WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales

Company Directive

STANDARD TECHNIQUE : OH4L/1

Relating to Stay Strands and Fittings for Overhead Lines

Author: **Mike Chapman**

Implementation Date: **March 2012**

Approved by

Policy Manager

Date: 9th March 2012

Document Revision & Review Table		
Date	**Comments**	**Author**
06/06/13	• Note 4 on page 6 - typing error corrected	Sven Hoffmann
01/11/13	The table in Fig 1 on page 5 has been amended. The reference to voltage has been removed to avoid confusion.	Philip Hooper

1.0 SCOPE

This Standard technique describes typical stay assemblies used within Western Power Distribution for wood pole construction up to 132kV and is based upon ENA TS 43-91.

2.0 ASSEMBLY

Methods of erecting stays are described in Section 6 of ST: OH 4F.

3.0 MATERIALS

3.1 Stay Strand

Stay strands shall be manufactured in accordance with BS 183. Table 1 shows the various sizes to be used within WPD.

Table 1 Stay Wire Strengths

Size	Grade	Specified Minimum Failure Load (kgf)	Safe Working Load (Factor of Safety 2.5) (kgf)
7/3.25mm	1150	6812	2560
7/4.00mm	1150	10299	4118
7/4.75mm	1150	17431	6970

Note: - The 7/4.75mm stay strand and fittings are available for 132 kV Wood Pole construction

3.2 Ferrous Components

All steel parts, other than wires shall be in accordance with BS EN 10025 grade S275 JR and suitably protected against corrosion by hot dip galvanising to the requirements of BS EN 1461.

4.0 STAY ASSEMBLIES

4.1 Typical stay assemblies

A typical stay assembly is shown in fig 2.

All the fittings should be matched in strength as closely as possible to that of the stay strand.

The overall strength of any stay assembly shall be determined by the weakest component. Typical values can be taken from Appendix A.

4.2 Screw in Anchors

Manually installed screw in anchors shall only be used for Low Voltage service lines.

They shall be installed in stony ground, loam or sandy clay subsoil to a depth of 1.2m. Subject to suitable soil conditions, the stay anchor will resist an uplift force of up to 12kN.

4.3 Power Installed

Power Installed ground anchors may be used by suitably trained staff, they comprise of one or two steel flanges (discs) normally 305mm (12 inches) in diameter welded to a rectangular body to form a single turn helix. The anchor is screwed to a 22mm diameter, 2m or 3m long galvanised steel tension connector rod which, when the anchor assembly is properly installed, will extend just above the ground level, this is in turn screwed to a turnbuckle which can be used to terminate and adjust the stay strand in the same way as a conventional stay rod.

If the anchor has two helix flanges, it is referred to as 'twin disc'; this type of screw anchor is normally used on Medium Voltage (33kV & 11kV) & LV overhead line construction where a Type 2 stay is required. The 'single disc' type is usually used on MV, LV and service line construction where a Type 1 stay is required.

The selection of connector rod length depends upon the type of ground; soft ground will require a 3 metre rod whereas in firmer ground a 2 metre rod will be sufficient.

The anchor must be installed in conjunction with a torque meter and in practice any combination of twin and single discs together with 2m or 3m rods may be used to achieve the required driving torque of 2000 to 7000 Newton Metres.

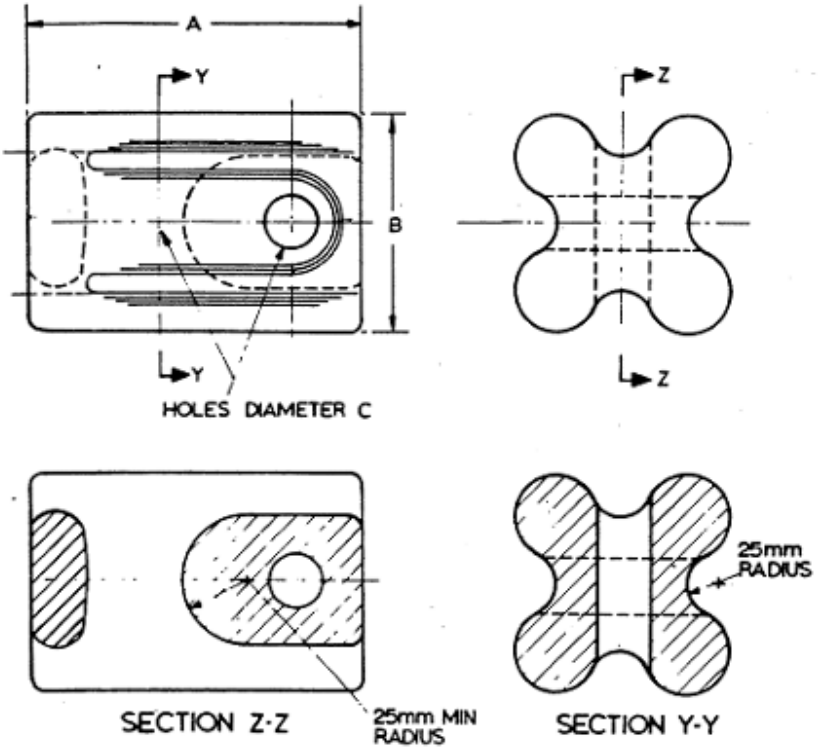
Where this torque cannot be achieved a conventional stay rod and block must be installed.

4.4 Toggle / Load Lock Type Anchor

Toggle type anchors such as the "Platipus System" shall be proof loaded by mechanical or hydraulic means in order lock the anchor into the load bearing position, and to confirm its loading capability at time of installation.

4.5 Insulation of Stays for Voltages up to 33kV

To reduce the risk of dangerous potential gradients occurring at ground level in the event of the stay top becoming live, the bottom half of the stay shall be insulated from the top assembly using stay insulators as shown in fig 1.



TYPE	MINIMUM DIMENSIONS		
	A	B	C
1	115	75	20
2	220	120	20
DIMENSIONS IN MILLIMETRES			

Fig 1 Porcelain Stay Insulators for lines up to 33kV

Solid stays shall not be used. Single type 1 stay insulators shall be used for all stays up to an including 11kV and earthed 33kV structures. For 33kV un-earthed structures two type 2 insulators linked in series shall be used. Stay insulators for 132kV lines are as in 4.5.

The insulators shall be linked using a factory formed arrangement using the procedure as described in ST: OH 4F.

