NSP/004/108 - (OHI 8) Guidance on the Installation of Compression Joints

1. Purpose

The purpose of this document is to provide guidance on the application of compression joints, and the associated care and testing of compression tools for use on the Northern Powergrid distribution system.

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

Reference	Version	Date	Title
NSP/004/108	2.1	August 2016	Guidance on the installation of compression joints

2. Scope

This guidance note provides detailed information on the installation of compression fittings. The contents are applicable up to and including 132kV Wood Pole overhead lines.

2.1 Table of Contents

3. Technical Specification

This document provides guidance on the followings key areas:

a) Care and inspection of compression tooling

b) Cleaning and preparation of conductors

c) Installation instructions for full tension and non-tension compression joints applied to copper or aluminium conductors utilising the 'die-less' or 'hexagonal' compression fitting tools used within Northern Powergrid

3.1. Care and Inspection and Operation of Compression Tools

It is necessary that all tooling is checked to confirm the correct application pressure on a daily basis or before each use as detailed in Section 3.2 of this document.

3.1.1. 'Die-less Compression' Hydraulic Hand Tool

On Site Care and Maintenance

a) Keep the tool clean and dry.

b) Keep the tool in its case when not in use; do not lay it on the ground.

c) Wipe any jointing compound or grease from the crimping dies.

d) After each day's use, wipe the entire tool thoroughly clean with a dry or slightly oily cloth.

e) Ensure that the advance handle is in the fully open position and operate the hydraulic release valve so that the dies fully retract, before storing the tool in its case.

Operation

a) Place fitting, complete with inserted conductor, in the die opening and operate the pump handle to close the universal die onto the fitting , now screw forward the reservoir handle to "pre-set " the universal die.

b) Position the fitting so that the dies will make the first crimp.

c) Actuate the pump handle and the dies will start compressing the fitting. A positive trip, accompanied by a distinct 'click', will occur when the crimp is fully made. Stop pumping. Rotate the advance handle (in an anti-clockwise direction) approximately ½ turn.

d) Release the compressed dies from the fitting by partially raising then rotating the pumping handle (clockwise) and push handle inward to depress the pressure relief valve. The dies will open sufficiently to allow the fitting to be positioned for the next crimping operation.

e) Continue to apply the crimps as directed by the instructions on the fitting.

f) After the last crimp has been made on the fitting, back off fully (anti clockwise) on the advance handle and release the dies as above.

Note: If the hand tool requires more than 35 pumping strokes or the battery operated tool takes more than 24 seconds to complete a full crimp, the tool requires maintenance and should be returned for repair.

3.1.2. Die-less Compression Tool with 12v Dc Motor Driven Hydraulic Pumps

On Site Care and Maintenance

a) Keep the tool clean and dry.

b) Keep the tool in its case when not in use; do not lay it on the ground.

c) Wipe any jointing compound from the crimping dies.

d) After each day's use:

(i) Wipe the entire tool thoroughly clean with a dry or slightly oily cloth ensuring that any foreign matter is completely removed from exposed ends of uncoupled hydraulic hose fittings.

(ii) Replace the dust caps on the hose ends.

(iii) Close the oil breather petcock.

(iv) Store the hose and crimping die inside the carrying bag.

3.1.3. Operation - Motor Driven Tool

Note: Ensure battery fully charged, the compression tool has adequate oil and the compression is satisfactory before using the tool.

a) Ensure hydraulic couplers are CLEAN before connecting them and are SECURELY tightened.

b) Check correct power connections and complete electrical connections.

c) Open vent plug before starting.

d) Start system by operating the 'ON - OFF' trigger mechanism in rapid succession, thus allowing pump to prime and lubricate itself.

Note: The above instructions should be located on the inside of the lid of the pump carrying case. In hot weather, leave the lid open.

a) Place fitting, complete with inserted conductor, in the die opening and operate the trigger until the dies loosely grip the fitting.

b) Position the fitting so that the dies will make the first crimp.

c) Depress the advance trigger and the dies will start compressing the fitting. A positive trip, accompanied by a distinct 'click', will occur when the crimp is fully made. Remove pressure from advance trigger.

d) Release the compressed dies from the fitting by depressing the release trigger. The dies will open sufficiently to allow the fitting to be repositioned for the next crimping operation.

