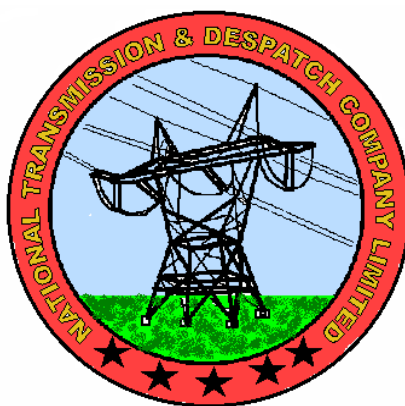


Draft

NATIONAL TRANSMISSION AND DESPATCH COMPANY

SPECIFICATION P- :2011



TENSION STRINGS FOR BUNDLE CONDUCTORS

DESIGN DEPARTMENT

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SPECIFICATION P- :2011

TENSION STRINGS FOR BUNDLE CONDUCTORS BUS FOR GRID STATIONS

0 FOREWORD

- 0.1 This standard has been introduced by NTDC and has been prepared by the office of the Chief Engineer (Design).
- 0.2 This standard is intended only for the purpose of technical specification to facilitate procurement of materials and does not include provision of contract.
- 0.3 This specification is subject to periodic revision and when required.

1 SCOPE

- 1.1 This specification covers the hardware of tension strings for two conductors bundle bus at Substations.

2 TYPE OF TENSION STRINGS

- 2.1 Tension strings described in this specification are of the following types.

Table-I			
Sr. #	Description	String Designation	Conductor OD (mm)
a)	Single Tension String 'HAWTHORN'	ST – H	31.95
b)	Double Tension String for twin bundle 'HAWTHORN'	DTB – H	31.95
c)	Double Tension String for triple bundle 'COREOPSIS'	DTB – C	36.99

- 2.2 The hardware used in the suspension string described above in this specification has been designated by the code numbers. These codes have been assigned in the following manner:
- The first letter 'S' stands for single and 'D' for Double.
 - The second letter 'S' stands for suspension.
 - The next letter 'B' stands for conductor Bundle.
 - The succeeding letters stand for the name of conductor for which the hardware is meant for i.e. 'H' for Hawthorn 'C' Coreopsis.

3 RATINGS OF HARDWARE

- 3.1 The hardware shall be of the ratings as specified in Tables-II, III and IV below:

Table-II
RATINGS OF HARDWRAE FOR SINGLE TENSION SINGLE CONDUCTOR STRING

Sr. #	Description	Failing Load (kN) ST – H
1.	Self Locking Ball Hook	120
2.	Socket Eye for Arcing Horn	120
3.	Bow Shackle	120
4.	Arcing Horn (L/E)	15
5.	Tension Clamp (Compression type)	95% of conductor UTS
6.	Turnbuckle	120

Table-III
RATINGS OF HARDWRAE FOR DOUBLE TENSION TWIN CONDUCTOR STRING

Sr. #	Description	Failing Load (kN) DTB – H
1.	V Shackle	210
2.	Bow Shackle (upper)	210
3.	Yoke Plate (upper)	210
4.	Ball Clevis	120 (per ball clevis)
5.	Socket Clevis for Arcing Horn	120 (per socket clevis)
6.	Bow Shackle (lower)	120 (per bow shackle)
7.	Tension Clamp (Compression type)	95% of conductors UTS
8.	Yoke Plate (bottom)	200
9.	Turnbuckle	120 (per turn buckle)
10.	Arcing Horn (L/E)	15

TABLE – IV
RATINGS OF HARDWRAE FOR DOBLE TENSION TRIPLE CONDUCTOR STRING

Sr. #	Description	Failing Load (kN) DTB - C
1.	Hinge	160 (per hinge)
2.	Bow Shackle	160 (per bow shackle)
3.	Twisted Ball Eye Link For Arcing Horn	160 (per twisted eye link)
4.	Socket Clevis	160 (per socket clevis)
5.	Yoke Plate For Arcing Horn	320
6.	Twisted Clevis Clevis (upper)	320
7.	Yoke Plate (upper)	320
8.	Twisted Clevis Clevis (lower)	320
9.	Yoke Plate (bottom)	320
10.	Twisted Clevis Clevis (lower)	160 (per twisted clevis)
11.	Clevis Clevis (Double Plate Link)	160
12.	Turnbuckle	160 (per turn buckle)
13.	Single Point Arcing Horn (E/E)	15
14.	Arcing Ring	0.44
15.	Tension Clamp (Compression type)	95% of conductors UTS

4 GENERAL REQUIREMENT

4.1 Each single tension string hardware shall consist of the following items:

1. Self-Locking Ball Hook
2. Socket Eye For Arcing Horn
3. Bow Shackle
4. Arcing Horn
5. Tension Clamp (Compression type)
6. Turnbuckle (where required)

4.2 Each double tension twin conductor string hardware shall consist of the following items:

1. Ball Hook/V Shackle
2. Bow Shackle (upper)
3. Yoke Plate (upper)
4. Ball Clevis
5. Socket Clevis for Arcing Horn
6. Bow Shackle Lower
7. Tension Clamp (compression type)
8. Yoke Plate (bottom)
9. Turnbuckle (where required)
10. Arcing Horn

4.3 Each double tension triple conductor string hardware shall consist of the following items:

1. Hinge
2. Bow Shackle
3. Twisted Ball Eye Link For Arcing Horn
4. Socket Clevis
5. Yoke Plate For Arcing Horn
6. Twisted Clevis Clevis (upper)
7. Yoke Plate (upper)
8. Twisted Clevis Clevis (lower)
9. Yoke Plate (bottom)
10. Twisted Clevis Clevis (lower)
11. Clevis Clevis (Double Plate Link)
12. Turnbuckle (where required)
13. Single Point Arcing Horn (Earth End)
14. Arcing Ring
15. Tension Clamp (Compression type)

4.4 The ball and socket shall be of size as per following table and IEC 120. The disc insulators

to be used for these strings shall conform to NTDC Specifications P-8 (latest)

Sr. No.	Conductor	Disc Strength	Coupling Dia
1.	Hawthorn	100 KN	16 mm
2.	Coreopsis	160 KN	20 mm

4.5 All ferrous parts shall be hot dip galvanized in accordance with NTDC Specification P-82 (latest revisions)

4.6 The coupling parts of hardware that mate with each other, shall not have a play of more than 2 mm

5 DIMENSIONS AND TOLERANCES

All hardware shall generally be in accordance with drawings forming a part of this Specification.

The dimensions of these parts of hardware that mate with other hardware or that determine the length of insulator string are binding and are shown enclosed on the drawing.

For dimensions that are fixed and binding the tolerance will be plus or minus 2 percent with a maximum of 0.8 mm. For dimensions that are shown as MAX or MIN there shall be no plus and minus tolerance respectively. The tolerance in the opposite sense may however be 4%.

6 DESIGN AND MATERIAL

6.1 Self-Locking Ball Hook/ V shackle

It shall be made from drop forged steel of suitable grade and shall be hot dip galvanized. The detail dimensions shall be according to Drawing No. 1 and 1 a. The ball when inserted in the Socket should not rotate and in the insulator cap closes a major position on the opening and prevents disconnection from the power as long as the hook is assembled with the insulator.

6.2 Socket Clevis

It shall be made from drop forged steel or malleable iron of suitable grade. It shall be hot dip galvanized and shall be made according to Drawing Nos. 2 and 3.

The socket shall be supplied with a round head rivet and plain washer made from galvanized steel and a split pin with retention clip made from stainless steel.

The clevis shall be supplied with rivet round handled with flat washer and straight split pin. The split pin shall be made from stainless steel.

6.3 Shackles

Shackles shall be of two different types i.e. H.S. (High Strength) and L.S. (Low Strength). The strengths of these shackles shall be as indicated in Table-II above. H.S. type shackle shall be given red coating so as to differentiate from type L.S. and shall be made according to Drawing Nos. 4, 5 and 6.

6.4 Arcing Horns

It shall be made from drop forged steel of suitable grade and shall be hot dip galvanized in accordance with ASTM 153. The dimensions shall preferably in accordance with Nos. 7, 8 and 9.

6.5 Arcing Rings

It shall be made from drop forged steel of suitable grade and shall be hot dip galvanized in accordance with ASTM 153. The dimensions shall preferably in accordance with Drawing No. 10.

6.6 Tension Clamps (compression type)

The tension clamp for aluminum conductors namely, Coreopsis and Hawthorn shall be of compression dead end type. It shall be composed of aluminum body and one galvanized steel terminal without tubular termination. The clamp when assembled shall be capable of developing not less than 95% of the rated minimum failing load as specified in Table-II, and has conductivity not less than that of conductor. The clamp shall be according to Drawing. Nos. 11 and 12.

6.7 Turn Buckle

The turnbuckle for aluminum conductors namely, Coreopsis and Hawthorn shall be made of drop forged steel preferably in accordance with the dimensions in drawing No. of compression dead end type. It shall be composed of aluminum body and one galvanized steel terminal without tubular termination. The clamp when assembled shall be capable of developing not less than 95% of the rated minimum failing load as specified in Table-II, and has conductivity not less than that of conductor. The clamp shall be according to Drawing. Nos. 13 and 14.

6.8 Yoke Plates

Yoke plates shall be of mono block type and shall be made from high grade steel, hot dip galvanized and subject to normalizing process. It shall be made according to Drawing. Nos. 15, 16, 17, 18 and 19.

6.9 Ball Clevis

It shall be made from drop forged steel of suitable grade and shall be hot dip galvanized. It shall be made according to Drawing. No. 20. The clevis shall be supplied with rivet round headed with washer made of galvanized steel. The split pin should be made from stainless steel.

6.10 Hinge

It shall be made from high grade steel of suitable grade and shall be hot dip galvanized. It shall be made according to Drawing. No. 21. The hinge shall be supplied with split pin should be made from stainless steel.

6.11 Twisted Clevis

It shall be made from high grade steel of suitable grade and shall be hot dip galvanized. It shall be made according to Drawing. Nos. 22, 23 and 24. The twisted clevis clevis shall be supplied with split pin should be made from tin plated copper.

6.12 Clevis (Double Plate Link)

It shall be made from high grade steel of suitable grade and shall be hot dip galvanized. It shall be made according to Drawing. No. 25. The Clevis Clevis (Double Plate link) shall be supplied with split pin should be made from tin plated copper.

6.13 Twisted Ball Eye Link For Arcing Horn

It shall be made from high grade steel of suitable grade and shall be hot dip galvanized. It shall be made according to Drawing. No. 26.

7 TESTS

7.1 Type Tests

- 7.1.1 Type tests are intended to verify and establish design characteristics. They shall be made once only on hardware identical in all essential details with those to be supplied.

The following type tests shall be carried out in accordance with clause 10, 11, 12, 13 and 14 in an independent testing laboratory.

i)	Mechanical Test	One each individual item of hardware
ii)	Resistance to Conductor Slippage Test	On Tension Clamp only
iii)	Heat Cycle Test	On Tension Clamp only (if it's current carrying device)
iv)	Resistance Test	On Tension Clamp only
v).	Corona Test	For complete insulator string.

- 7.1.2 The Contractor shall supply heat cycle test result with the bid (applicable for tension clamp if it's a current carrying device).

7.2 Sample Tests

Sample tests shall be made to verify the quality and workmanship.

The following sample test shall be performed in accordance with clause 8, 9, 10, 11, 13 and 15.

i).	Visual Examination	On each item of hardware
ii).	Verification of Dimensions	
iii).	Mechanical test	On Tension Clamp only
iv).	Resistance to Conductor Slippage Test	
v).	Resistance Test	
vi).	Galvanizing Test	On all ferrous parts.

8 VISUAL EXAMINATION

The test samples shall be examined visually for the following defects.

Table-V
Visual Examination

Examination	Defects
Material	Not as specified in relevant Clauses
Construction	Not of the shape given in relevant Drawing. Any part missed.
Finish	Galvanizing not proper, presence of burrs, black and bare spots, dross and projections, which will interfere with proper use of the articles.

9 VERIFICATION OF DIMENSIONS

The binding dimensions of the hardware shall be measured and shall be as shown on the relevant approved drawings subject to the tolerance given in clause 5.

10 MECHANICAL TEST

10.1 For Hardware except arcing horn

The fitting shall be held in tensile testing machine in a manner approximating as nearly as possible to the arrangement to be used in service. A tensile load equal to one-half of the specified minimum failing load equal to one-half of the specified minimum failing load shall be applied and increased at a steady rate. Failure of the fitting shall not occur at a load less than the specified minimum failing load as per Table-II.

11 RESISTANCE TO CONDUCTOR SLIPPAGE TEST

Test piece shall be assembled in accordance with manufacturer's recommendations on conductors of the size and type with which it is to be used. The assembly shall be mounted in a tensile testing machine and anchored in a manner approximating as nearly as possible to the arrangement to be used in service, precautions being taken to avoid bird caging of the conductor.

The length of conductor joint in the test assembly should preferably be not less than 100 times the overall diameter of the conductor.

A tensile load of about 50% of the minimum failing load as specified in table-II shall be applied and the conductor shall be marked in such a way that movement relative to the fitting can easily be detected, without any subsequent adjustment of the fitting, the load shall be steadily increased to 95% of the minimum failing load and then reduced to 90% of the minimum failing load and maintained for 1 minute. There shall be no movement of the conductor relative to the fitting due to slip during this 1 minute period and no failure of the fitting.