Page revised 1 November 2013

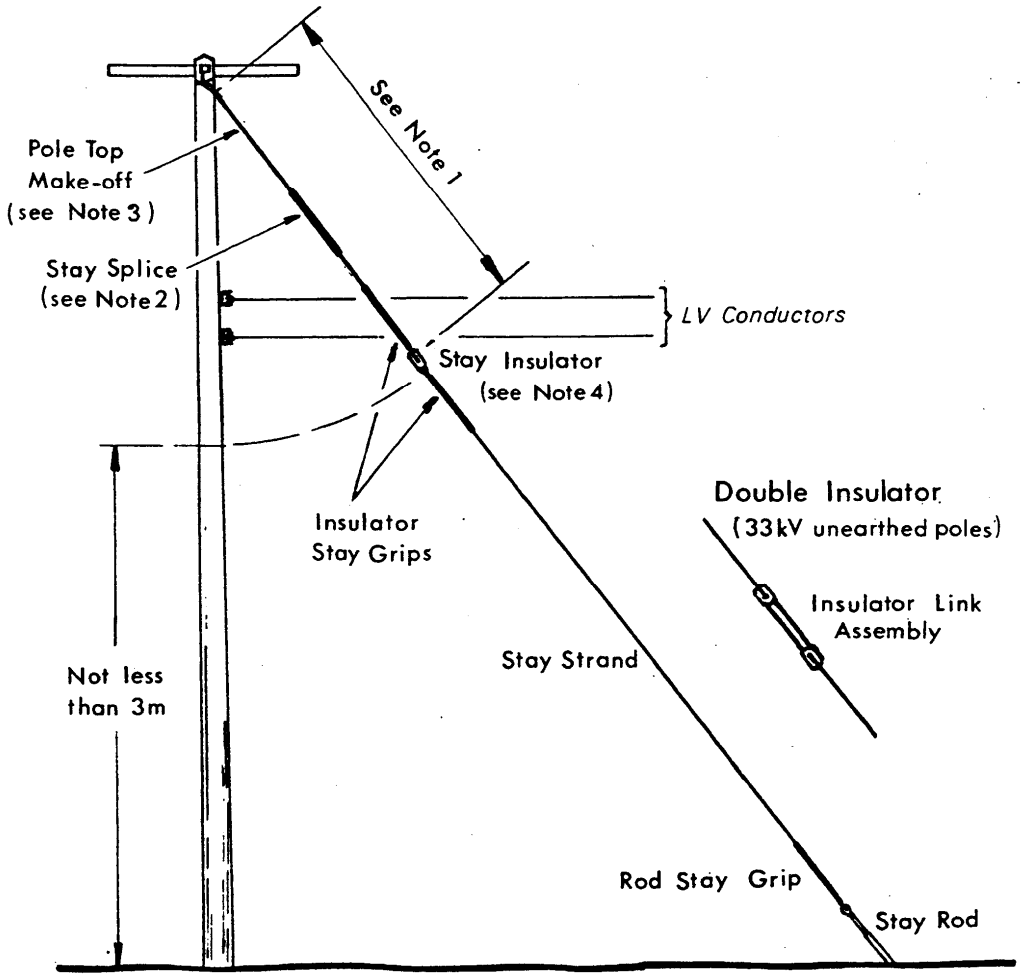


Fig 2 Assembly of Preformed Stay Fittings

Notes:

1. **Stay insulators shall be a minimum of 1.8m from the pole. However where broken jumpers or stays could result in the stay wire becoming 'live', then the distance must be increased to ensure the stay insulator will be below the likely point of contact with live metal. (e.g where the LV conductors are below the HV line as shown in the diagram)**

2. **A stay splice (with a short length of stay wire) will only be required where the distance between the pole and stay has to be greater than 1.8 metres.**

3. **The centre wire (king wire) of the Pole Top Stay Grip must be bonded to the steelwork on all 11kV and 33kV stays.**

4. **A single (Type 1) insulator shall be fitted in all 11kV or LV stays and on 33kV earthed poles.**
   A double (Type 2) linked insulator shall be fitted in all stays on all unearthed 33kV poles.

Stay assemblies for overhead lines of up to 33kV shall be assembled as shown in fig 2.

Page revised 6 June 2013

The mechanical strengths for Type 1 and 2 insulators to be used in stays for overhead lines of up to 33kV are:-

- A Specified Minimum Failure load of 110kN
- A Safe Working Load of 4485 kg

4.6 Stay Insulators for 132kV

Glass and porcelain insulators to be used in stay assemblies for 132kV lines shall be tension insulator sets in accordance with BS EN 60305, and shall match as near as possible the mechanical strengths of the stay assemblies in which they are to be used.

Polymeric insulators with equivalent mechanical and electrical characteristics may also be used.

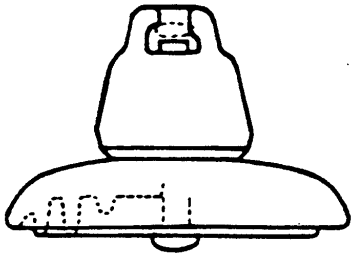


Fig 3 Typical Glass or Porcelain Insulator used in 132kV Stay Assembly

Table 2 below gives suitable mechanical ratings to match other components which are in accordance with BS 3288 Part 2

Table 2 Mechanical Requirements for Stay Insulators and Fittings for 132kV Lines

Stay Type	Specified Mechanical Failing Load (kN)	Safe Working Load (Factor of Safety 2.5) (kgf)
7/3.25 (1150)	70	2854
7/4.00 (1150)	125	5096
2 x 7/4.00 (1150)	190	7747

The number of insulators to be used in each assembly will be:-

- 1 on earthed structures.
- 5 on un-earthed Structures.

4.7 Installation of Stay Blocks

Wooden stay blocks shall be installed as described in ST: OH 4F to the depths shown in table 3 below.

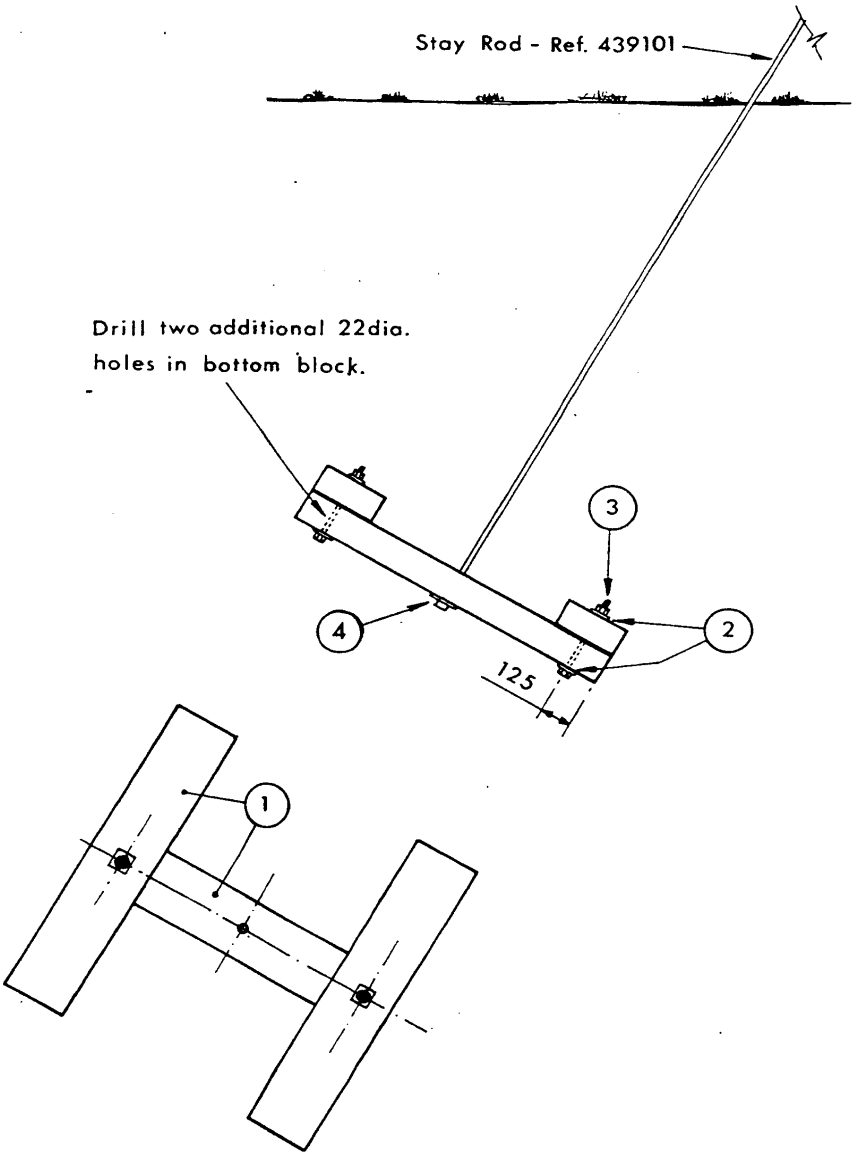
Table 3 Burying Depth for Stay Blocks		
Block Type	Stay at 45° to the pole	Stay at 30° to the pole
Type 1	1.6m	1.8m
Type 2	1.8m	2.0m
Concrete	1.8m	1.8m