3.2. Compression Tool Testing

3.2.1. Die-less Compression Tools

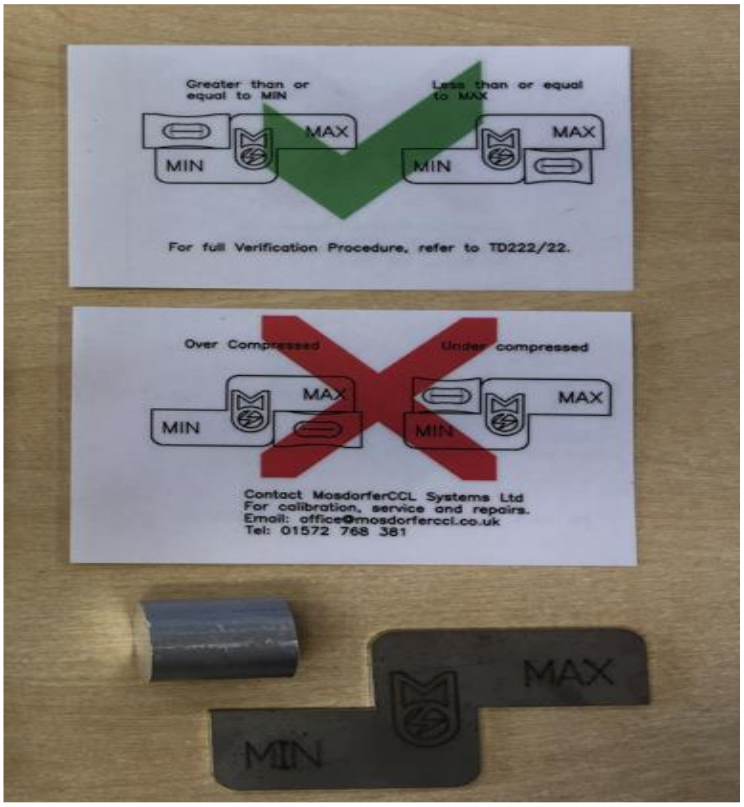
Carry out tests 1 & 2 below; the tool must pass both tests before use. If the tool fails either test, return it for maintenance.

Test 1

Compress a test slug (commodity code 307326 test slug only and 307325 for test slug gauge kt) and compare it against a test gauge as shown below. The compressed slug must be equal or longer than the “GO” side of the gauge and equal or shorter than the “NO GO” side of the gauge.

Test 2

Make sure the compression head is empty and the jaws fully open. Carry out a full compression sequence, the tool must blow off between 28 and 35 full strokes. With the jaws closed you must not be able to pass the test gauge through.



3.2.2. Die Hexagonal Type Compression Tools

Check when making die type compression joints that the two die faces meet on each compression. If they don't the tool needs to be returned for maintenance. Die hexagonal type compression tools must be calibrated during maintenance using a load cell to a set blow off pressure.

3.3. Conductor Cleaning

3.3.1. Non ACSR Conductor

Before any conductor is jointed it must be cleaned, failure to do so may cause joint failure. Separate cleaning brushes must be used for copper and aluminium conductors.

Clean copper conductors using a stainless steel wire brush or scratch pad to produce a shiny finish and joint immediately.

Clean aluminium (AAAC) conductors using a stainless steel wire brush (dry wire brushing technique). Upon completion the conductor shall be jointed immediately.

Clean insulated conductors by removing the required length of insulation and if in good condition clean as above. If the conductor is in poor condition joint elsewhere or if in doubt contact your supervisor.

3.3.2. ACSR Conductors

Extreme care is required when making joints on old conductors as it is possible that the conductor may be unsuitable for re-jointing.

Note: Aluminium conductor which is still on its original storage drum or is used within 30 days of leaving storage can be regarded as a new conductor and must be cleaned as detailed in the Stage 1 process below. All other conductors must be regarded as old conductors and inspected to determine the degree of cleaning required.

- When cleaning aluminium conductors strands use a stainless steel wire brush dedicated for use on aluminium conductors.
- Cut the conductor to the correct length. PVC tape can be applied to ensure that the ends are square before cutting with a hacksaw of approved conductor cutter
- To inspect an old conductor apply PVC tape to the conductor 500mm from the end to prevent unravelling and unwind 6 or more outer strands for 300mm from the end and visually inspect the inner layers. Look for signs of corrosion/oxidisation and presence of internal conductor grease.
- If the inner layers of an old conductor have a full covering of internal conductor grease clean the conductor to Stage 2. If they have little or no internal conductor grease clean the conductor to Stage 3.

If during cleaning any signs of damage, corrosion and oxidisation or conductor brittleness are found, the findings shall be reported to a supervisor. Signs to look out for are a white powdery substance (aluminium hydroxide) or any signs of rusting of the steel core. It is also possible that the aluminium hydroxide may be stained red by rust from the steel core.

Stage 1 Cleaning

- Apply a thin layer of neutral based grease to the conductor outer surface.
- Using your stainless steel brush, thoroughly clean the conductor through the grease. Brush along the length of the conductor to make sure that the bristles clean between the conductor strands.
- Using a clean dry rag, remove the contaminated neutral based grease.
- Re-apply a new thin layer of neutral based grease to the conductor outer surface.
- Prepare the conductor for jointing.

Stage 2 Cleaning

- Unwind a single strand from the outer layer of the conductor and apply a thin layer of neutral based grease to the conductor strand surface.
- Using your stainless steel brush, thoroughly clean the conductor strand through the grease.
- Using a clean dry rag, remove the contaminated neutral based grease.
- Re-apply a new thin layer of neutral based grease to the conductor strand surface.
- Replace the strand into its original position.
- Repeat the process for the other strands.
- Clean the whole conductor following Stage 1 cleaning as detailed above.

Stage 3 Cleaning

- Unwind all the outer strands from the conductor and apply a thin layer of neutral based grease to the conductor inner aluminium strands.
- Using your stainless steel brush, thoroughly clean the conductor inner strands through the grease. Brush along the length of the conductor to make sure that the bristles clean between the conductor strands.
- Using a clean dry rag, remove the contaminated neutral based grease.
- Re-apply a new thin layer of neutral based grease to the conductor inner strand surface.