12 HEAT CYCLES TEST

The test current shall be that power frequency current which raises the surface temperature of the conductor 40 deg C above 40° C ambient temperature and maintains the temperature at a steady value. The minimum length of conductor used for determining this current shall be 2 meters and the conductor temperature shall be measured near the center of the test length. Only applicable if tension clamp is a current carrying device.

The joint shall be assembled in accordance with the manufacturer's recommendations on conductor of the size and type with which it is to be used. The assembly, to which a tensile load not exceeding 20% of the rated minimum failing load as specified in Table-II may be applied, shall be directed indoors so that the conductor is roughly horizontal. Air shall be able to circulate freely round the assembly which shall not however be exposed to draughts. The minimum length of conductor on each side of the fitting shall be 2 meters.

The test current shall be passed continuously through the assembly for a period of 30 min. The current shall then be interrupted, and the assembly shall be allowed to cool to within 5 deg C. above the ambient temperature. The sequence of operation shall be repeated so that 250 cycles of heating and cooling are applied.

During the last five cycles, the maximum temperature, measured when the test current is flowing, at any points on the surface of the fittings, shall not exceed that of the conductor. At the end of the test the joint shall meet, the requirements of the resistance test specified above. There shall be no sign of local heating, burning or fusing of any part of the joint or of the conductor.

13 RESISTANCE TEST

Test piece shall be assembled in accordance with the manufacturer's recommendations on the conductors of the size and type with which it is to be used. The electrical resistance shall be measured between points on the conductor on either side and just

clear of the fitting and shall not exceed 75% of the measured resistance of the equivalent length of conductor.

The test may be made with direct current or with alternating current at any convenient power frequency. The current connections shall be at a distance not less than 50 times the diameter of the conductor from the fitting and shall be so made that effective contact is made with all these strands of the conductor which would be taken into account in calculating its equivalent resistance.

14 CORONA TEST

Typical insulator sets completely assembled with all fittings shall be set up in a manner as nearly as possible to the arrangement to be used in service with not less than 3 meters of conductor. A voltage of 160 KV shall be applied between the conductor and earth for five minutes during which time no corona formation shall be visible or audible with the room in complete darkness.

15 GALVANIZING TEST

This test shall be carried out on all ferrous parts complying with the following with the following requirements.

- i) Weight of zinc coating
- ii) Uniformity of zinc coating
- iii) Adherence of zinc coating

This test shall be performed in accordance with NTDC Specification P- 82(latest revision).

16 SAMPLING PLAN - ACCEPTANCE AND REJECTION

- i) Sampling sizes are designated by code letters. Table-III shall be used to find the applicable code letter for the particular lot or batch size for various tests specified in this specification. While the number of units of product from each lot or batch which are to be inspected (sample size) and the criteria for determining the acceptability of the lot or batch (acceptance and rejection numbers) for different code letters can be obtained from the table-IV given below.
- ii) The number of sample units inspected shall be equal to the first sample size given in Table-IV. If the number of defective units found in the first sample is equal to or less than the first acceptance number, the lot shall be acceptable. If the number of defectives found in the first sample is equal to or greater than the first rejection number, the lot shall be rejected. If the number of defectives found in the first sample is between the first acceptance and rejection number, second sample of the size given by the plan shall be inspected. The No. of defectives found in the first and

the second samples shall be accumulated. If the cumulative ---- of defectives is equal to or less than the second acceptance number the lot shall be acceptable. If the cumulative No. of defectives is equal to or greater than the second rejection number, the lot shall be rejected.

TABLE – VI
Sample Size

Lot or Batch Size	Sample size for test specified in clause 10,11,13 & 15	Sample size for dimensional and finish defects
2 to 8	A	A
9 to 15	A	B
16 to 25	A	C
26 to 50	A	D
51 to 90	B	E
91 to 150	B	F
151 to 280	B	G
281 to 500	B	H
501 to 1200	C	J

TABLE – IV
Sample Acceptance Criteria

Sample Size code letters	Sample	Sample Size	Cumulative sample size	Acceptance Number	Rejection Numbers
A	First Second	1 -	1 -	0 -	1 0
B	First Second	2 2	2 4	0 1	2 2
C	First Second	3 3	3 6	0 1	2 2
D	First Second	5 5	5 10	0 1	2 2
E	First Second	8 8	8 16	0 1	2 2
F	First Second	13 13	13 26	0 3	3 4
G	First Second	20 20	20 40	1 4	4 5
H	First Second	32 32	32 64	2 6	5 7
J	First Second	50 50	50 100	3 8	7 9

17 MARKING AND PACKING

The material shall be packed in wooden crates for export shipment to permit convenient

handling and to protect against loss permit damage to final destination. Containers (Wooden Crates) shall be designed for handling by fork lift, truck and by slings around the container. The weight of each package should be between 100 and 150 kg.

Packages shall be designed for rough handling. All wooden crates shall be clearly marked to indicate

1. Quantity
2. Name of hardware item
3. Manufacturer's Name

All packages shall be numbered consecutively so that total shipment can be readily determined.

18 INFORMATION TO BE SUPPLIED

The following information shall be supplied with the bid and failure to supply the same may subject the bid to disqualification.

- i) Detailed fully dimensioned drawings of hardware for Tension Strings
- ii) Specification giving material grade and composition of all items of hardware.
- iii) Catalogues/literature of standardized items
- iv) Test certificates
- v) One complete sample of hardware for all types of Tension Strings.
- vi) Detail of manufacturing & testing facilities available with manufacturers.

19 DRAWINGS

The following drawings form the part of this Specification.

S. No.	Description	Drawing No.
1	Self-locking Ball Hook	1
2	V Shackle	1a
3	Socket Eye/Clevis For Arcing Horn	2 & 3
4	Bow Shackle	4, 5, 6
5	Arcing Horn (L/E)	7 & 8,
6	Arcing Horn (E/E)	9
7	Arcing Ring	10
8	Tension Clamp (Compression Type)	11 & 12
9	Turnbuckle	13 & 14
10	Yoke Plate	15, 16, 17, 18 & 19
11	Ball Clevis	20
12	Hinge	21
13	Twisted Clevis	22, 23, & 24
14	Clevis (Double Plate Link)	25
15	Twisted Ball Eye Link For Arcing Horn (E/E)	26

**Draft Reference Drawings for 132 kV, 220 kV and 500 KV
Tension Strings
(For Tendering Purpose only)**

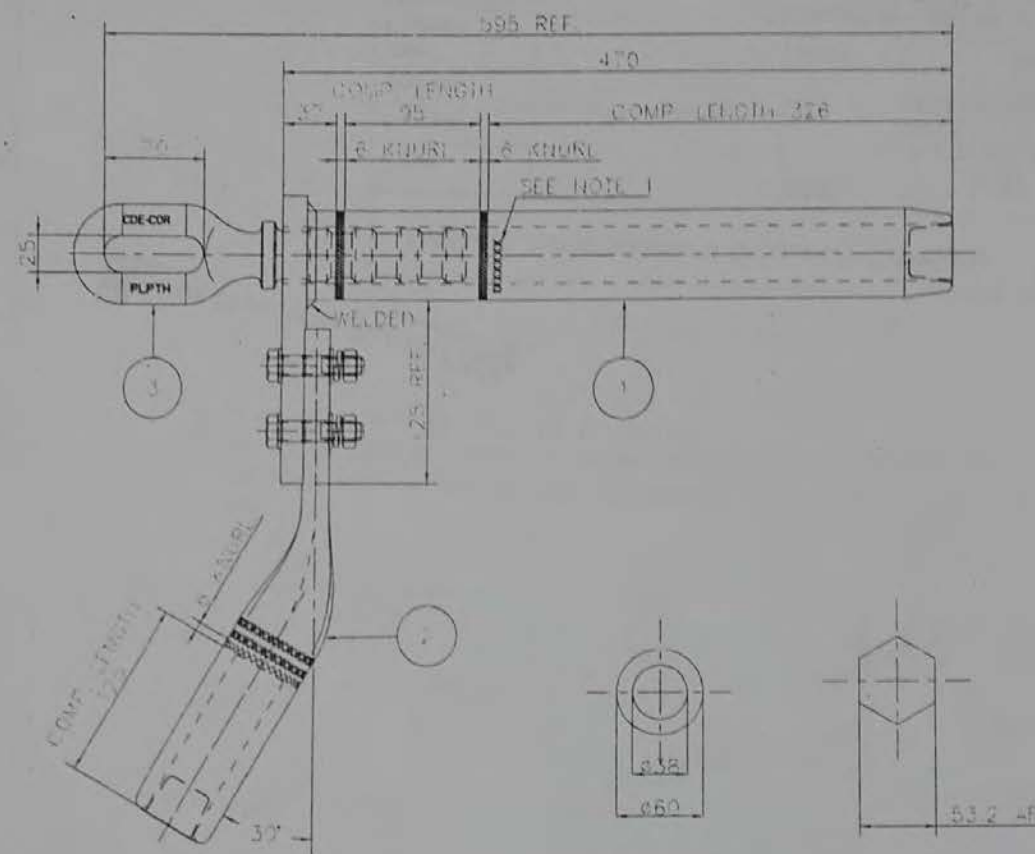
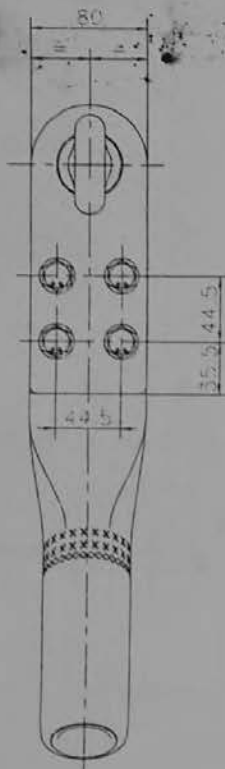
For WB-05A-2019 Only

SCHEDULE OF TECHNICAL DATA FOR							
SINGLE TENSION SINGLE CONDUCTOR STRING ASSEMBLY							
		132kV SINGLE TENSION SINGLE COND WITH TUTNBUCKLE			132kV SINGLE TENSION SINGLE COND WITHOUT TUTNBUCKLE		
Sr. No.	Description	Value Required	Value Offered	Unit	Value Required	Value Offered	Unit
1	i) Manufacturer's Name and Address						
	ii) Standard followed	Wapda Specification / IEC			Wapda Specification / IEC		
2	Self Locking Ball Hook	Drwg No.			Drwg No.		
	i) Ball size (Type-A)	16		mm	16		mm
	ii) Hook opening	22		mm	22		mm
	iii) Failing Load	120		kN	120		kN
3	Socket Eye for A/H	Drwg No.			Drwg No.		
	i) Socket size	16		mm	16		mm
	ii) Eye Size	17.5		mm	17.5		mm
	iii) Eye Thickness	22		mm	22		mm
	iv) Failing Load	120		kN	120		kN
4	Arcing Horn	Drwg No.			Drwg No.		
	i) Length (A)	300		mm	300		mm
	ii) Length (B)	120		mm	120		mm
	iii) Dia	19		mm	19		mm
	iv) Failing Load	15		kN	15		kN
5	Bow Shackle	Drwg No.			Drwg No.		
	i) Shackle Opening 'A'	25		mm	25		mm
	ii) Pin Dia 'B'	16		mm	16		mm
	iii) Height 'C'	73		mm	73		mm
	iv) Radius 'D'	20		mm	20		mm
	v) Shackle Thickness 'E'	16		mm	16		mm
	vi) Failing Load	120		kN	120		kN
6	Tension Clamp (Compression Type)	Drwg No.			Drwg No.		
6.1	a) Eye	HAWTHORN			HAWTHORN		
	i) Eye Opening	25-70		mm	25-70		mm
	ii) Thickness of Eye	21		mm	21		mm
	iii) Failing load	95% of Conductor		%	95% of Conductor		%
	b) Aluminium Body						
	i) Inner dia	34		mm	34		mm
	ii) Outer dia	54		mm	54		mm
	iii) Length	515mm (before comp.)		mm	515mm (before comp.)		mm
	iv) Dia size	46mm. A/F		mm	46mm. A/F		mm
	v) Failing load	95% of conductor		%	95% of conductor		%
	vi) Heat cycle test	Applicable only for Current carrying part			Applicable only for Current carrying part		
6.2	Turnbuckle	Drwg No.			N/A		
	i) Eye Opening	25		mm			
	ii) Clevis Opening	25		mm			
	iii) Rivet Pin Dia	16 - Rivet Type		mm			
	iv) Adjusted Length	500-740		mm			
	v) Failing load	120		kN			
7	Drawing No. (attach with bid)						
8	Disc insulator (ball, socket type)	IEC 120/16			IEC 120/16		