In all cases the block shall be placed with the flat side uppermost to provide the maximum uplift resistance. The excavation for the rod must be slotted so that it is in line with the stay wire.

The concrete block and Type 1 wooden stay block have been designed to have a mechanical failing load and resistance to uplift of 65 kN to be used with a type 1 stay rod.

The Type 2 wooden stay block have been designed to have a mechanical failing load and resistance to uplift of 110 kN to be used with a type 2 stay rod.

For marshy ground the arrangement as shown in fig 4 may be used.



MATERIAL LIST			
ITEM No	QUANTITY	DESCRIPTION	COMPONENT REF.
1	3	WOOD STAY BLOCK	439103 Type2
2	4	SQUARE WASHER FLAT	439604
3	2	M20x300 BOLT	—
4	1	STAY BLOCK NAIL	—

Fig 4 Stay Foundations for use in Marshy Ground

4.8 Stay Rods

The mechanical strengths for Type 1, 2 stay rods and Screw in anchors to be used in stays for overhead lines are shown in table 4.

Table 4 Mechanical Requirements for Stay Rods

Rod Type	Specified Minimum Failure Load (kN)	Safe Working Load (Factor of Safety 2.5) (kgf)
Type 1	65	2650
Type 2	110	4485
Manual Screw in Anchor	12	489

In ground with high acid content, such as in peat it will be necessary to protect the stay rod against corrosion by the application of a suitable tape or heat shrinkable tubing.

4.9 Precautions against Access

Where necessary following an assessment of location etc, barbed wire shall be fitted to stays in accordance with ENATS 43-90 to prevent unauthorised climbing.

4.10 Bonding of Stays

All stays supporting high voltage lines shall be bonded at the top to the steelwork.

The method of bonding is to take the centre (king) wire from the pole top make off and connect it to the HV steelwork. The method to be used is described in ST: OH 4F section 6.

A stay attached to a stay strap need not be bonded separately if it is fitted to a bolt in contact with the steelwork.

4.11 Stay Thimbles

All stay terminations attached to metal fittings shall be fitted with galvanized thimbles as shown in fig 5.

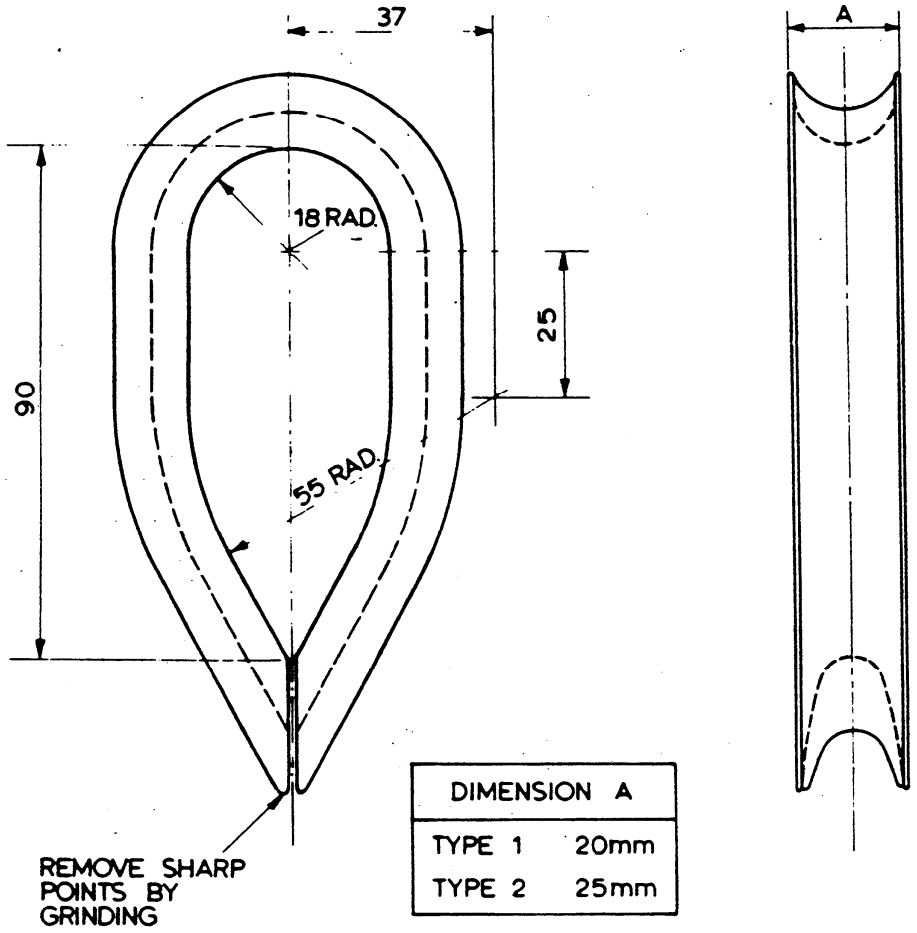


Fig 5 Stay Thimble

Type 1 thimbles are suitable for factory formed helical fittings to be used with 7 strand stay wire. Type 1 thimbles will normally be supplied with fittings unless specified.

Type 2 thimbles are suitable for factory formed helical fittings to be used with 19 strand stay.

4.12 Stay Straps

Light duty stay straps shall not be used within Western Power Distribution.