- Clean the conductor outer strands following Stage 2 cleaning as detailed above

3.3.3. Approved Neutral Grease for ACSR Conductors

Types of greases recommended and their purpose

Type of Grease	Purpose
Castrol SDS Rustillio 431 (Cat No. 361774)	The incorporation of this grease in the cleaning process in connection with conductors and fittings prevents the cleaned surface from being exposed to the atmosphere and consequentially the formation of a high resistance oxide layer.

3.4. Compression Sequence for Tension & Non Tension Joints on Copper or Aluminium Alloy Conductors

Prior to compressing the fitting ensure that it cleaned appropriately as previously detailed and that the conductor is full inserted into the fitting by measuring and applying marker tape.

Straighten and support the conductors before and during compression. This is more critical on the larger aluminium conductors as failing to do this will cause the joint to “banana”. Follow the appropriate compression sequence shown below. When it is required to take conductor insulation into a compression fitting this point must be compressed first, the appropriate compression sequence can then be followed.

For each type, the compress sequence is as follows:

Anchor Clamp

Commence compression at the point indicated on the joint proceeding to end of the joint overlapping each indent by approximately one third of the nib width. Remove marker tape after first compression.

Note: It is imperative to the joint developing maximum holding power that the indentations stop short of the end taper of the joint; therefore the last few compressions are equalled out to ensure the compressions terminate at least 2 mm from the start of the taper.

Tension Joint

The procedure for compressing Tension Joints is the same as for the anchor clamp with the following exception:

Compression is commenced by one compression on either side of the position indicated on the fitting. Then compress one side of the joint as for the Anchor Clamp finishing at least 2 mm from the start of the end taper of the joint.

Non-Tension Lug and Non-Tension through Joint

Ensure the ends of the conductor are not damaged and that the steel core and aluminium strands are flush. Clean the conductor to be inserted as previously detailed. Remove the cap from the end of the fitting and push the conductor end fully into the lug barrel positioning the fitting according to the natural line of the conductor with regard to its final positioning.

Compress the fitting starting at the position marked on the fitting.

Bi Metal Connections

The non-tension fittings specified above are also suitable for jointing to Type 8 PVC covered copper jumper conductor to form a bi metal connection.

Cut back the PVC covering from the conductor end for a distance equal to the length of the lug bore less 9 mm, to allow the PVC covered conductor to enter 9 mm into the nose end of the connector.

On completion, the junction of the PVC covering and end of the barrel is to be wrapped with 'Denso' tape.

Terminal Lug Bolted Connections

When making bolted connections between anchor clamp palm and terminal lug etc., remove plastic coating from each fitting, apply jointing compound liberally to all faces and tighten. It is not necessary to wire brush the surfaces protected by the plastic coating as these are pre-treated, but a careful examination must be made to ensure that the faces and edges of the fittings have not been damaged during storage or transportation. Any high spots or similar blemish arising from rough usage must be carefully filed level. The plastic coating should not be removed until immediately before the bolted connections are made.

Aluminium Bail Clamp

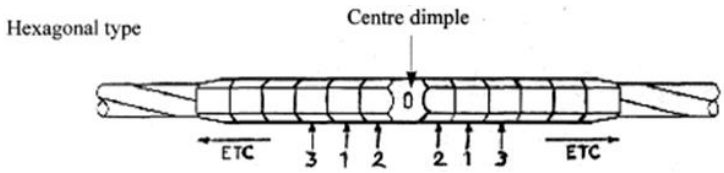
Thoroughly clean the conductor with a stainless steel wire brush where the stirrup connection is to be made and apply conductor grease. Place the horizontal rod of the bail in the compression tool and turn up the advance handle until the stirrup is gripped firmly in the tool.

Sizes 1

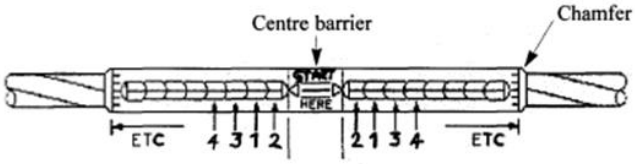
Offer the stirrup and tool to the conductor and compress one connection around the conductor, making certain that the back of the stirrup groove is pressed firmly against the conductor; release the tool and compress the other connector of the stirrup, making sure the back of the stirrup groove is pressed firmly against the conductor and that the stirrup is held at the same angle as for the first crimp.

Size 2

Apply as detailed above for Size 1above but apply two compressions per connector.