SCHEDULE OF TECHNICAL DATA FOR DOUBLE TENSION TWIN CONDUCTOR STRING ASSEMBLY								
			132kV DOUBLE TENSION TWIN COND WITHOUT TURNBUCKLE			132kV DOUBLE TENSION TWIN COND WITH TURNBUCKLE		
Sr.No.		Description	Value Required	Value Offered	Unit	Value Required	Value Offered	Unit
1	i)	Manufacturer's Name and Address						
	ii)	Standard followed	Wapda Specification / IEC			Wapda Specification / IEC		
2		<u>Socket Clevis for A/H</u>	Drwg No.			Drwg No.		
	i)	Socket size	16		mm	16		mm
	ii)	Rivet Pin Dia	16		mm	16		mm
	iii)	Clevis Opening	20		mm	20		mm
	iv)	Failing Load	120		kN	120		kN
3		<u>Ball Clevis</u>	Drwg No.			Drwg No.		
	i)	Ball size	16		mm	16		mm
	ii)	Rivet Pin Dia	16		mm	16		mm
	iii)	Clevis Opening	22		mm	22		mm
	iv)	Failing Load	120		kN	120		kN
4		<u>Arcing Horn</u>	Drwg No.			Drwg No.		
	i)	Length (A)	286		mm	286		mm
	ii)	Length (B)	120		mm	120		mm
	iii)	Dia	19		mm	19		mm
	v)	Failing Load	15		kN	15		kN
5		<u>Bow Shackle (Lower)</u>	Drwg No.			Drwg No.		
	i)	Shackle Opening 'A'	25		mm	25		mm
	ii)	Pin Dia 'B'	16		mm	16		mm
	iii)	Height 'C'	73		mm	73		mm
	iv)	Radius 'D'	20		mm	20		mm
	v)	Shackle Thickness 'E'	16		mm	16		mm
	vi)	Failing Load	120		kN	120		kN
6		<u>Bow Shackle (upper)</u>	Drwg No.			Drwg No.		
	i)	Shackle Opening 'A'	27		mm	27		mm
	ii)	Pin Dia 'B'	22		mm	22		mm
	iii)	Height 'C'	92		mm	92		mm
	iv)	Radius 'D'	22		mm	22		mm
	v)	Shackle Thickness 'E'	22		mm	22		mm
	vi)	Failing Load	210		kN	210		kN
7		<u>Ball Hook/V-Shackle</u>	Drwg No.			Drwg No.		
	i)	Shackle Opening 'A'	66		mm	66		mm
	ii)	Pin Dia 'B'	20		mm	20		mm
	iii)	Height 'C'	195		mm	195		mm
	iv)	Radius 'D'	16		mm	16		mm
	v)	Shackle Thickness 'E'	20		mm	20		mm
	vi)	Failing Load	210		kN	210		kN
8		<u>Yoke Plate (Upper)</u>	Drwg No.			Drwg No.		
	i)	Dimensions (A to C)	(400,76,19)		mm	(400,76,19)		mm
	ii)	Failing Load min.	210		kN	210		kN
9		<u>Yoke Plate (bottom)</u>	Drwg No.			Drwg No.		
	i)	Hole Spacing	400 -76		mm	400 -76		mm
	ii)	Thickness	16		mm	16		mm
	iii)	Failing Load	210		kN	210		kN
10		<u>Tension Clamp (Compression Type)</u>	Drwg No.			Drwg No.		
		<u>HAWTHORN</u>				<u>HAWTHORN</u>		
	a)	<u>Eye</u>						
	i)	Eye Opening	25-70		mm	25-70mm.		mm
	ii)	Thickness of Eye	21		mm	21mm.		mm
	iii)	Failing load	95% of conductor		%	95% of conductor		%
	b)	<u>Aluminium Body</u>						
	i)	Inner dia	34		mm	34mm.		mm
	ii)	Outer dia	54		mm	54mm.		mm
	iii)	Length	515mm (before comp.)		mm	515mm (before comp.)		mm
	iv)	Dia size	46mm. A/F		mm	46mm. A/F		mm
	v)	Failing load	95% of conductor		%	95% of conductor		%
	vi)	Heat cycle test	Applicable only for Current carrying part			Applicable only for Current carrying part		
	vii)	<u>Turnbuckle</u>	N/A			Drwg No.		
	i)	Eye Opening				25		mm
	ii)	Clevis Opening				25		mm
	iii)	Rivet Pin Dia				16-Rivet Type		mm
	iv)	Adjusted Length				500-740		mm
	v)	Failing load				120		kN
11		Drawing No. (attach with bid)						
12		Disc insulator (ball, socket type)	IEC 120/16			IEC 120/16		
13		No. of packages to be shipped						
14		Weight of each package						

SCHEDULE OF TECHNICAL DATA FOR							
DOUBLE TENSION TWIN CONDUCTOR STRING ASSEMBLY							
		220 kV DOUBLE TENSION TWIN COND WITHOUT TURNBUCKLE			220 kV DOUBLE TENSION TWIN COND WITH TURNBUCKLE		
Sr.No.	Description	Value Required	Value Offered	Unit	Value Required	Value Offered	Unit
1	i) Manufacturer's Name and Address						
	ii) Standard followed	Wapda Specification / IEC			Wapda Specification / IEC		
4	Socket Clevis for A/H	Drwg No.			Drwg No.		
	i) Socket size	16		mm	16		mm
	ii) Rivet Pin Dia	16		mm	16		mm
	iii) Clevis Opening	20		mm	20		mm
	iv) Failing Load	120		kN	120		kN
5	Ball Clevis	Drwg No.			Drwg No.		
	i) Ball size	16		mm	16		mm
	ii) Rivet Pin Dia	16		mm	16		mm
	iii) Clevis Opening	22		mm	22		mm
	iv) Failing Load	120		kN	120		kN
6	Arising Horn	Drwg No.			Drwg No.		
	i) Length (A)	350		mm	350		mm
	ii) Length (B)	123		mm	123		mm
	iii) Dia	27 (Pipe)		mm	27 (Pipe)		mm
	iv) Failing Load	15		kN	15		kN
7	Bow Shackle (lower)	Drwg No.			Drwg No.		
	i) Shackle Opening 'A'	25		mm	25		mm
	ii) Pin Dia 'B'	16		mm	16		mm
	iii) Height 'C'	73		mm	73		mm
	iv) Radius 'D'	20		mm	20		mm
	v) Shackle Thickness 'E'	16		mm	16		mm
	vi) Failing Load	120		kN	120		kN
8	Bow Shackle (upper)	Drwg No.			Drwg No.		
	i) Shackle Opening 'A'	27		mm	27		mm
	ii) Pin Dia 'B'	22		mm	22		mm
	iii) Height 'C'	92		mm	92		mm
	iv) Radius 'D'	22		mm	22		mm
	v) Shackle Thickness 'E'	22		mm	22		mm
	vi) Failing Load	210		kN	210		kN
9	Ball Hook/V-Shackle	Drwg No.			Drwg No.		
	i) Shackle Opening 'A'	66		mm	66		mm
	ii) Pin Dia 'B'	20		mm	20		mm
	iii) Height 'C'	195		mm	195		mm
	iv) Radius 'D'	16		mm	16		mm
	v) Shackle Thickness 'E'	20		mm	20		mm
	vi) Failing Load	210		kN	210		kN
10	Yoke Plate (Upper)	Drwg No.			Drwg No.		
	i) Dimensions (A to C)	(400,76,19)		mm	(400,76,19)		mm
	ii) Failing Load min.	210		kN	210		kN
11	Yoke Plate (Bottom)	Drwg No.			Drwg No.		
	i) Hole Spacing	400-76		mm	400-76		mm
	ii) Thickness	16		mm	16		mm
	iii) Failing Load	200		kN	200		kN
12	Tension Clamp (Compression Type)	Drwg No.			Drwg No.		
12.1	a) Eye	HAWTHORN			HAWTHORN		
	i) Eye Opening	25-70		mm	25-70		mm
	ii) Thickness of Eye	21		mm	21		mm
	iii) Failing load	95% of conductor		%	95% of conductor		%
	b) Aluminium Body						
	i) Inner dia	34		mm	34		mm
	ii) Outer dia	54		mm	54		mm
	iii) Length	515mm (before comp.)		mm	515mm (before comp.)		mm
	iv) Dia size	46mm. A/F		mm	46mm. A/F		mm
	v) Failing load	95% of conductor		%	95% of conductor		%
	vi) Heat cycle test	Applicable only for Current carrying part			Applicable only for Current carrying part		
12.2	Turnbuckle	N/A			Drwg No.		
	i) Eye Opening				25		mm
	ii) Clevis Opening				25		mm
	iii) Rivet Pin Dia				16 Dome Nut Type		mm
	iv) Adjusted Length				500-740		mm
	v) Failing load				120		kN
13	Drawing No. (attach with bid)						
14	Disc insulator (ball, socket type)	IEC 120/16			IEC 120/16		

SCHEDULE OF TECHNICAL DATA FOR							
DOUBLE TENSION TRIPLE CONDUCTOR STRING ASSEMBLY							
		500 kV DOUBLE TENSION TRIPLE COND WITHOUT TURNBUCKLE			500 kV DOUBLE TENSION TRIPLE COND WITH TURNBUCKLE		
Sr. No.	Information Required	Value Required	Value Offered	Unit	Value Required	Value Offered	Unit
1	i) Manufacturer's Name and Address						
2	ii) Standard followed	Wapda Specification / IEC			Wapda Specification / IEC		
3	Dimension of tension string:	Drwg No.			Drwg No.		
i)	Dimensions (please see attach drawing)			mm			mm
ii)	Failing Load min. UTS	320		KN	320		KN
4	Hinge	Drwg No.			Drwg No.		
i)	Clevis opening	25		mm	25		mm
ii)	Failing Load min.	160		KN	160		KN
5	Bow Shackle	Drwg No.			Drwg No.		
i)	Shackle Opening 'A'	27		mm	27		mm
ii)	Pin Dia 'B'	20		mm	20		mm
iii)	Height 'C'	84		mm	84		mm
iv)	Radius 'D'	23		mm	23		mm
v)	Shackle Thickness 'E'	20		mm	20		mm
vi)	Failing Load	160		KN	160		KN
6	Twisted Ball Eye Link for Arcing Horn	Drwg No.			Drwg No.		
i)	Eye opening	30		mm	30		mm
ii)	Thickness of eye	20		mm	20		mm
iii)	Ball size	20		mm	20		mm
iv)	Failing Load	210		KN	210		KN
7	Socket Clevis	Drwg No.			Drwg No.		
i)	Socket size	20		mm	20		mm
ii)	Rivet Pin Dia	20		mm	20		mm
iii)	Clevis Opening	24		mm	24		mm
iv)	Failing Load	210		KN	210		KN
8	Yoke Plate for Arcing Horn	Drwg No.			Drwg No.		
i)	Dimensions (A to C)	(400,110,22)		mm	(400,110,22)		mm
ii)	Failing Load min.	320		KN	320		KN
9	Twisted Clevis Clevis (upper)	Drwg No.			Drwg No.		
i)	Rivet Pin Dia	24		mm	24		mm
ii)	Clevis Opening	26		mm	26		mm
iii)	Failing Load	320		KN	320		KN
10	Yoke Plate (Upper)	Drwg No.			Drwg No.		
i)	Dimensions (A to C)	(285,70,22)		mm	(285,70,22)		mm
ii)	Failing Load min.	320		KN	320		KN
11	Twisted Clevis Clevis (lower)	Drwg No.			Drwg No.		
i)	Rivet Pin Dia	19		mm	19		mm
ii)	Clevis Opening	24		mm	24		mm
iii)	Failing Load	160		KN	160		KN
12	Yoke Plate (bottom)	Drwg No.			Drwg No.		
i)	Dimensions (A to C)	(330,100,20)		mm	(330,100,20)		mm
ii)	Failing Load min.	320		KN	160		KN
13	Clevis Clevis (Double plate link)	Drwg No.			Drwg No.		
i)	Rivet Pin Dia	19		mm	19		mm
ii)	Clevis Opening	25		mm	25		mm
iii)	Failing Load	320		KN	320		KN
14	Twisted Clevis Clevis (lower)	Drwg No.			Drwg No.		
i)	Rivet Pin Dia	16		mm	16		mm
ii)	Clevis Opening	22		mm	22		mm
iii)	Failing Load	160		KN	160		KN
15	Turnbuckle	N/A			Drwg No.		
i)	Eye Opening				25		mm
ii)	Clevis Opening				25		mm
iii)	Rivet Pin Dia				16		mm
iv)	Adjusted Length				500-740		mm
v)	Failing load				160		kN
16	Tension Clamp (Compression Type)	Drwg No.			Drwg No.		
		COREOPSIS			COREOPSIS		
a)	Eye						
i)	Eye Opening	25		mm	25		mm
ii)	Thickness of Eye	21		mm	21		mm
iii)	Failing load	95% of conductor		%	95% of conductor		%
b)	Aluminium Body						
i)	Inner dia	38		mm	38		mm
ii)	Outer dia	60		mm	60		mm
iii)	Length	595		mm	595		mm
iv)	Dia size	53.2		mm	53.2		mm
v)	Failing load	95% of conductor		%	95% of conductor		%
vii)	Heat cycle test	Applicable only for Current carrying part			Applicable only for Current carrying part		
17	Line end Arcing Ring	Drwg No.			Drwg No.		
i)	Length (A,B)	(969.5 , 144)		mm	(969.5 , 144)		mm
ii)	Dia	28.5		mm	28.5		mm
18	Earth end Arcing Horn	Drwg No.			Drwg No.		
i)	Length (A,B)	(650 , 350)		mm	(650 , 350)		mm
ii)	Dia	27		mm	27		mm