The heavy duty strap is for the attachment of stays to 132kV crossarm assemblies. It is attached to the crossarm with two M24 x 60 bolts and nuts, each with two washers and to the stay wire or insulator as shown in Appendix B. The strap may be used on lines of lower voltage where the design load is compatible.

4.13 Multiple Stay Arrangements

When two stays are fitted to a single pole they must be arranged either in a splayed or tandem configuration as shown in fig 6.

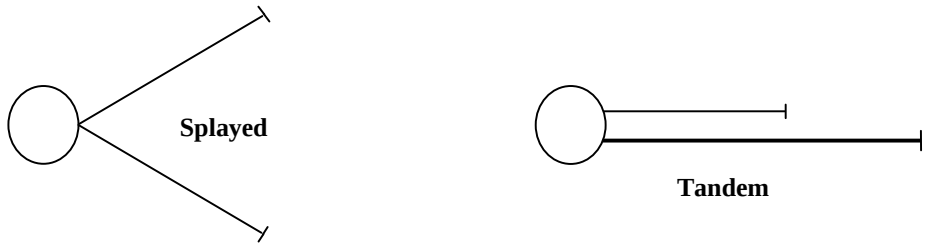


Fig 6

When more than one stay is required on an 'H' pole angle structure, it is preferable to use the arrangement shown in fig 7 in order to distribute the load between the two legs of the structure.

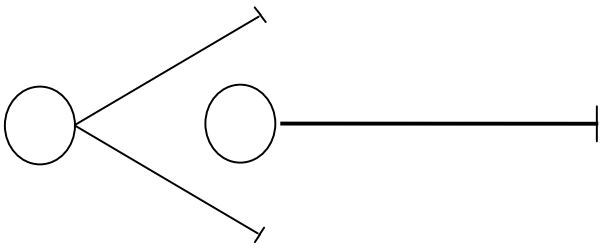


Fig 7 Three Stays on 'H' Pole

Where multiple stays are used, the stay blocks should be installed with a sufficient space between them as to ensure an adequate frustum of soil in line of pull of each block to ensure a safe anchorage. The length of undisturbed ground between the stay pits must not be less than 2 metres.

APPENDIX A

Strength of Stay Assemblies												
Stay Strand			**Rod**		**Block**		**Insulator**		**Overall Assembly Strength**	**Safe Working Load kg**	**Weakest Fitting**	**Use**
Grade	**Size Wires/mm**	**S.M.F.L kN**	**Type**	**S.M.F.L kN**	**Type**	**S.M.F.L kN**	**Line Voltage kV**	**S.M.L kN**				
1150	7/3.25 7/4.00	66.8 101	Screw in	12	-	-	Up to 33	110	12	489	Rod	LV Services
1150	7/3.25	66.8	1	65	1	65	Up to 33	110	65	2650	Rod & Block	Up to 33kV
							132	70	65	2650	Rod & Block	132kV Wood Pole
1150	7/4.00	101	2	110	2	110	Up to 33	110	101	4118	Strand	11kV and 33kV
							132	125	101	4118	Strand	132kV Wood Pole
1150	2 x 7/4.00	202	2 x 2	220	2 x 2	220	132	190	190	7747	Insulator	132kV Wood Pole

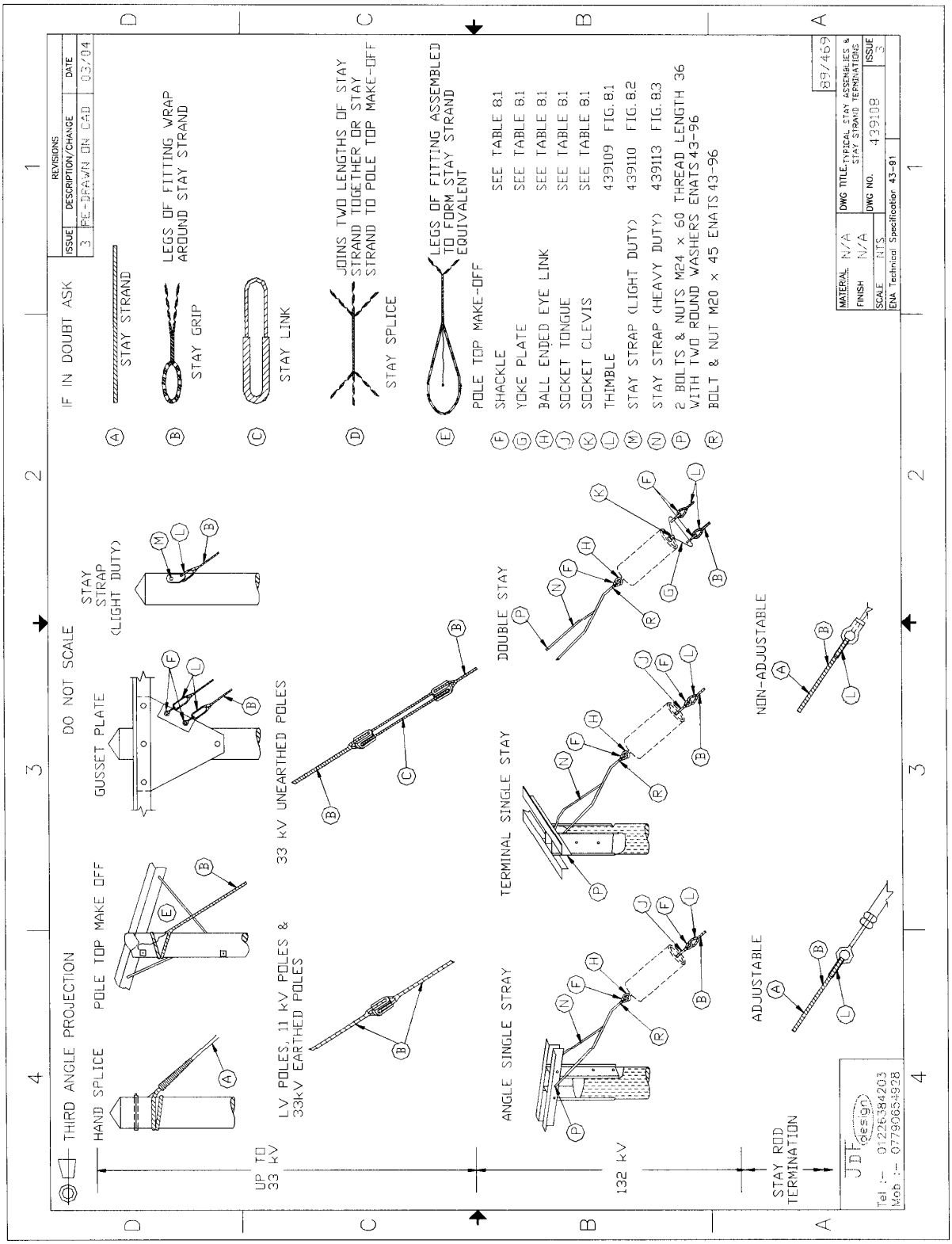
Note:- 1 The Safe Working Load value is based upon an applied Factor of Safety of 2.5.