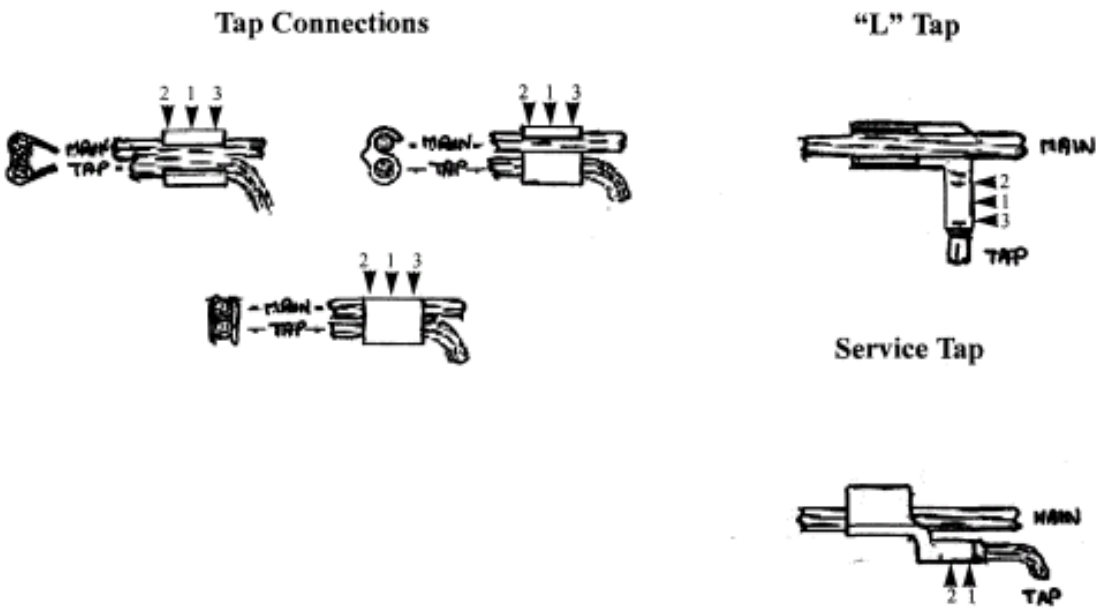


Compression Sequence, Die less Tension and Non Tension Joint



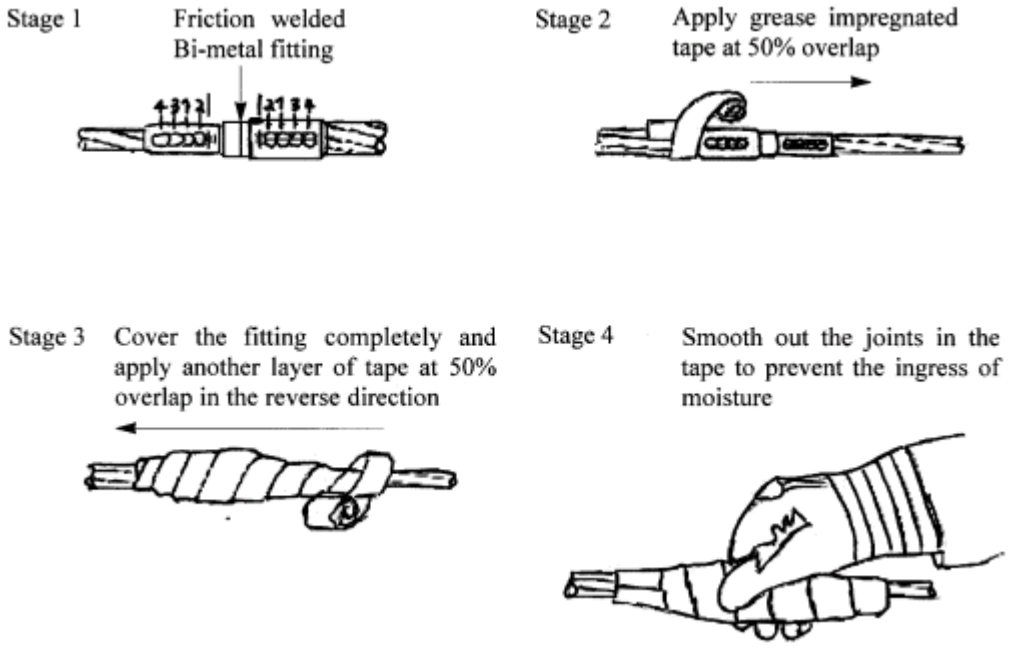
Tap Connectors

On the open 'C' part of the connector start compressing in the centre and work outward. On the tubular part of the connector follow the sequence identified for half a non-tension joint.



Bi-metal non Tension Connection

For bi-metal connections the aluminium conductor shall be predominantly situated above the copper conductor to limit the possibility of corrosion. It shall also be protected from moisture by using heavy wall tubing or grease impregnated 'Denso' tape as shown below.



3.5. Assembly and Compression Instructions for Hexagonal Die Compression Joints onto ACSR and 175mm AAAC conductor.

Due to the variations and amount of detail instructions for hexagonal die compression fittings are shown in appendix 1 of this document.

4. References

4.1. External Documentation

Reference	Title
n/a	

4.2. Internal Documentation

Reference	Title
NSP/004/106	OHI 6 Guidance on the selection and application of conductor joints, terminations & binders
NSP/004/107	OHI 7 Guidance on the selection of conductor Jumpers and Non-tension connections

4.3. Amendments from Previous Version

Reference	Details
3.2.1 Di-less Compression Tools	.Test slug and gauge new image added and commodity codes updated
3.3.3 Approved Greases	Removed reference to approved grit grease as all fittings are now supplied fully greased

5. Definitions

Term	Definition
n/a	

6. Authority for Issue

6.1. CDS Assurance

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

		Date
Liz Beat	Governance Administrator	23/01/2024

6.2. Author

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

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

Standard CDS review of 3 years	**Non Standard Review Period & Reason**	
Yes	Period:	Reason:
Should this document be displayed on the Northern Powergrid external website?		**Yes**

		Date
Steve Salkeld	Policy and Standards Engineer	24/01/2024

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	Senior Policy and Standards Engineer	23/01/2024

6.4. Authorisation

Authorisation is granted for publication of this document.