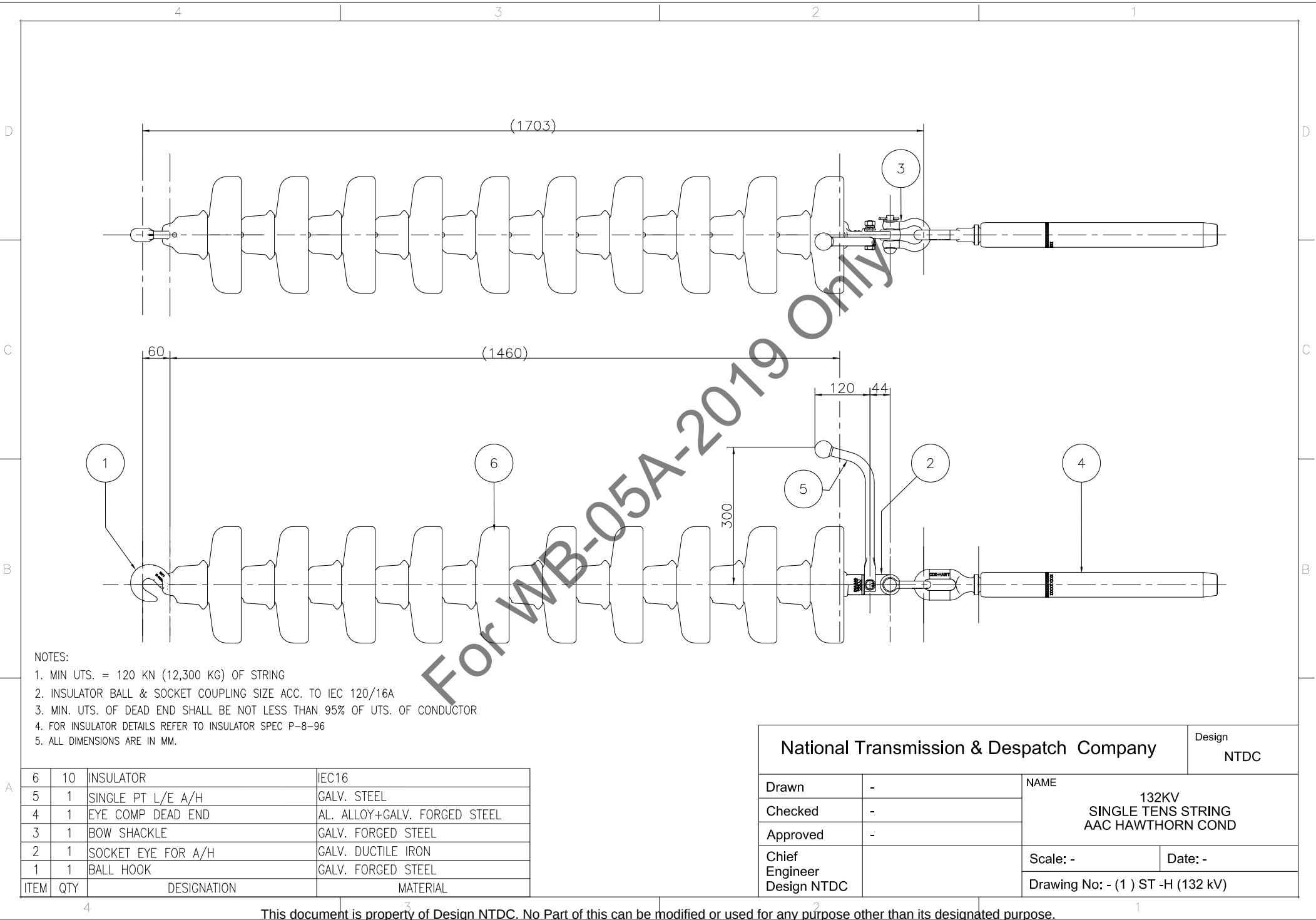
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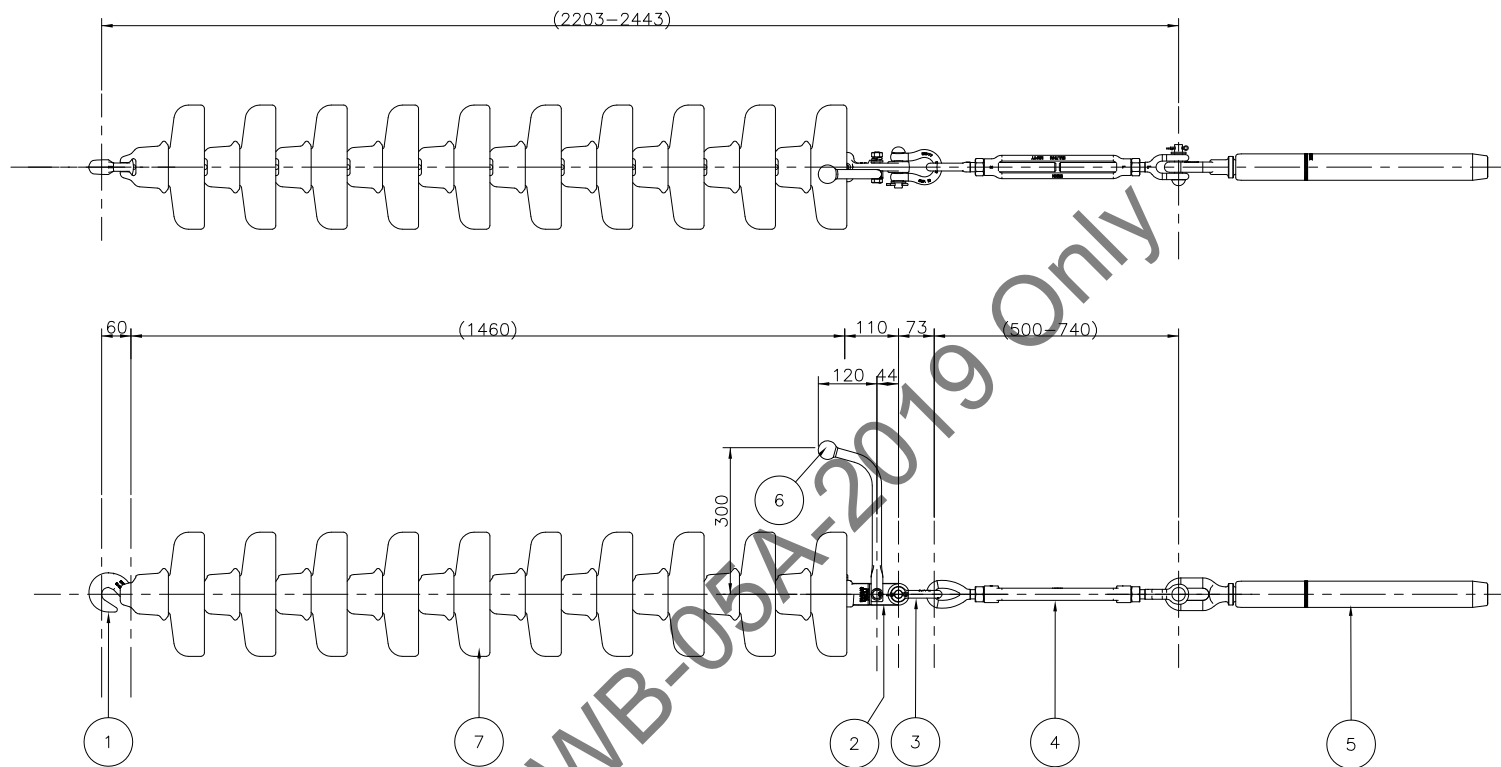
1. BOLT & NUT TIGHTENING TORQUE 45 Nm.
2. SLEEVE SHALL BE FACTORY PREFILLED WITH OXIDE INHIBITING COMPOUND AND SEALED.
3. MIN. UTS. OF DEAD END = 95% OF UTS OF CONDUCTOR
4. ALL FERROUS METAL PARTS SHALL BE HOT-DIP GALVANIZED IN ACCORDANCE WITH ASTM A 153.

Reference Drawing for Tendering Only

National Transmission & Despatch Company			Design
			NTDC
Drawn	-	NAME	
Checked	-	EYE COMP. DEAD END ASSY	
Approved	-	810SGMM COREOPSIS AAC	
Chief Engineer		Scale: -	Date: -
Design NTDC		Drawing No: -	

ITEM	QTY	DESIGNATION	MATERIAL
3	1	EYE TAIL	GALV. FORGED STEEL
2	1	JUMPER TERMINAL	ALUMINIUM + GALV. STEEL
1	1	BODY	AL. ALLOY (GRADE 1050 T1)



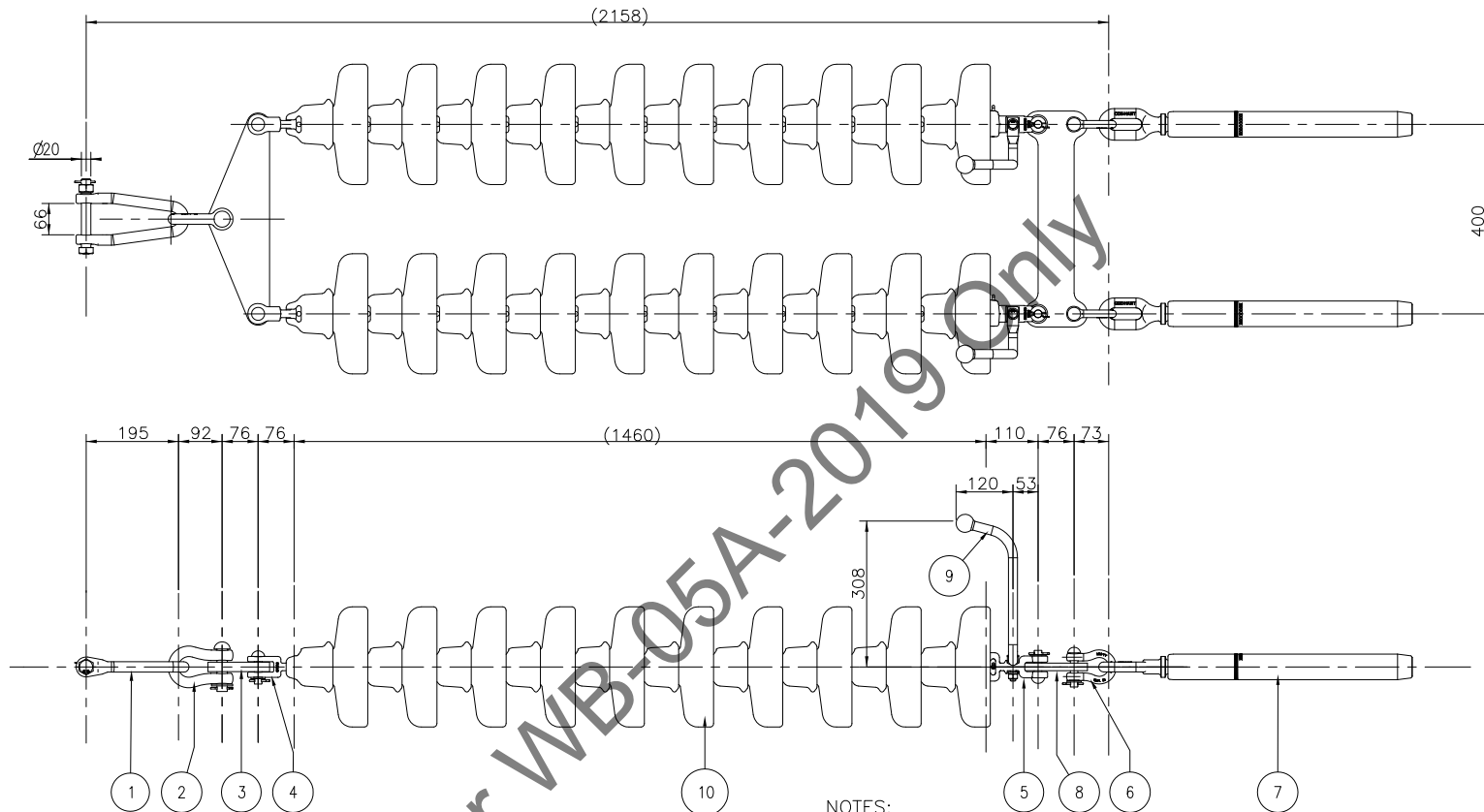


NOTES:

1. MIN UTS. = 120 KN (12,300 KG) OF STRING
2. INSULATOR BALL & SOCKET COUPLING SIZE ACC. TO IEC 120/16A
3. MIN. UTS. OF DEAD END SHALL BE NOT LESS THAN 95% OF UTS. OF CONDUCTOR
4. FOR INSULATOR DETAILS REFER TO INSULATOR SPEC P-8-96
5. ALL DIMENSIONS ARE IN MM.