2 The concrete block is equivalent to the Type 1 Wood Block

3 Power Installed Anchors - Providing the required torque can be achieved during installation a 1 disc anchor can be treated equivalent to a Type 1 block and a 2 disc equivalent to a Type 2 block.

4 S.M.F.L: Specified Minimum Failure Load applicable to stay rods, stay wires and fittings.

5 S.M.L: Specified Mechanical Failure Load applicable to insulators.


THIRD ANGLE PROJECTION
DO NOT SCALE
IF IN DOUBT ASK
REVISIONS
ISSUE | DESCRIPTION/CHANGE | DATE
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STAY STRAND
LEGS OF FITTING WRAP AROUND STAY STRAND
STAY GRIP
STAY LINK
JOINS TWO LENGTHS OF STAY STRAND TOGETHER OR STAY STRAND TO POLE TOP MAKE-OFF
STAY SPLICE
LEGS OF FITTING ASSEMBLED TO FORM STAY STRAND EQUIVALENT
POLE TOP MAKE-OFF
SHACKLE SEE TABLE 8.1
YOKE PLATE SEE TABLE 8.1
BALL ENDED EYE LINK SEE TABLE 8.1
SOCKET TONGUE SEE TABLE 8.1
SOCKET CLEVIS SEE TABLE 8.1
THIMBLE 439109 FIG. 8.1
STAY STRAP (LIGHT DUTY) 439110 FIG. 8.2
STAY STRAP (HEAVY DUTY) 439113 FIG. 8.3
2 BOLTS & NUTS M24 x 60 THREAD LENGTH 36 WITH TWO ROUND WASHERS ENATS 43-96
BOLT & NUT M20 x 45 ENATS 43-96
HAND SPLICE
POLE TOP MAKE OFF
GUSSET PLATE
STAY STRAP (LIGHT DUTY)
LV POLES, 11 kV POLES & 33kV EARTHED POLES
33 kV UNEARTHED POLES
DOUBLE STAY
TERMINAL SINGLE STAY
ANGLE SINGLE STAY
NON-ADJUSTABLE
ADJUSTABLE
STAY ROD TERMINATION
UP TO 33 kV
132 kV
JDF Design
Tel :- 01226384203
Mob :- 07960654928
MATERIAL N/A
FINISH N/A
SCALE NTS
DWG NO. 439108
ISSUE 3
DWG TITLE TYPICAL STAY ASSEMBLIES & STAY STRAND TERMINATIONS
ENA Technical Specification 43-91
89/469

TABLE 8.1- FITTINGS FROM BS 3288

THIRD ANGLE PROJECTION

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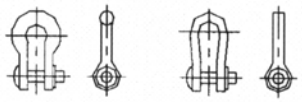
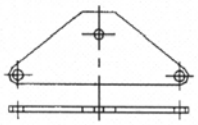
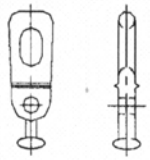
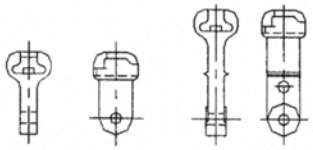
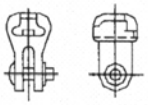
ILLUSTRATION	REF E.N.A. DRG No 439108	BS 3288 REFERENCE		
		7/4.00 (700) OR 7/3.25 (1150)	19/3.55 (700) OR 7/4.00 (1150)	2 x 19/3.55 (700) 2 x 7/4.00 (1150)
SHACKLE 	G	15 / 29	28 / 29	42 / 29
YOKE PLATE 	H	———	———	42 / 42
BALL ENDED EYE LINK 	J	15 / 30	28 / 30	42 / 30
SOCKET TONGUE 	K	15 / 85	28 / 36A	———
SOCKET CLEVIS 	L	———	———	42 / 37