		Date
Paul Black	Head of System Engineering	22/02/2024

Appendix 1 - Compression Instructions for Hexagonal Die Compression Joints

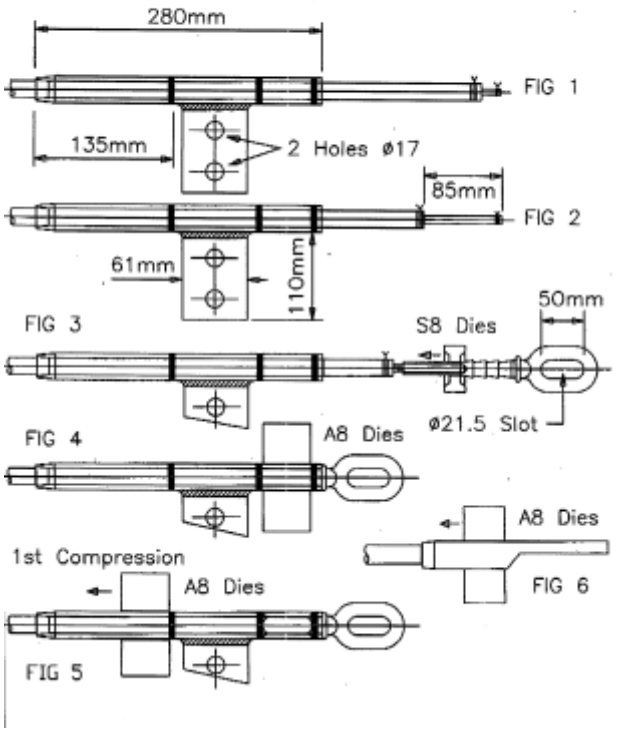
Assembly Method for Hexagonal Die Compression (AA150/175 – Wolf/Lynx) Anchor Clamps Ref 226/10
For Diagrams See TD226/10B
1. Remove the aluminium body and steel eyebolt from sealed packing which should ensure components are clean. 2. Examine conductor end and, if damaged, cut back and ensure it is clean and square. 3. Bind conductor using suitable soft wire or tape approximately 30mm from end. Cut back the Aluminium strands, care being taken not to damage the steel strands. Bind the exposed steel strands using suitable soft wire or tape to prevent un-stranding (Fig.1). 4. Thoroughly clean the aluminium strands of the conductor for a distance of at least 500mm. Remove the binding and un-strand the conductor to clean. In the case of heavily greased conductor, the grease should be removed by recommended solvent before wire brushing. For black conductor, emery cloth or a stiff wire brush should be used. 5. Insert conductor into anchor clamp (ENSURE CORRECT POSITIONING OF FITTING MOUTH, I.E. AWAY FROM CONDUCTOR END) and slide along conductor for approximately' 1 metre. 6. Bind the conductor at a distance of 85mm from the end and cut back aluminium strands to this binding taking care not to damage the steel core (Fig.2). 7. Mark the steel core 70mm from end (this being the bore depth of the eyebolt). Insert the steel core a minimum of 20mm into the eyebolt prior to removing the binding then insert fully up to mark on core. 8. Using Code S8 dies compress the steel eyebolt cylindrical section starting at the toothed end and working towards the eyebolt mouth (4 compressions, using Hexagonal Die Compression) with 5mm overlap (Fig.4). 9. Slide aluminium body over the conductor and fully home onto the eyebolt ensuring the lay of eyebolt and jumper lug are in the required plane to give correct positioning of the jumper lug. Using Code A8 dies apply one compression between the knurled marked rings between the jumper lug and eyebolt head (Fig.4). 10. Using Code A8 dies apply one compression at the aluminium body mouth, Figure 5, and then beginning at the knurled marking ring adjacent to the jumper lug, compress towards the mouth with 10mm overlaps until the entire compression length has been covered (3 compressions using Hexagonal Die Compression). 11. For assembly of jumper terminal ensure conductor end is square and clean. Thoroughly clean conductor by wire brushing as per instructions. Mark conductor 100mm from end of conductor this being the bore depth of the jumper terminal. Insert conductor fully into jumper terminal. Using Code A8 dies compress the jumper terminal cylindrical section starting at the palm end knurled mark. Repeat with a 10mm overlap until all of the terminal body is compressed. (see Fig.6), 2 compressions using Hexagonal Die Compression. 12. Any sharp flashes shall be removed, with a file, after compression. 13. To assemble jumper terminal to anchor clamp, first thoroughly wire brush contact faces of jumper lug and terminal 'palm through approved base grease. Ensure correct orientation of jumper terminal. Use bolts, washers and nuts provided and ensure all nuts are tightened down firmly (67Nm minimum.)