7	10	INSULATOR	IEC16
6	1	SINGLE PT L/E A/H	GALV. STEEL
5	1	EYE COMP DEAD END	AL. ALLOY+GALV. FORGED STEEL
4	1	CLEVIS-EYE TURNBUCKLE	GALV. FORGED STEEL
3	1	BOW SHACKLE	GALV. FORGED STEEL
2	1	SOCKET EYE FOR A/H	GALV. DUCTILE IRON
1	1	BALL HOOK	GALV. FORGED STEEL
ITEM	QTY	DESIGNATION	MATERIAL

National Transmission & Despatch Company			Design NTDC
Drawn	-	NAME 132KV SINGLE TENS STRING (ADJ) AAC HAWTHORN COND	
Checked	-		
Approved	-		
Chief Engineer Design NTDC		Scale: -	Date: -
		Drawing No: - (2) - ST - H (132 kV)	

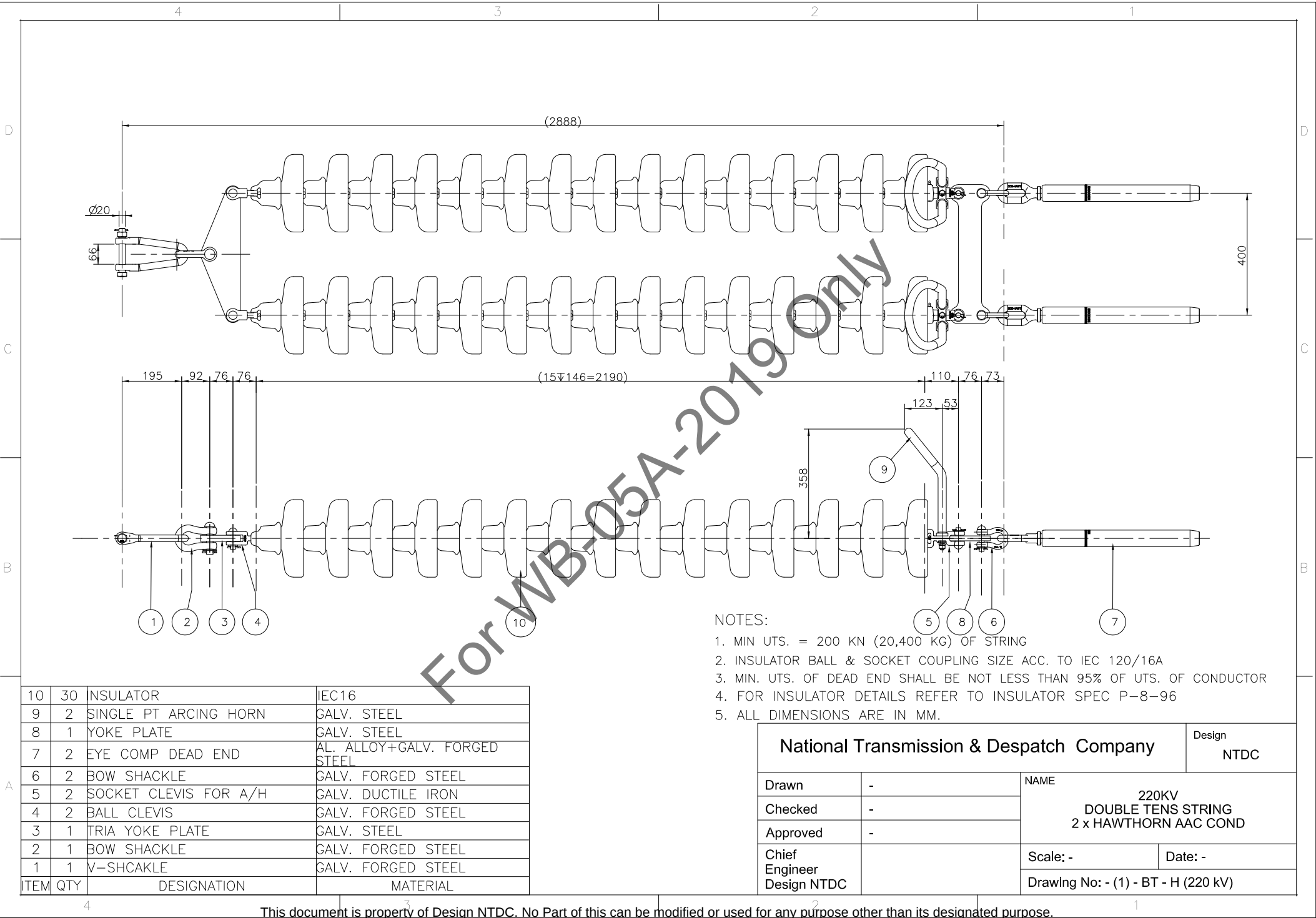


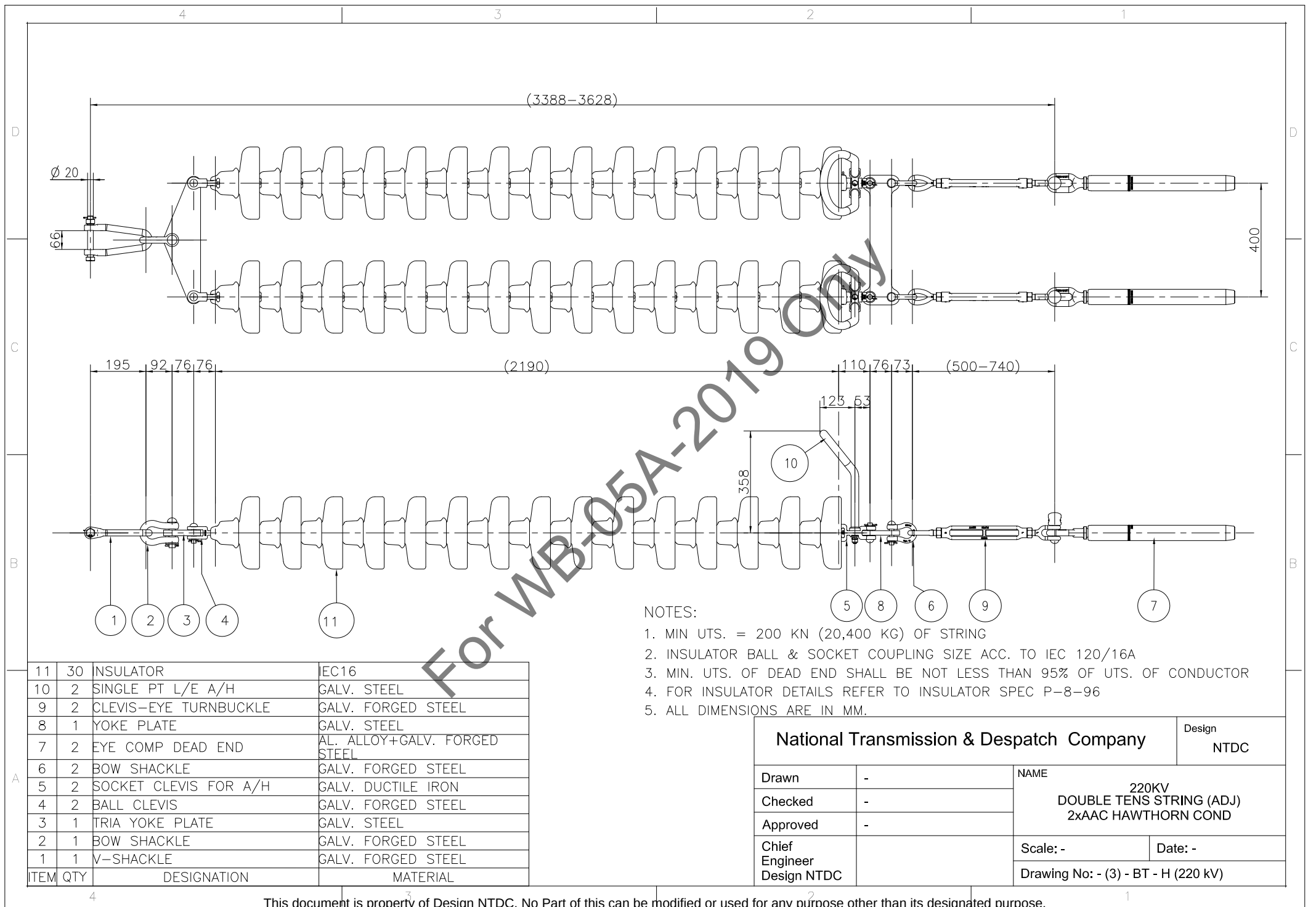
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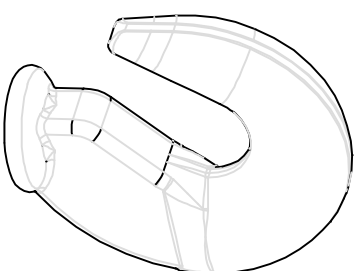
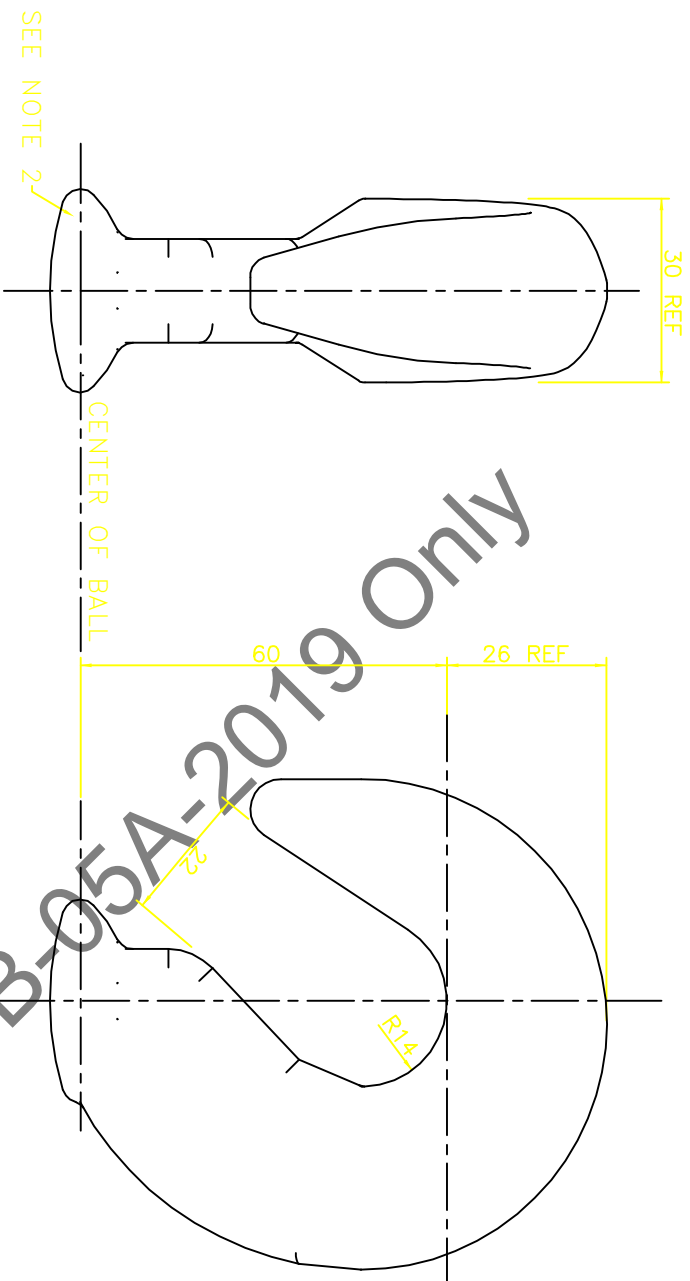
1. MIN UTS. = 200 KN (20,400 KG) OF STRING
2. INSULATOR BALL & SOCKET COUPLING SIZE ACC. TO IEC 120/16A
3. MIN. UTS. OF DEAD END SHALL BE NOT LESS THAN 95% OF UTS. OF CONDUCTOR
4. FOR INSULATOR DETAILS REFER TO INSULATOR SPEC P-8-96
5. ALL DIMENSIONS ARE IN MM.