DO NOT SCALE

IF IN DOUBT ASK

89/465

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Mob :- 07790654928

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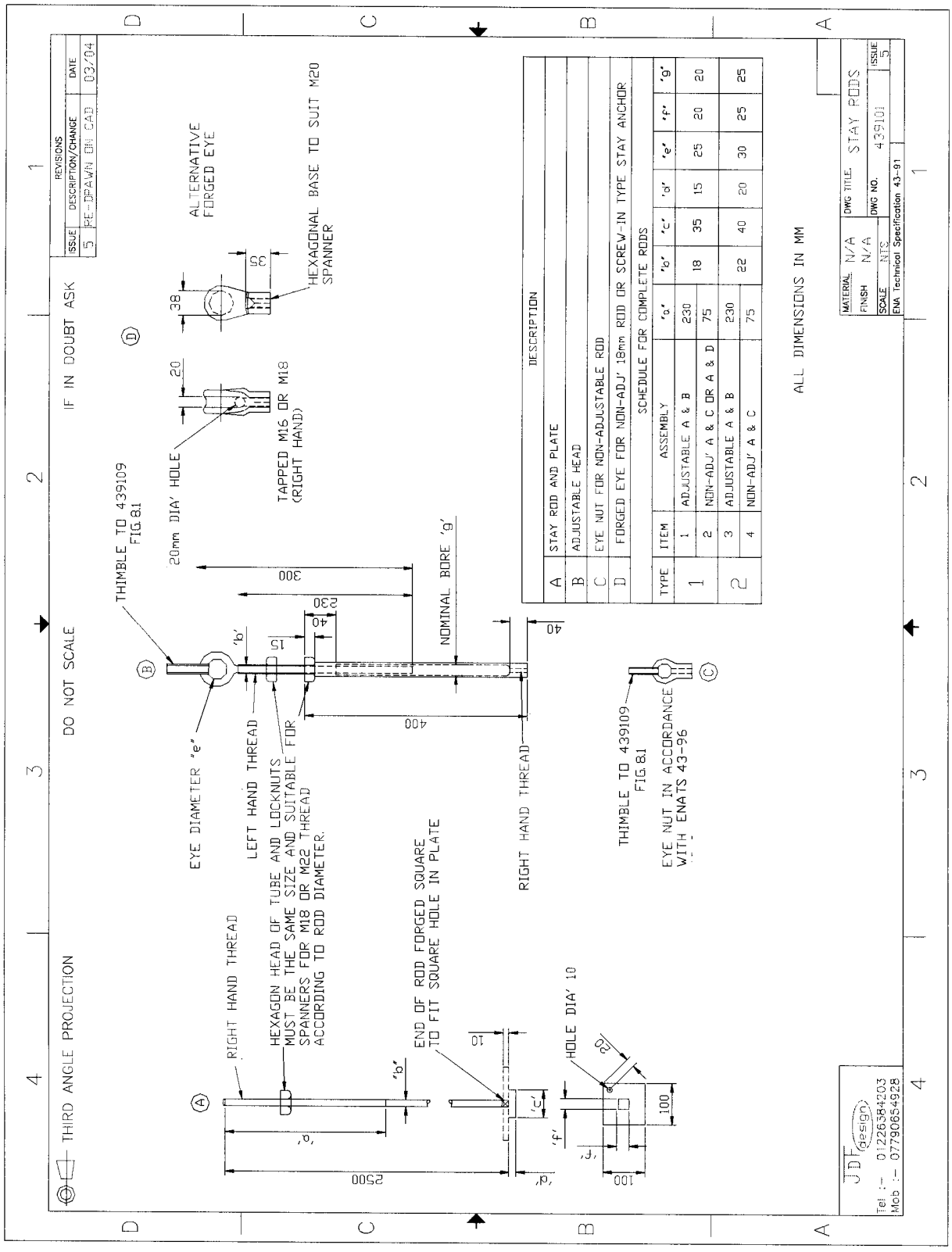
ENA Technical Specification 43-91			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FINISH N/A
SCALE NTS
DWG TITLE STAY RODS
DWG NO. 439101
ISSUE 5
ENA Technical Specification 43-91
UDT Design
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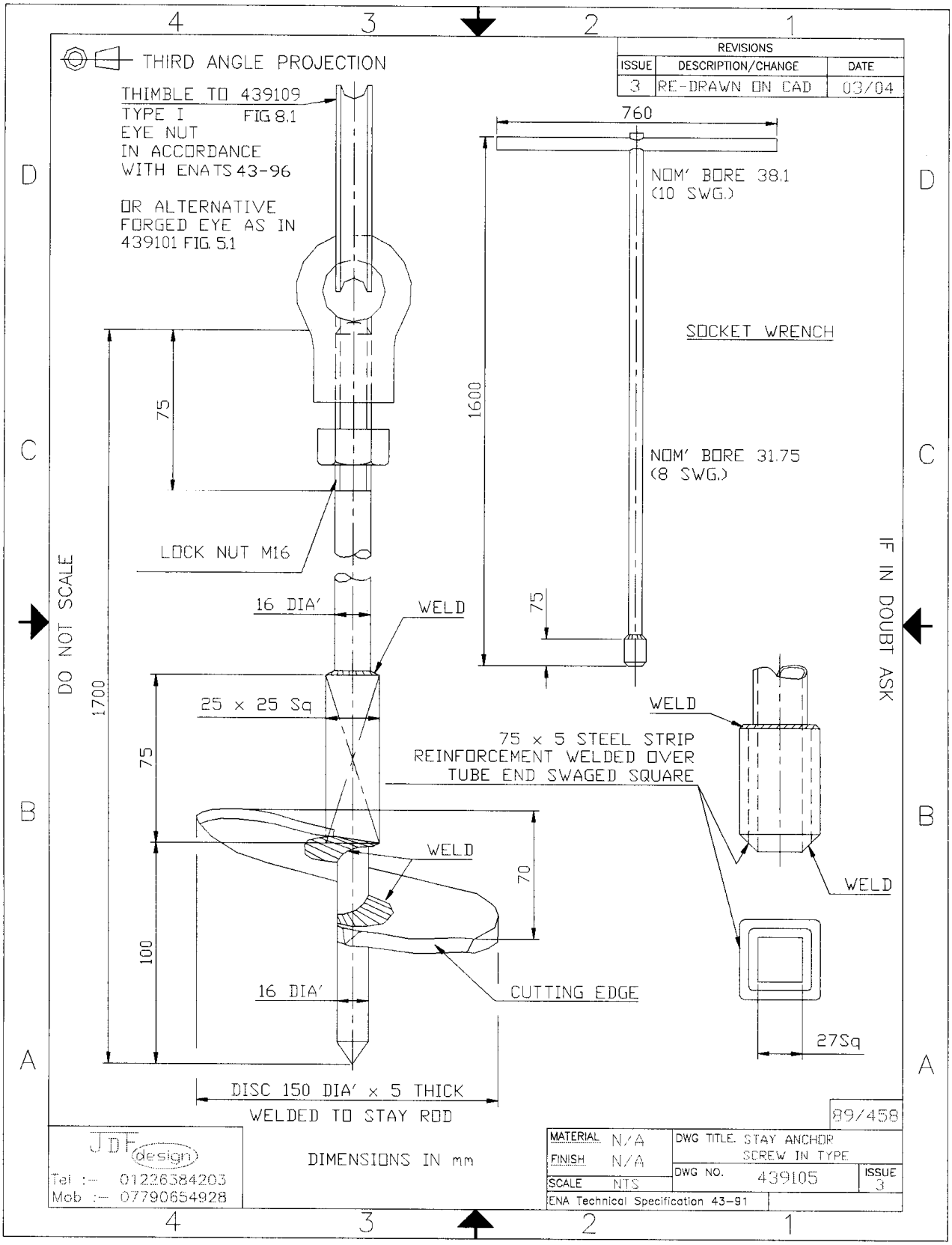
Mob :- 07790654928
DESCRIPTION
A STAY ROD AND PLATE
B ADJUSTABLE HEAD
C EYE NUT FOR NON-ADJUSTABLE ROD
D FORGED EYE FOR NON-ADJ' 18mm ROD OR SCREW-IN TYPE STAY ANCHOR
SCHEDULE FOR COMPLETE RODS
TYPE ITEM ASSEMBLY 'a' 'b' 'c' 'd' 'e' 'f' 'g'
1 1 ADJUSTABLE A & B 230 18 35 15 25 20 20
2 NON-ADJ' A & C OR A & D 75
2 3 ADJUSTABLE A & B 230 22 40 20 30 25 25
4 NON-ADJ' A & C 75
THIMBLE TO 439109 FIG.8.1
20mm DIA' HOLE
TAPPED M16 OR M18 (RIGHT HAND)
ALTERNATIVE FORGED EYE
HEXAGONAL BASE TO SUIT M20 SPANNER
EYE DIAMETER 'e'
LEFT HAND THREAD
HEXAGON HEAD OF TUBE AND LOCKNUTS MUST BE THE SAME SIZE AND SUITABLE FOR SPANNERS FOR M18 OR M22 THREAD ACCORDING TO ROD DIAMETER.
NOMINAL BORE 'g'
RIGHT HAND THREAD
END OF ROD FORGED SQUARE TO FIT SQUARE HOLE IN PLATE
HOLE DIA' 10
THIMBLE TO 439109 FIG.8.1
EYE NUT IN ACCORDANCE WITH ENATS 43-96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REVISIONS