ASSEMBLY METHOD FOR CCL HEX-PRESS®
AA150/175 (WOLF/LYNX) ANCHOR CLAMPS

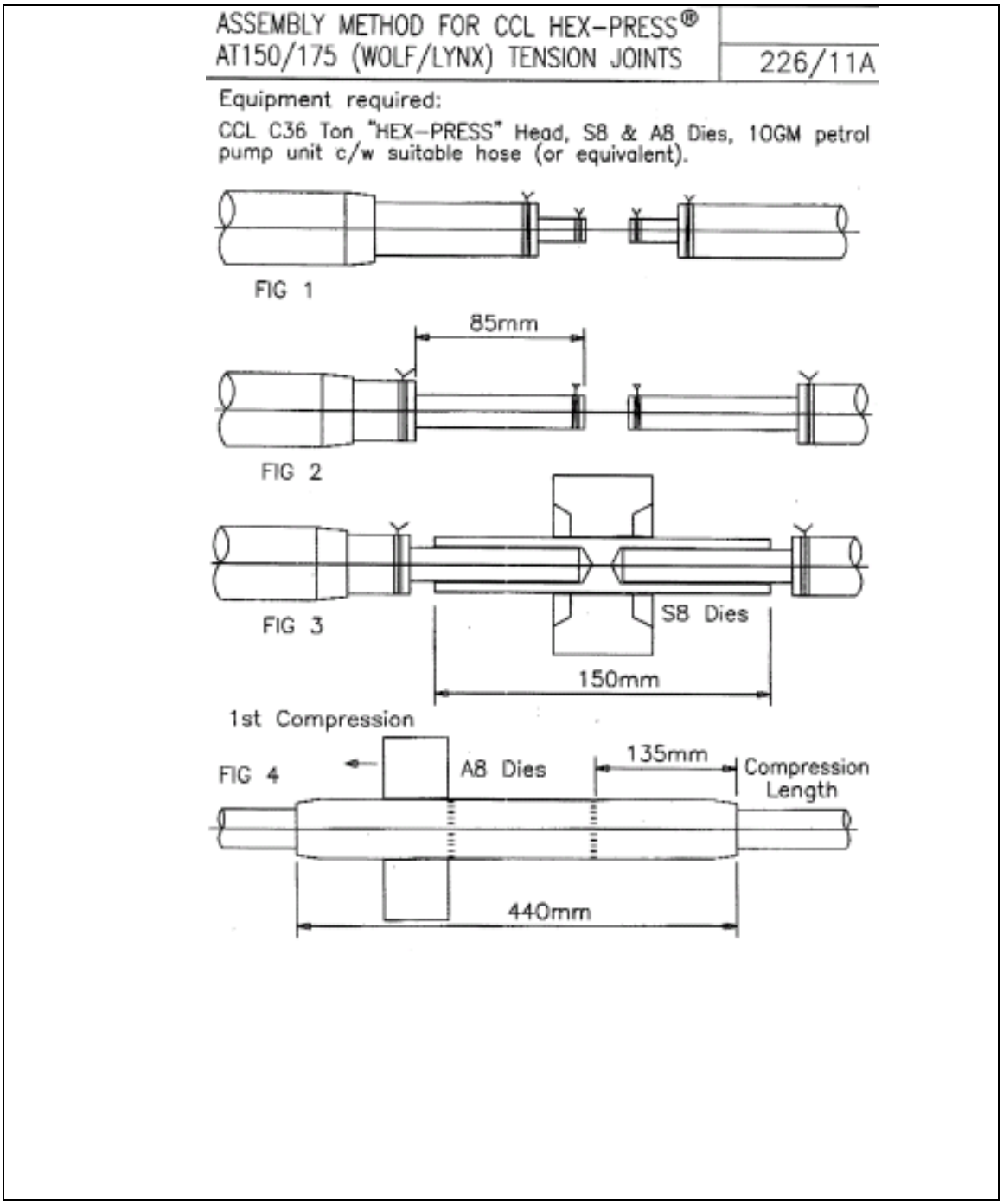
226/10B

Equipment required:

CCL C36 Ton "HEX-PRESS" Head, S8 & A8 Dies, 10GM petrol pump unit c/w suitable hose (or equivalent).



Assembly Method for Hexagonal Die Compression (AA150/175 – Wolf/Lynx) Tension Joints Ref 226/11
For Diagrams See TD226/11A
1. Remove aluminium and steel sleeves from sealed packing which should ensure components are clean. 2. If either of the conductor ends are damaged. Cut back and ensure ends are clean and square. 3. Insert one end of conductor into aluminium sleeve and pass through. Slide aluminium sleeve down conductor for a minimum of 1metre. 4. Bind both conductor ends using suitable soft wire or tape a distance of 30mm from the conductor end and cut back outer aluminium strands, taking care not to damage steel core. Bind steel core to prevent un-stranding, Fig.1. 5. Bind both conductor ends at a distance of 85mm from the conductor end and cut back aluminium strands to this binding taking care not to damage the steel core, Fig.2. 6. Thoroughly clean the aluminium strands of both conductors for a distance of at least 500mm. Remove the binding and un-strand the conductor to clean. In the case of heavily greased conductor, the grease should be removed by recommended solvent before wire brushing. For black conductor emery cloth or stiff wire brush should be used. 7. Mark the steel core 70mm from the end (this being the bore depth of the steel sleeve) and insert fully both pieces of conductor a minimum of 20mm before removing binding and then insert to the marks. Using Code S8 dies compress the steel sleeve, the first compression to be central on the sleeve, then alternate sides with 5mm overlap per compression until the entire sleeve length is compressed (9 compressions using Hexagonal Die Compression; Fig.3). 8. Mark one of the conductors 225mm from the centre of the steel sleeve. Slide the aluminium sleeve over both conductors until this mark is reached when the aluminium sleeve covers both the conductors equally. At one end, using A8 dies apply the first compression at the knurled marked ring. Compress over the compression length with 10mm overlap (3 compressions using Hexagonal Die Compression). This process is then repeated for the uncompressed side of the joint; Fig.4. ELECTRICAL RESISTANCE TESTS The electrical resistance of each part of the completed assembly shall be measured by a suitable approved instrument. The electrical resistance of such fittings shall not exceed 75% of an equivalent length of conductor.