10	20	INSULATOR	IEC16
9	2	SINGLE PT L/E A/H	GALV. STEEL
8	1	YOKE PLATE	GALV. STEEL
7	2	EYE COMP DEAD END	AL. ALLOY+GALV. FORGED STEEL
6	2	BOW SHACKLE	GALV. FORGED STEEL
5	2	SOCKET CLEVIS FOR A/H	GALV. DUCTILE IRON
4	2	BALL CLEVIS	GALV. FORGED STEEL
3	1	TRIA YOKE PLATE	GALV. STEEL
2	1	BOW SHACKLE	GALV. FORGED STEEL
1	1	V-SHACKLE	GALV. FORGED STEEL
ITEM	QTY	DESIGNATION	MATERIAL

National Transmission & Despatch Company		Design NTDC	
Drawn	-	NAME 132KV DOUBLE TENS STRING 2xAAC HAWTHORN COND	
Checked	-		
Approved	-		
Chief Engineer Design NTDC		Scale: -	Date: -
		Drawing No: - (1) BT- H (132 kV)	







3D VIEW

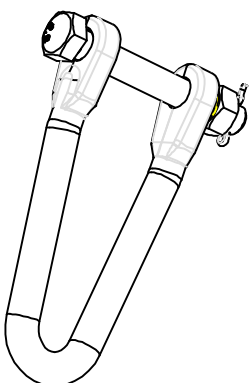
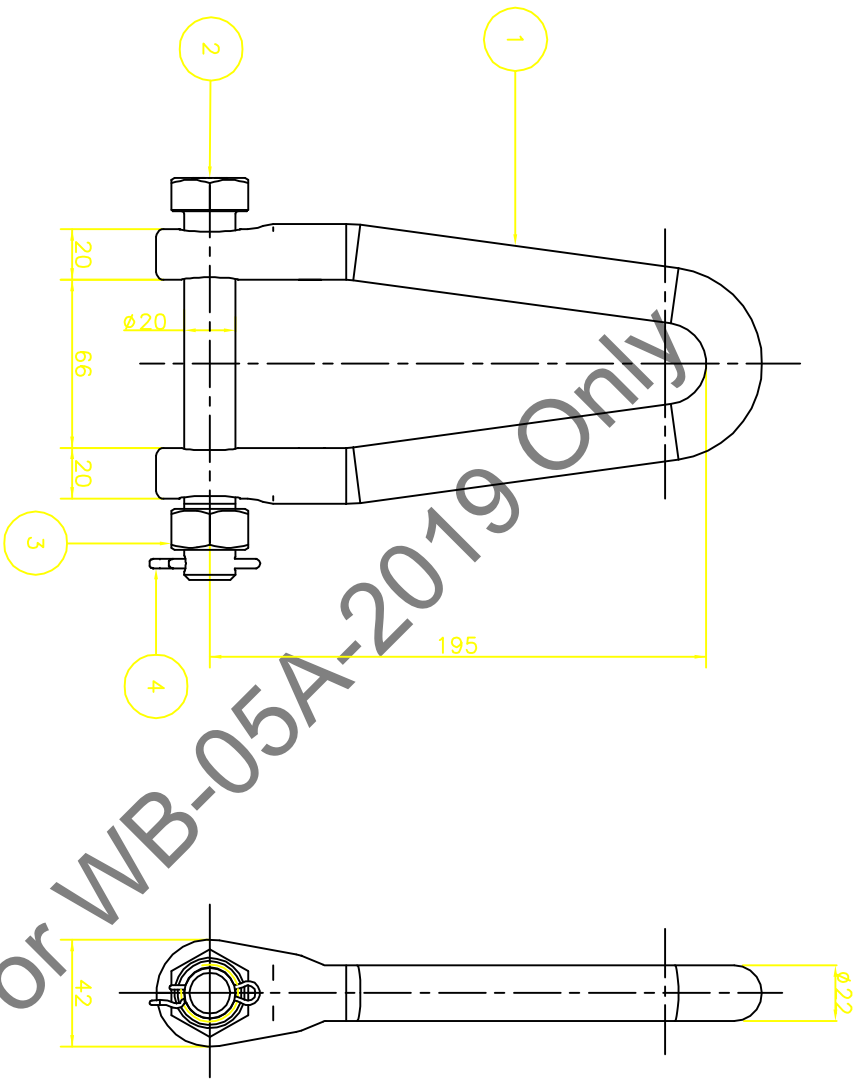
For WB-05A-2019 Only

NOTES

1. MARKED : Manufacturer Name
MONTH/YEAR OF MANUFACTURE
2. BALL DIMENSIONS SHALL GENERALLY BE AS PER IEC PUB120-16A TO EXTENT POSSIBLE TO COMPLY WITH SELF LOCKING FEATURE
3. MIN. UTS. 120 KN. (12,300 KG.)
4. ALL FERROUS METAL SHALL BE HOT-DIP GALVANIZED IN ACCORDANCE WITH ASTM A153.

1	1	BALL HOOK	GALV. FORGED STEEL	MATERIAL
ITEM	QTY	DESIGNATION		

National Transmission & Despatch Company			Design NTDC
Drawn	-	NAME	16MM SELF LOCK BALL HOOK
Checked	-		
Approved	-		
Chief Engineer Design NTDC		Scale: -	Date: -
		Drawing No: - 1	



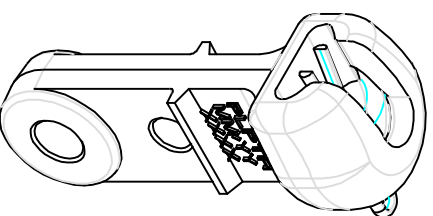
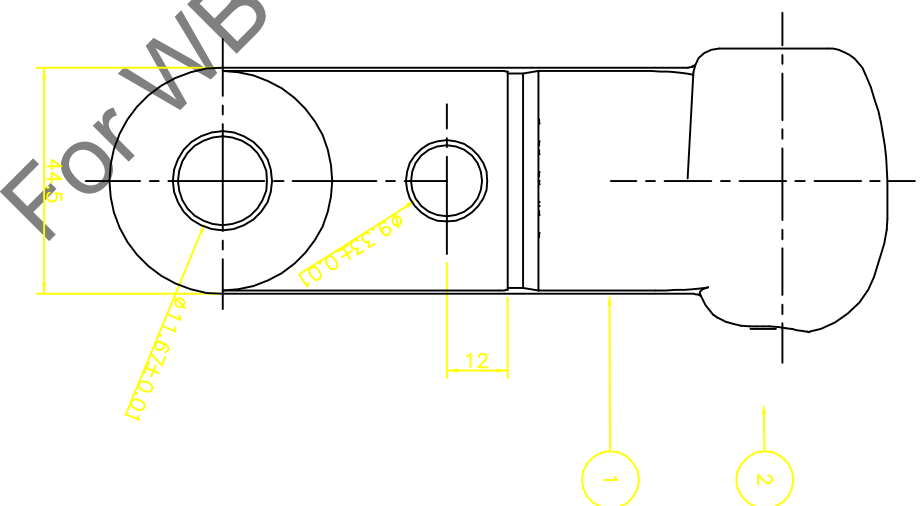
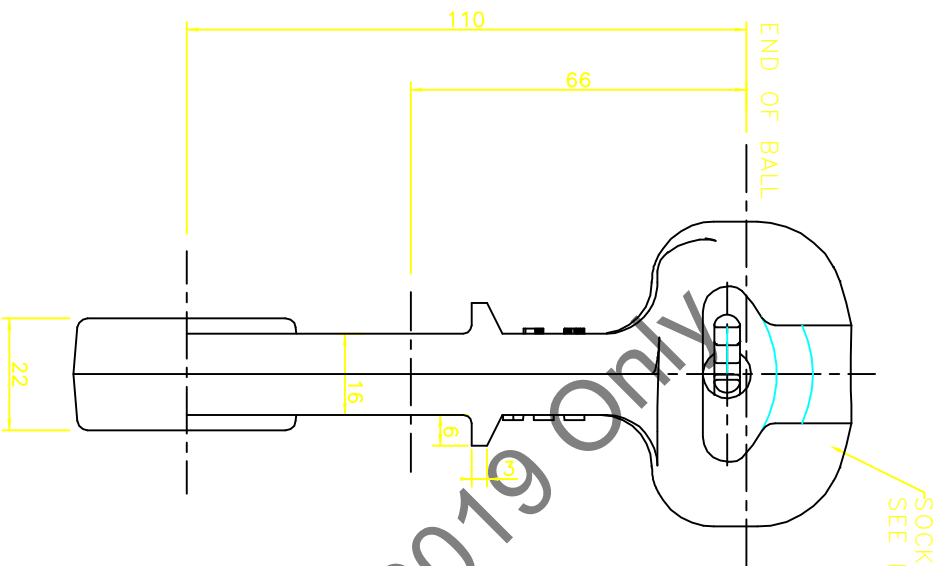
3D VIEW

NOTES

1. MARKED : Manufacturer Name
MONTH/YEAR OF MANUFACTURE
2. MIN. UTS. 210 KN. (21,400 KG.)
3. ALL FERROUS METAL SHALL BE HOT-DIP GALVANIZED
IN ACCORDANCE WITH ASTM A153.

4	1	SPLIT PIN	STAINLESS STEEL
3	1	HEX. NUT M20	GALV. STEEL GRADE 8
2	1	HEX. BOLT M20-145-30 DRILL Ø5.5	GALV. STEEL GRADE 8.8
1	1	BODY	GALV. FORGED STEEL
ITEM QTY		DESIGNATION	MATERIAL

National Transmission & Despatch Company			Design
NTDC			
Drawn	-	NAME	
Checked	-	22MM V-SHACKLE SPACING 195	
Approved	-		
Chief Engineer	-		
Design NTDC	-	Scale: -	Date: -
		Drawing No: - 1a	



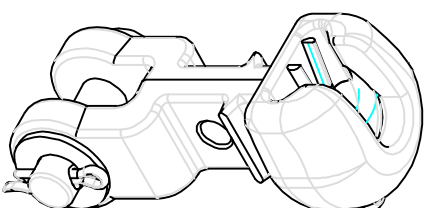
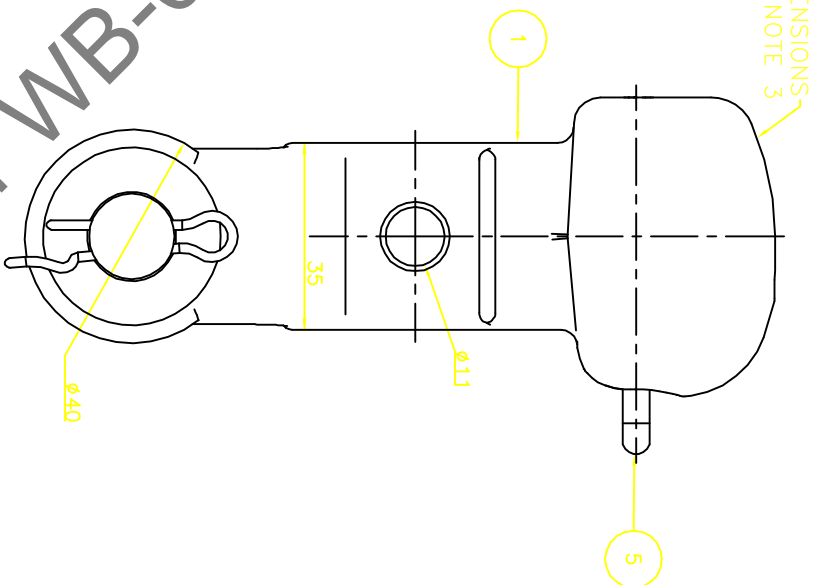
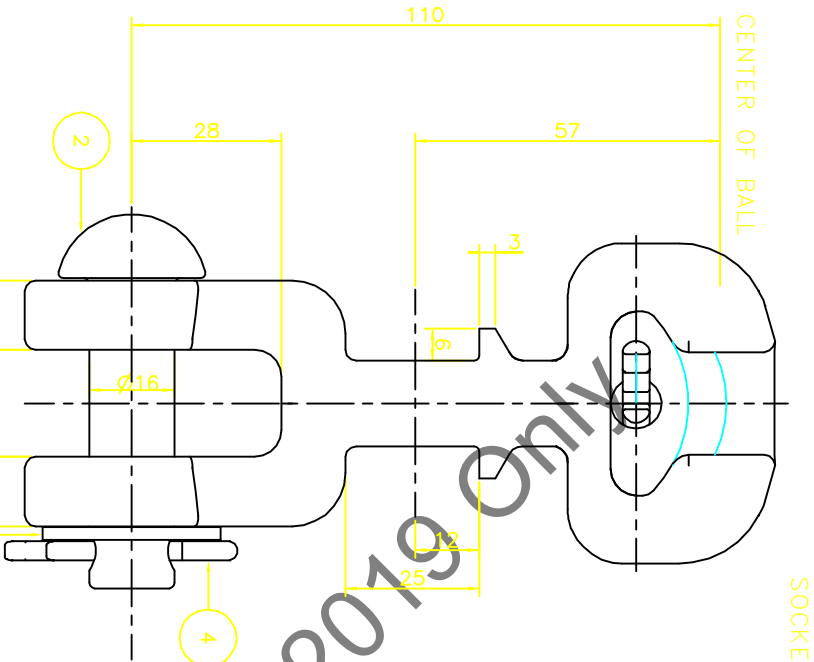
3D VIEW

NOTES

1. MARKED : Manufacturer Name
MONTH/YEAR OF MANUFACTURE
2. MIN. UTS. 120 KN. (12,300 KG.)
3. SOCKET DIMENTIONS ARE AS PER IEC. PUB 120-16MM TYPE A
4. ALL FERROUS METAL SHALL BE HOT DIP GALVANIZED IN ACC. WITH ASTM A153.