ISSUE | DESCRIPTION/CHANGE | DATE
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THIMBLE TO 439109
TYPE I FIG 8.1
EYE NUT
IN ACCORDANCE
WITH ENATS 43-96
OR ALTERNATIVE
FORGED EYE AS IN
439101 FIG 5.1
760
NOM' BORE 38.1
(10 SWG.)
SOCKET WRENCH
1600
NOM' BORE 31.75
(8 SWG.)
75
LOCK NUT M16
16 DIA'
WELD
75
1700
25 x 25 Sq
75 x 5 STEEL STRIP
REINFORCEMENT WELDED OVER
TUBE END SWAGED SQUARE
WELD
WELD
WELD
70
100
16 DIA'
CUTTING EDGE
27Sq
DISC 150 DIA' x 5 THICK
WELDED TO STAY ROD
DO NOT SCALE
IF IN DOUBT ASK
89/458
JDF design
Tel :- 01226384203
Mob :- 07790654928
DIMENSIONS IN mm
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FINISH N/A
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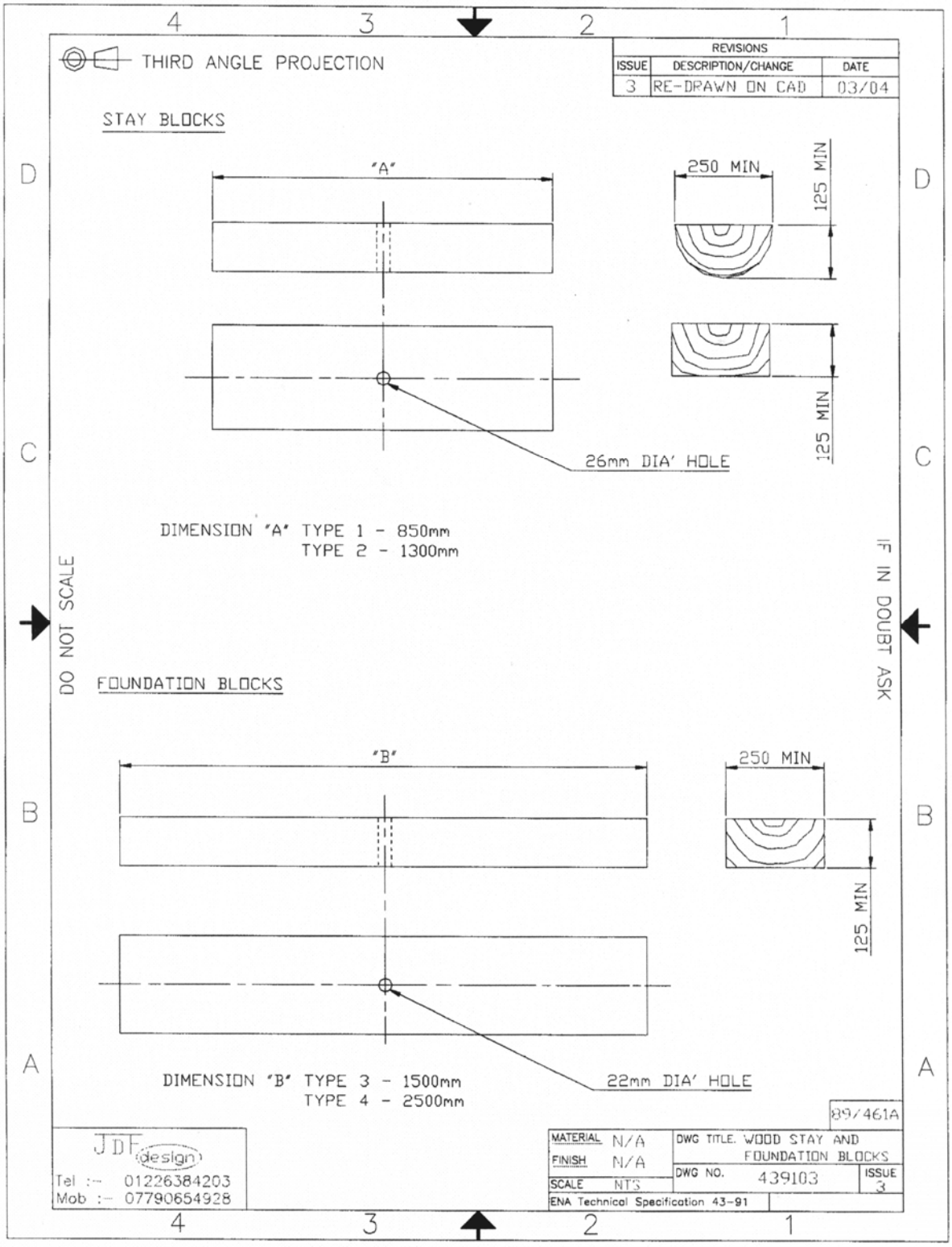
SCREW IN TYPE
DWG NO. 439105
ISSUE 3
ENA Technical Specification 43-91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125 MIN
125 MIN
26mm DIA' HOLE
DIMENSION "A" TYPE 1 - 850mm
TYPE 2 - 1300mm
DO NOT SCALE
IF IN DOUBT ASK
FOUNDATION BLOCKS
"B"
250 MIN
125 MIN
22mm DIA' HOLE
DIMENSION "B" TYPE 3 - 1500mm
TYPE 4 - 2500mm
89/461A
JDF design
Tel :- 01226384203
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SCALE NTS
ENA Technical Specification 43-91
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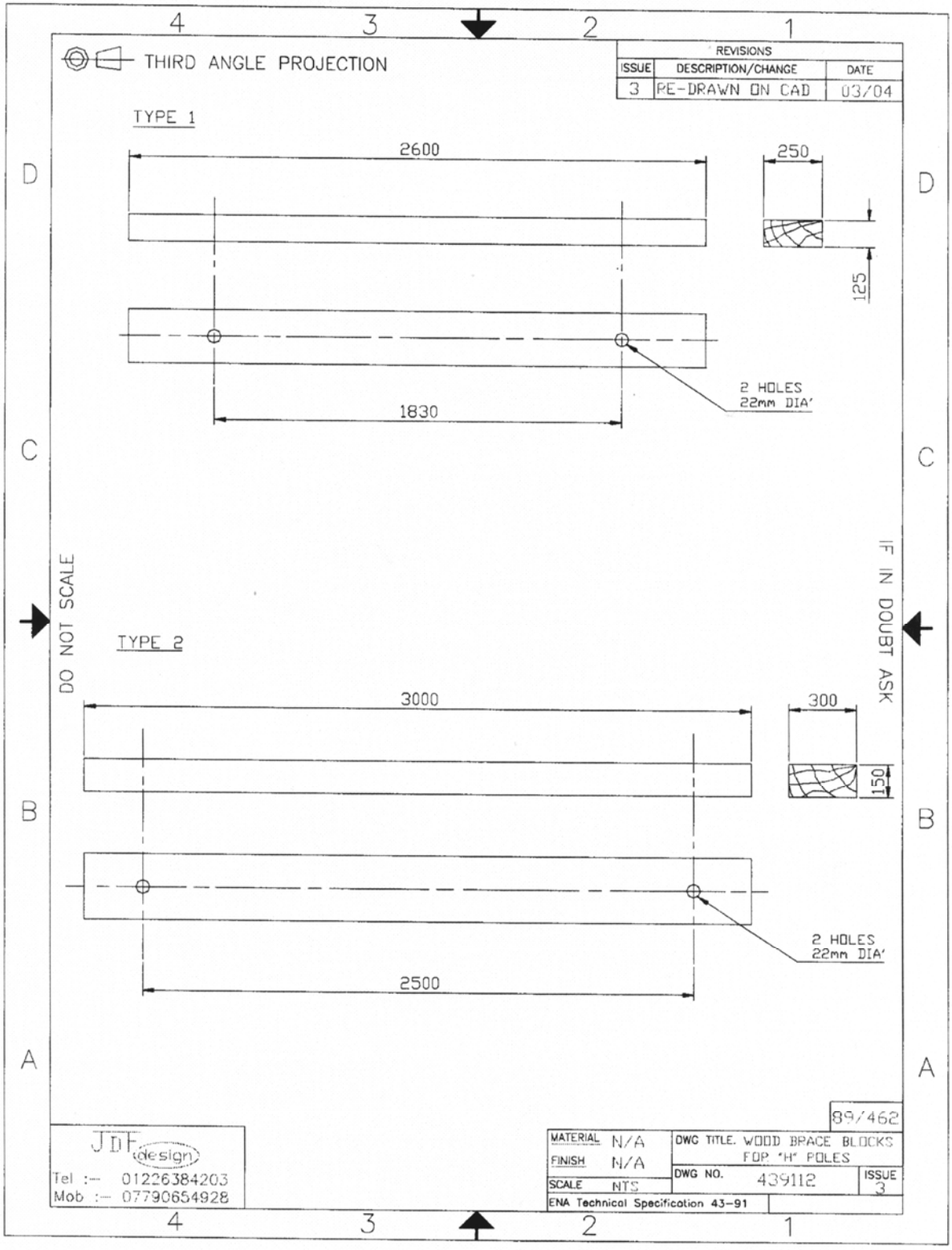
DWG NO. 439103
ISSUE 3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125
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1830
