they shall be installed using the following types;

   a) Straight jumpers 1091010660

   b) Angled jumpers 1091010662

### 3.3.8. EHV Wood Pole Line (33kV – 66kV) Intermediate and Angle Fittings

| Conductor Type / Size | Type of Fitting | Selection Chart Drawing Number |
|---|---|---|
| All conductor types | Helical Side Tie | 1091010662 |

## 3.4. Helical Fittings for Stays

See NSP/004/104 for further details on approved fittings types for terminating stays wire.

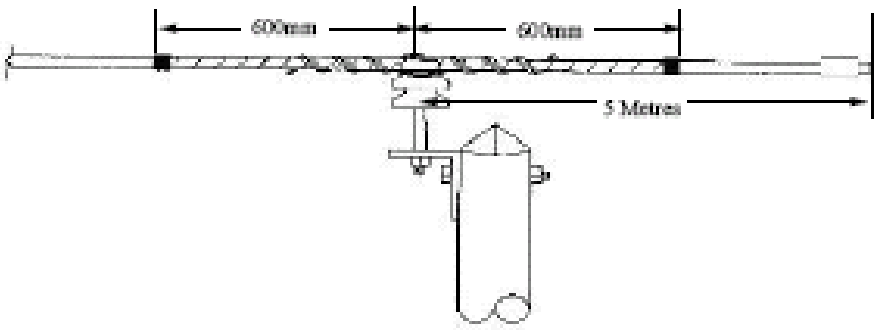
## 3.5. Application of Helical Fittings

### 3.5.1. Application of Helical Fittings – General

- Always ensure the correct fitting is used and applied in line with the manufacturer's instructions.
- All helical fittings are supplied with a weatherproof tag to identify the conductor and insulator range suitable for application.
- Additionally, all fittings are colour coded in line with ENA TS 43-15 (appendix D) and 43-91 (section 9.5) identifying the conductor and insulator range suitable for application.
- Dead-end termination fittings shall have the same direction of lay of the conductor or stay wire.
- Dead-end fittings shall not be used as tools e.g. come- along clamps or pulling grips.
- When applying preformed fittings, the starting point of application on dead ends and helical ties is easily determined by paint markings applied to the fittings at the beginning of the helix. However, the fitting should be applied before the minimum starting point where possible.
- Helical fitting must be fitted in their entirety before any tension is released onto the fitting. Failing to do so will result in the minimum failing load of the fitting being severely reduced.
- Helical fittings shall only be fitted a maximum of 3 times before they should be scrapped. As a key aspect of the fitting's performance grit is glued internally to the strands with any loss of this reducing the minimum failing load of the fitting.

### 3.5.2. Application of Helical Fittings - Covered Conductors

- To overcome television interference caused by electrical discharges at the insulators, the XLPE or PVC covered conductor shall be wrapped with semi-conducting tape for 600mm each side of the insulator centre before binding in the conductor. Note the tie pads are not required in these circumstances. PVC covered conductor shall no longer be installed, however where it is retained the following additional info shall apply.
- At existing PVC insulated positions make sure that the distance between the insulator and the point where the PVC covering is terminated is not less than 5m.
- Where XLPE or PVC coverings are removed from the conductor, the ends of the conductor or the exposed part on XLPE covered lines shall be insulated to prevent longitudinal moisture ingress and ore restore the electrical properties of the insulation. This shall be achieved by the application of a 50% overlapped layer of self-amalgamating tape.


600mm
600mm
5 Metres

# 4. References

The products described within this specification shall comply with all current versions of the relevant International Standards, British Standard Specifications and all relevant Energy Networks Association Technical Specifications (ENATS) current at the time of supply.

## 4.1. External Documentation

| Reference | Title |
|---|---|
| ENA TS 43-15 | Insulator binds and equivalent helical fittings for overhead lines |
| ENA TS 43-91 | Stay strands and stay fittings for overhead lines |

## 4.2. Internal Documentation

| Reference | Title |
|---|---|
| NPS/001/002 | Technical Specification for Helical Products |
| NPS/001/016 | Technical Specification for Compression and Mechanical Fittings for Overhead Lines |
| NSP/004/030 | Specification for the Construction and Refurbishment of 33-132kV Steel Tower Lines |
| NSP/004/045 | Code of Practice for EHV Wood Pole Lines operating up to 132kV with span lengths up to 220m |
| NSP/004/104 | (OHI 4) Guidance on the Types and Installation Requirements for Stays |
| NSP/004/107 | (OHI 7) Guidance on the selection of conductor jumpers and non-tension connections |

## 4.3. Amendments to Previous Version

| Reference | Description |
|---|---|
| 3.3.4 Tower Line Fittings | Table added |
| 3.5 Application of Helical Fittings | Additional application guidance added |
| 3.6 Guidance on the Application of Helical Fittings. | Section added |
| 4.1 External Documentation | Reference to two additional documents added (also referenced in Section 3.6) |
| 4.2 Internal Documentation | Reference to two additional documents added (also referenced in Section 2) |

# 5. Definitions

| Term | Definition |
|---|---|
| n/a | |

# 6. Authority for Issue

## 6.1. CDS Assurance

I sign to confirm that this document has been assured for issue on to the CDS system

| | | Date |
|---|---|---|
| Liz Beat | Governance Administrator | 26/05/2022 |

## 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: n/a | Reason: n/a |
| **Should this document be displayed on the Northern Powergrid external website?** | | Yes |

| | | Date |
|---|---|---|
| Steven Salkeld | Policy and Standards Engineer | 07/06/2022 |

## 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 | Senior Policy and Standards Engineer | 26/05/2022 |
| Joseph Helm | Policy and Standards Manager | 26/05/2022 |

## 6.4. Authorisation

Authorisation is granted for publication of this document

| | | Date |
|---|---|---|
| Paul Black | System Engineering Manager | 13/06/2022 |