2	1	R CLIP	STAINLESS STEEL
1	1	BODY	GALV. DUCTILE IRON
ITEM	QTY	DESIGNATION	MATERIAL

National Transmission & Despatch Company			Design
			NTDC
Drawn	-	NAME	16MM SOCKET EYE FOR A/H 22MM BOSS
Checked	-		
Approved	-		
Chief Engineer Design NTDC		Scale: -	Date: -
		Drawing No: - 2	



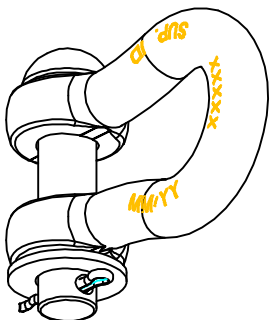
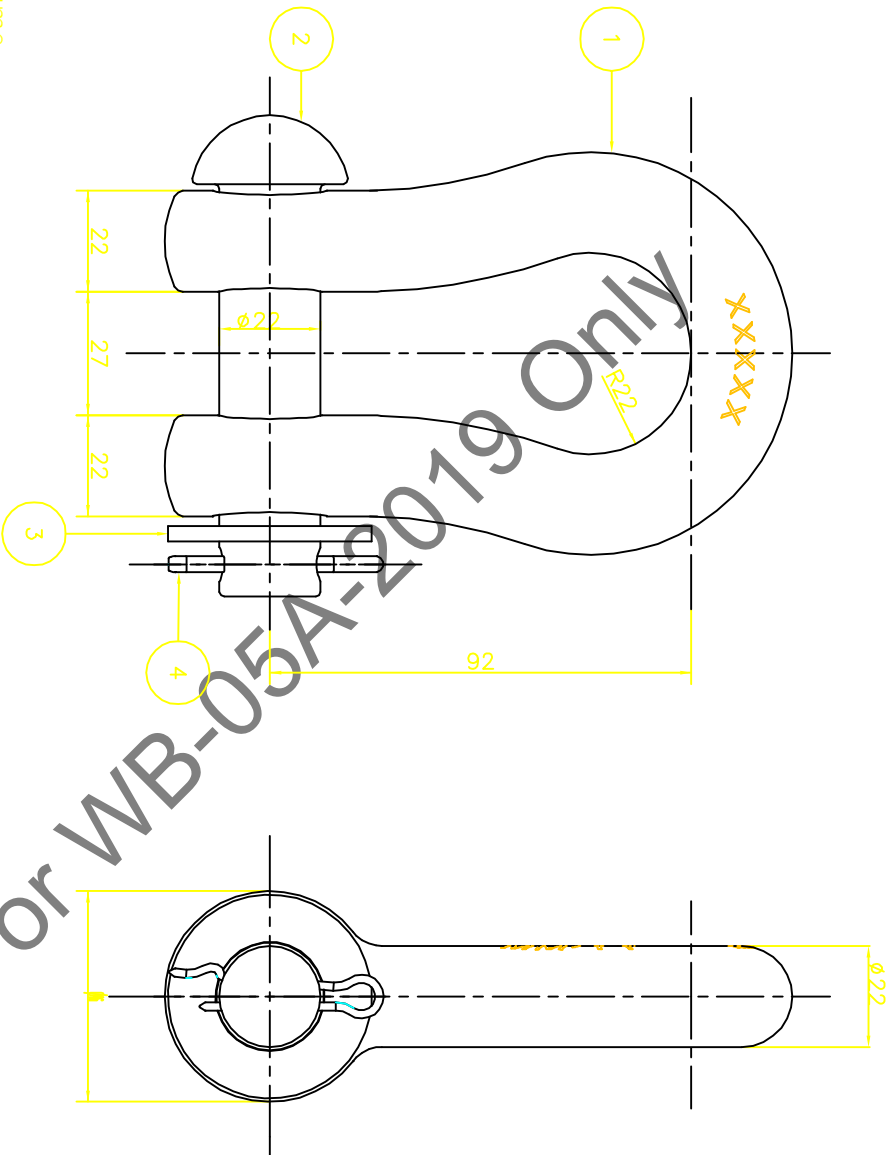
3D VIEW

NOTES

1. MARKED : Manufacturer Name
MONTH/YEAR OF MANUFACTURE
2. MIN .UTS. 120 KN. (12,300 KG.)
3. SOCKET DIMENTIONS ARE AS PER IEC PUB 120-16MM TYPE A
4. ALL FERROUS METAL SHALL BE HOT DIP GALVANIZED IN ACC. WITH ASTM A153.

5	1	R CLIP	STAINLESS STEEL
4	1	SPLIT PIN	STAINLESS STEEL
3	1	FLAT WASHER Ø6	GALV. STEEL
2	1	RIVET Ø6mm LENGTH 58mm	GALV. STEEL
1	1	BODY	GALV. DUCTILE IRON
ITEM	QTY	DESIGNATION	MATERIAL

National Transmission & Despatch Company			Design
			NTDC
Drawn	-	NAME	
Checked	-	16MM SOCKET CLEVIS FOR A/H	
Approved	-		
Chief Engineer		Scale: -	
Design NTDC		Drawing No: - 3	
		Date: -	

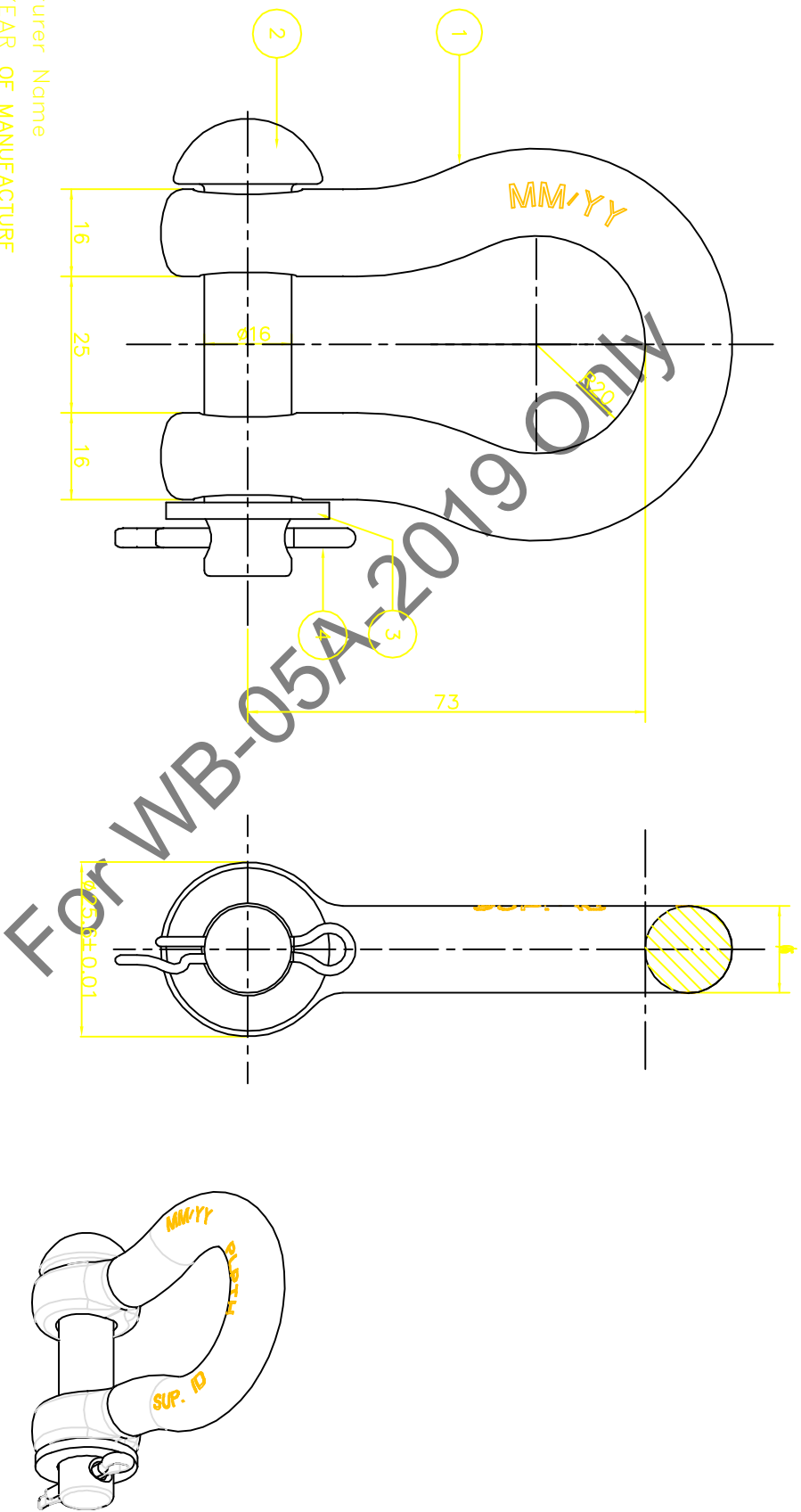


3D VIEW

- NOTES
1. MARKED : Manufacturer Name
MONTH/YEAR OF MANUFACTURE
 2. MIN. UTS. 210KN. (21,410KG.)
 3. ALL FERROUS METAL PARTS SHALL BE HOT-DIP GALVANIZED
IN ACCORDANCE WITH ASTM A153.

4	1	SPLIT PIN $\phi 22mm$	STAINLESS STEEL
3	1	PLAIN WASHER $\phi 22mm$	GALV. STEEL
2	1	RIVET $\phi 22mm$ LENGTH 90 mm	GALV. STEEL
1	1	BODY	GALV. FORGED STEEL
ITEM	QTY	DESIGNATION	MATERIAL

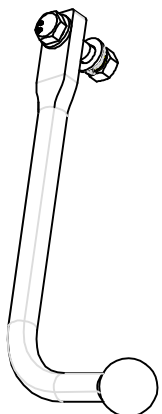
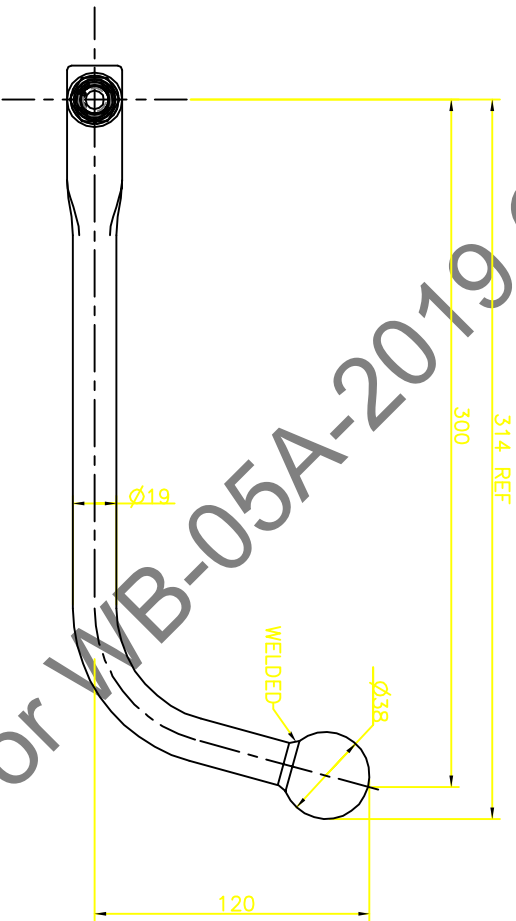
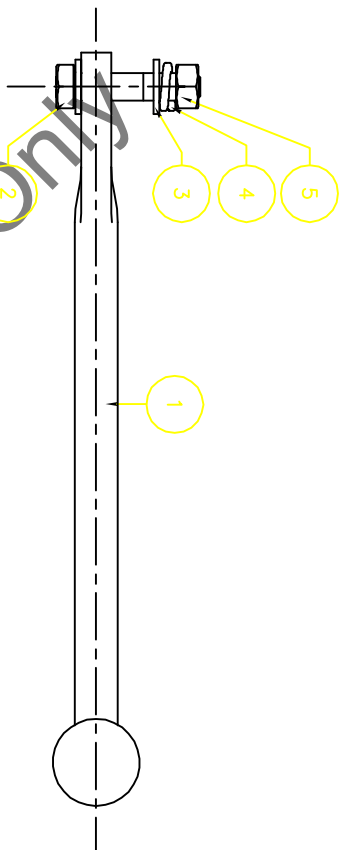
National Transmission & Despatch Company			Design NTDC
Drawn	-	NAME	
Checked	-	22MM BOW SHACKLE	
Approved	-		
Chief Engineer Design NTDC			
Scale: -		Date: -	
Drawing No: - 4			



- NOTES
1. MARKED : Manufacturer Name
MONTH/YEAR OF MANUFACTURE
 2. MIN. UTS. 120 KN. (12,300 KG.)
 3. ALL FERROUS METAL SHALL BE HOT-DIP GALVANIZED IN ACCORDANCE WITH ASTM A153.