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IF IN DOUBT ASK
TYPE 2
3000
300
150
2 HOLES 22mm DIA'
2500
89/462
JDT design
Tel :- 01226384203
Mob :- 07790654928
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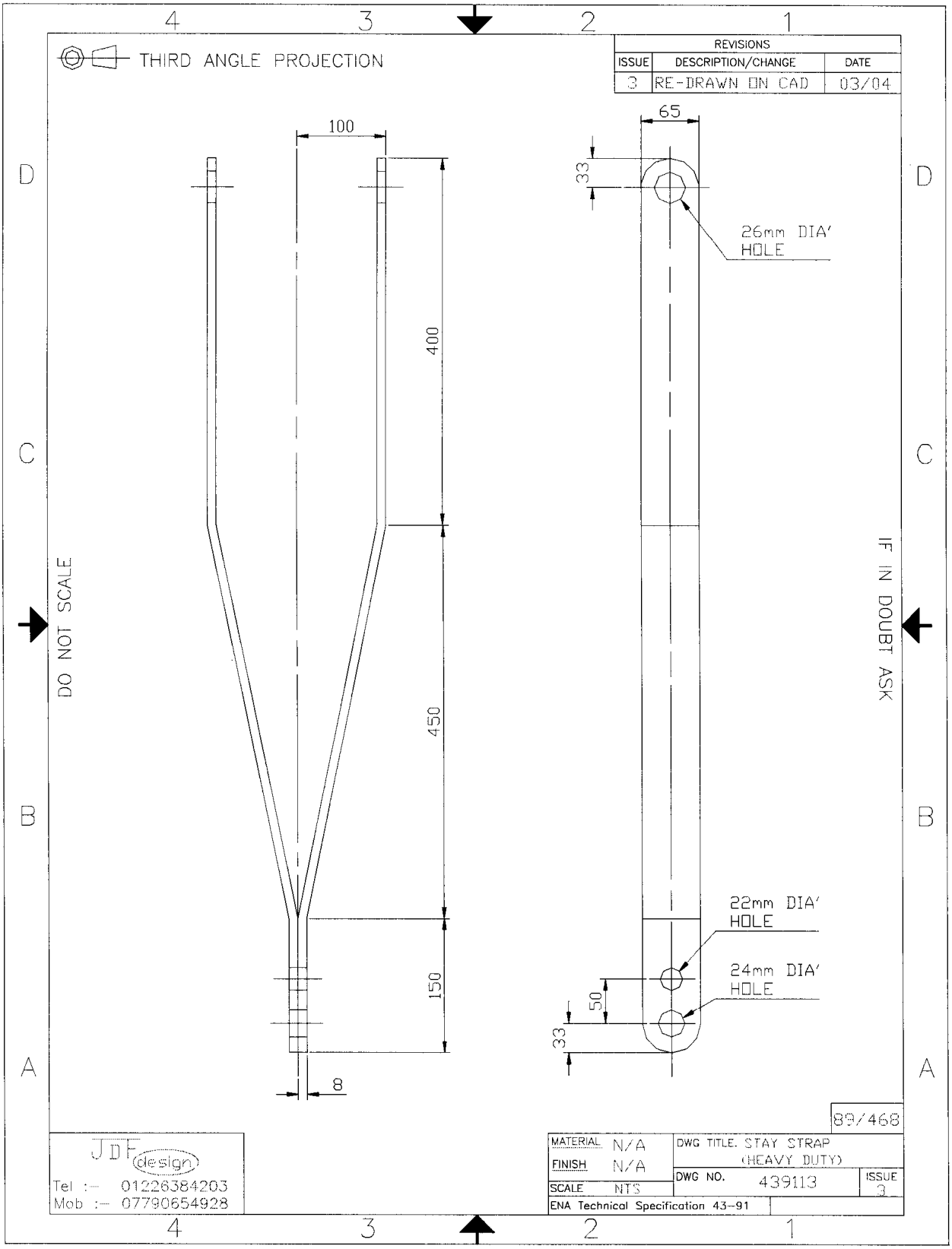
DWG NO. 439112
ISSUE 3
ENA Technical Specification 43-91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ISSUE | DESCRIPTION/CHANGE | DATE
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65
33
26mm DIA' HOLE
400
450
150
8
22mm DIA' HOLE
24mm DIA' HOLE
50
33
DO NOT SCALE
IF IN DOUBT ASK
89/468
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FINISH N/A
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DWG TITLE. STAY STRAP (HEAVY DUTY)
DWG NO. 439113
ISSUE 3
ENA Technical Specification 43-91

APPENDIX C

SUPERSEDED DOCUMENTATION

This document supersedes ST:OH4L dated August 2006 which should now be withdrawn.
All Midlands related documentation.

APPENDIX D

ASSOCIATED DOCUMENTATION

APPENDIX E

IMPACT ON COMPANY POLICY

There is no change to company policy within the South West & Wales
New Policy for the Midlands

APPENDIX F

IMPLEMENTATION OF POLICY

This policy shall be implemented immediately.
Team managers should ensure all relevant staff have been briefed.

APPENDIX G

KEY WORDS

Stay, Stay Wire, Stay Fittings

APPENDIX H

DATE LAST REVIEWED

March 2012
Inclusion of Power Installed Stay Anchors