ASSEMBLY METHOD FOR CCL HEX-PRESS®
AT150/175 (WOLF/LYNX) TENSION JOINTS
226/11A
Equipment required:
CCL C36 Ton "HEX-PRESS" Head, S8 & A8 Dies, 10GM petrol pump unit c/w suitable hose (or equivalent).
FIG 1
85mm
FIG 2
FIG 3
S8 Dies
150mm
1st Compression
FIG 4
A8 Dies
135mm
Compression Length
440mm

Assembly Method for CCL Hex-Press - Bi Metal Jumper Lug 226/16
For Diagrams See TD226/16A
1. Remove fitting and liner from sealed packing which should ensure bores of aluminium sleeves are thoroughly clean. 2. Cut conductor end to ensure it is clean and square (if required). 3. Strip back P.V.C. insulation a distance of 70mm (the length of the liner). 4. Thoroughly wire brush conductor through approved grease WHICH SHOULD NOT BE WIPED OFF. 5. Fit liner over conductor ensuring it is pushed firmly up to the insulation and that the conductor is flush with the end of the liner (see Fig.1). 6. Mark the insulation 90mm from the end of the conductor (see Fig.1) and insert into the lug up to or beyond the 90mm mark (see Fig.2). 7. Using Code A8 Dies compress the lug barrel, starting at the palm end knurled mark, then 10mm overlap until all of the lug body is compressed (see Fig. 3) ; 2 compressions using Hexagonal Die Compression. JUMPER TERMINAL BOLTED CONNECTIONS When making bolted connection between dead end palm and jumper terminal lug, remove plastic coating from each fitting, apply conductor grease liberally to all faces and tighten. It is not necessary to scratch brush the surfaces protected by the plastic coating as these are pre-treated, but a careful examination must be made to ensure that the faces and edges of the fittings have not been damaged during storage or transportation. Any high spots or similar blemish arising from rough usage must be carefully filed level. The plastic coating must not be removed until immediately before the bolted connection is made. Immediately prior to reconnecting a jumper terminal lug to an unshielded existing dead end palm, the mating faces of the fittings must be abraded by dry wire brushing and then coated liberally with conductor grease. ELECTRICAL RESISTANCE TESTS The electrical resistance of each part of dead end assemblies and bi metal terminals shall be measured by a suitable approved instrument. The electrical resistance of such fittings shall not exceed 75% of an equivalent length of conductor.

ASSEMBLY METHOD FOR CCL HEX-PRESS® AL125 BI-METAL JUMPER TERMINALS

226/16A

Equipment required:

CCL 36 Ton "HEX-PRESS" Head, A8 Die Set, 10GM petrol pump unit c/w suitable hose (or equivalent).

FIG 1

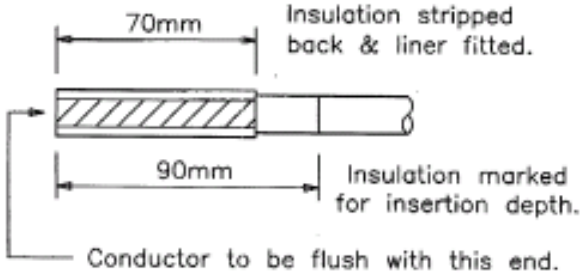


FIG 2

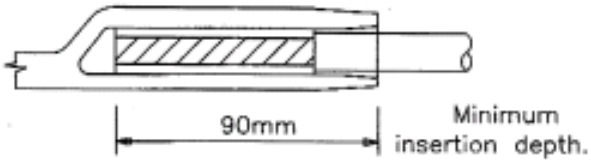
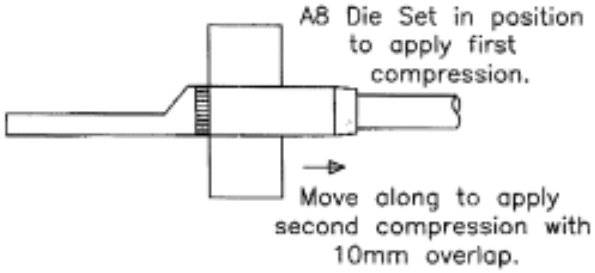


FIG 3



Assembly Method for Hexagonal Die Compression Fittings for AAAC Conductors Ref 226/40

For Diagrams See TD226/40A

Tension Fittings

(1) Ensure that the conductor ends are cut square and are free from burrs.

(2) Clean the conductor with a wire brush kept for the purpose or a length greater than the insertion length, NB With old conductors some un-stranding and cleaning of the inner strands may be necessary, See Figure 1. on TD226/40A.

(3) Fully insert the conductor into the fitting and compress starting against the knurling for the full compression length; with a 5mm overlap between "bites", See Figure 2 on TD226/40A.

(4) Repeat instructions (2) and (3) for the second end.

Non tension Fittings

(1) Prepare conductor ends as per Tension Fitting.

(2) Compress fitting as per Tension Fitting for the full compression length,

Jumper Terminals

(1) Install as per half of a Non-Tension Fitting.

Disconnect able Joints

(1) This joint is composed of two Jumper Terminals.

Anchors

(1) Install as per half of a Tension Fitting.

Tee Joint Fittings

(1) Slide the "Tee° Joint over the conductor past the desired final location, Clean the conductor over the required length.

(2) Slide the fitting into position and compress each end.

(3) Compress Tee of conductor as per half a. Non-Tension fitting.

ASSEMBLY DIAGRAMS FOR CCL HEX-PRESS® FITTINGS FOR AAAC CONDUCTORS

226/40A

SEE TD226/40 FOR INSTRUCTIONS

FIGURE 1

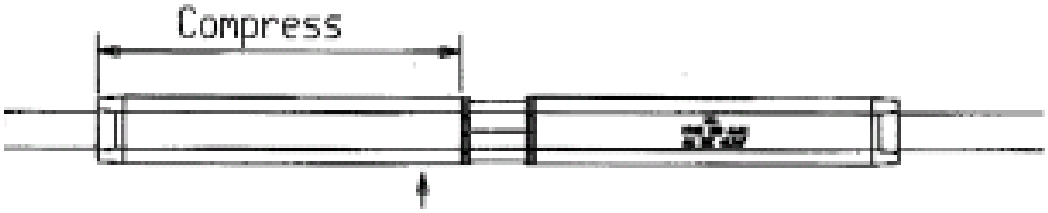


FIGURE 2a (TENSION JOINT)

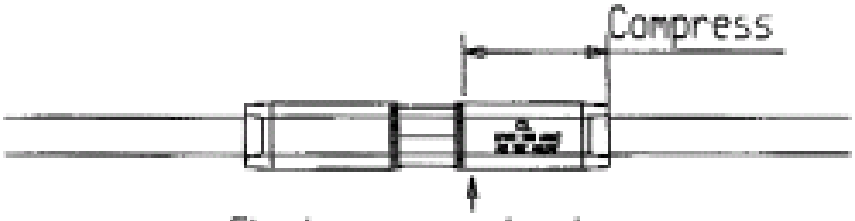


FIGURE 2b (NON-TENSION JOINT)

Appendix 2 – Conductor Parameters and Die Sizes for Hexagonal Press System

Conductor Code Name			Horse	Keziah	OPGW	Lynx	Upas	Zebra	Totara	Collybia	Rubus
Nom. Aluminium Area (mm^2)			70	160	160	175	300	400	425	500	500
Material Code			ACSR	AACSR	AACSR	ACSR	AAAC	ACSR	AAAC	ACAR	AAAC
Stranding			12/7	30/7	28/10	30/7	37	54/7	37	24/37	61
Strand Diameter (mm)			2.79	2.79	2.50	2.79	3.53	3.18	4.14	3.37	3.50
Actual Area (mm^2)			116.2	226.2	203.2	228.2	362.2	484.5	498.1	544.1	586.9
Conductor Diameter (mm)			13.95	19.53	20.60	19.53	24.71	28.62	28.98	30.33	31.50
Nominal Breaking Load (kN)			61.20	102.00	102.70	79.80	101.50	131.90	140.0	127.00	164.0
D.C Resistance at 20°C (μΩ)			393.60	172.00	172.00	157.60	85.90	67.40	62.50	57.50	53.10
Steel or Comp.	Across Flats (mm)		15.11	15.11		15.11	-	16.05	-	-	-
	Die Ref.		S9	S9		S9		S10			
Al. or Al. Alloy	Across Flats (mm)		32.33	32.33		32.33	40.21	40.21	45.72	45.72	45.72
	Die Ref.		A9	A9		A9	A11	A11	A12	A12	A12
Steel or Comp.	Width of Dies (mm)	100 Ton	35 (+/-3)	35 (+/-3)	-	35 (+/-3)	-	35 (+/-3)	-	-	-
		60 Ton	27 (+/-2)	27 (+/-2)		27 (+/-2)	-	27 (+/-2)	-	-	-
		36 Ton	15 (+/-1)	15 (+/-1)		15 (+/-1)	-	15 (+/-1)	-	-	-
Al. or Al. Alloy		100 Ton	71 (+/-5)	71 (±5)		71 (± 5)	71 (± 5)	71 (± 5)	65 (± 5)	65 (± 5)	65 (± 5)
		60 Ton	65 (+/-5)	65 (±5)		65 (± 5)	65 (± 5)	65 (± 5)	50 (± 5)	50 (± 5)	50 (± 5)
		36 Ton	48 (+/-3)	48 (+/-3)		48 (+/-3)	48 (+/-3)	48 (+/-3)	48 (+/-3)		48 (+/-3)