4	1	SPLIT PIN	STAINLESS STEEL
3	1	PLAIN WASHER M16	GALV. STEEL
2	1	RIVET $\phi 16mm$ LENGTH 72mm	GALV. STEEL
1	1	BODY	GALV. FORCED STEEL
ITEM	QTY	DESIGNATION	MATERIAL

National Transmission & Despatch Company				Design NTDC	
Drawn	-	NAME 16MM BOW SHACKLE			
Checked	-				
Approved	-				
Chief Engineer Design NTDC		Scale: - Date: -			
		Drawing No: - 5			



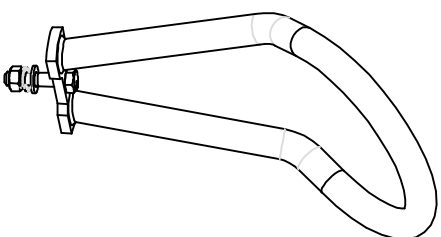
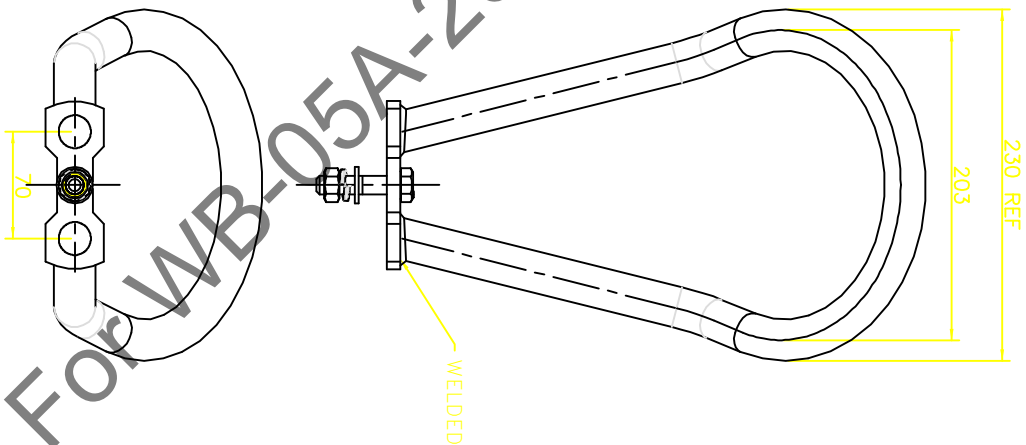
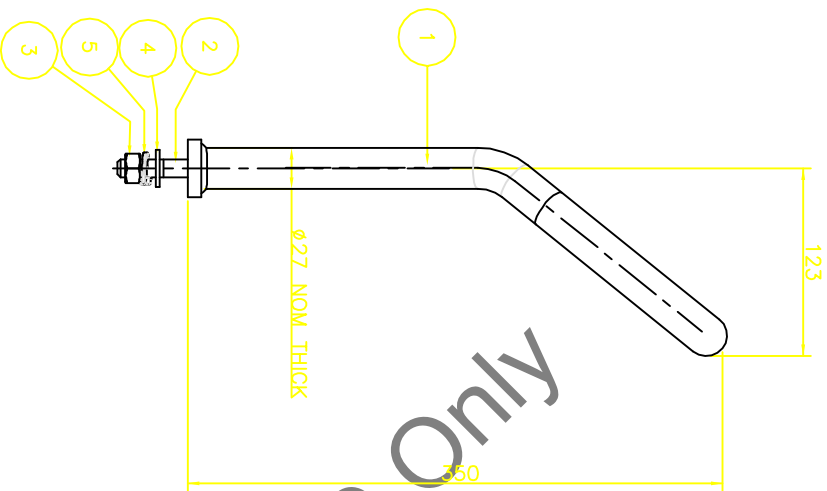
3D VIEW

NOTES

- 1. MARKED : Manufacturer Name
MONTH/YEAR OF MANUFACTURE
- 2. BOLT & NUT TIGHTENING TORQUE = 45 Nm.
- 3. ALL FERROUS METAL PARTS SHALL BE HOT-DIP GALVANIZED IN ACCORDANCE WITH ASTM A 153

5	1	HEX. NUT M12	GALV. STEEL GRADE 8
4	1	SPRING WASHER M12	GALV. STEEL SPRING
3	2	PLAIN WASHER M12	GALV. STEEL
2	1	HEX. BOLT M12-55-25	GALV. STEEL GRADE 8.8
1	1	BODY	GALV. STEEL
ITEM	QTY	DESIGNATION	MATERIAL

National Transmission & Despatch Company			Design
			NTDC
Drawn	-	NAME	SINGLE POINT LINE END ARCING HORN
Checked	-		
Approved	-		
Chief Engineer Design NTDC			
Scale: -		Date: -	
Drawing No: - 7			

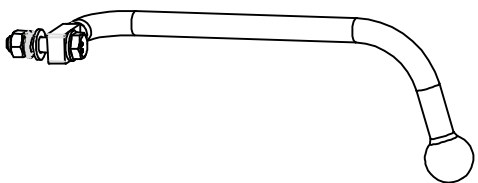
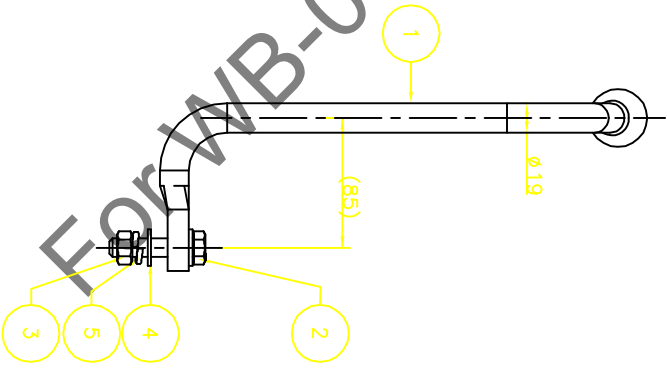
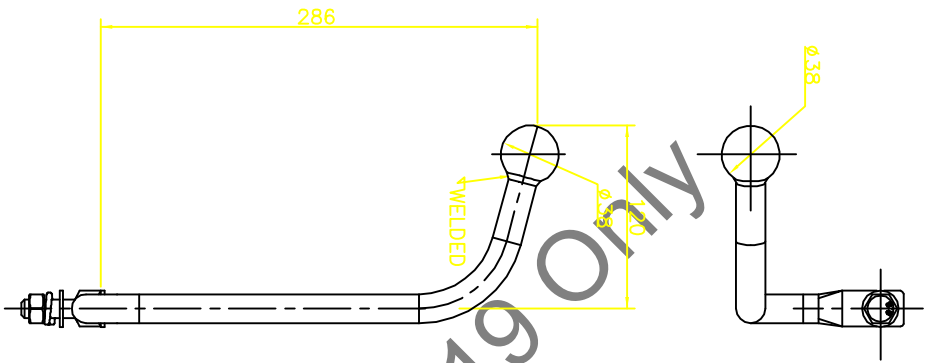


3D VIEW

- NOTES
1. MARKED : Manufacturer Name
MONTH/YEAR OF MANUFACTURE
 2. BOLT & NUT TIGHTENING TORQUE 45 Nm.
 3. ALL FERROUS METAL PARTS SHALL BE HOT-DIP GALVANIZED
IN ACCORDANCE WITH ASTM A153.

5	1	SPRING WASHER M12	GALV. STEEL, SPRING
4	1	PLAIN WASHER M12	GALV. STEEL
3	1	HEX. NUT M12	GALV. STEEL, GRADE 8
2	1	HEX. BOLT M12-55-30	GALV. STEEL, GRADE 8.8
1	1	BODY	GALV. STEEL
ITEM	QTY	DESIGNATION	MATERIAL

National Transmission & Despatch Company			Design NTDC
Drawn	-	NAME	
Checked	-	SINGLE POINT LINE END ARCING HORN	
Approved	-		
Chief Engineer Design NTDC			
Scale: -		Date: -	
Drawing No: - 8			



- NOTES
1. MARKED : Manufacturer Name
MONTH/YEAR OF MANUFACTURE
 2. BOLT & NUT TIGHTENING TORQUE = 45 Nm.
 3. ALL FERROUS METAL PARTS SHALL BE HOT-DIP GALVANIZED IN ACCORDANCE WITH ASTM A 153.

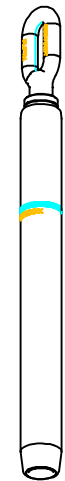
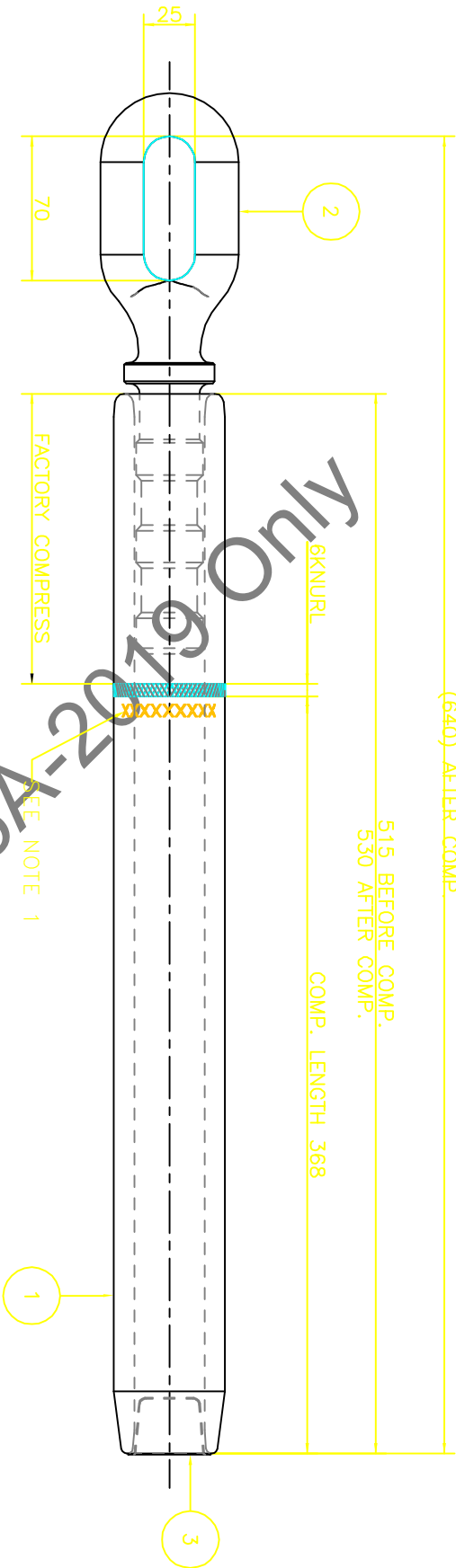
5	1	SPRING WASHER M12	GALV. STEEL SPRING
4	2	PLAIN WASHER M12	GALV. STEEL
3	1	HEX. NUT M12	GALV. STEEL GRADE 8
2	1	HEX. BOLT M12-55-25	GALV. STEEL GRADE 8.8
1	1	BODY	GALV. STEEL GRADE S45C
ITEM	QTY	DESIGNATION	MATERIAL

National Transmission & Despatch Company		Design NTDC
Drawn	-	NAME
Checked	-	
Approved	-	
Chief Engineer Design NTDC		
SINGLE POINT LINE END ARCING HORN		
Scale: -		Date: -
Drawing No: - 8a (132 KV BT-H)		

(630) BEFORE COMP.
(640) AFTER COMP.

515. BEFORE COMP.
530 AFTER COMP.

COMP. LENGTH 368



3D VIEW

NOTES

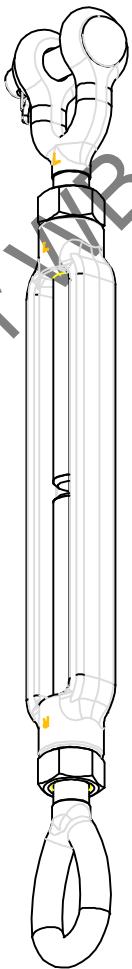
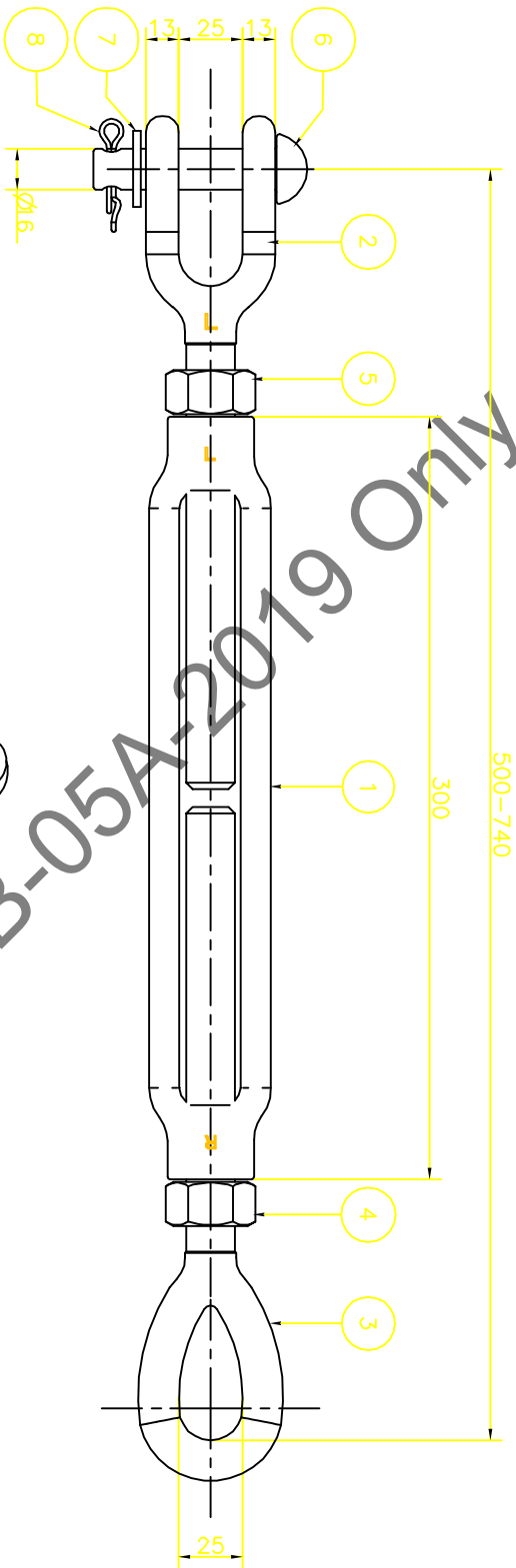
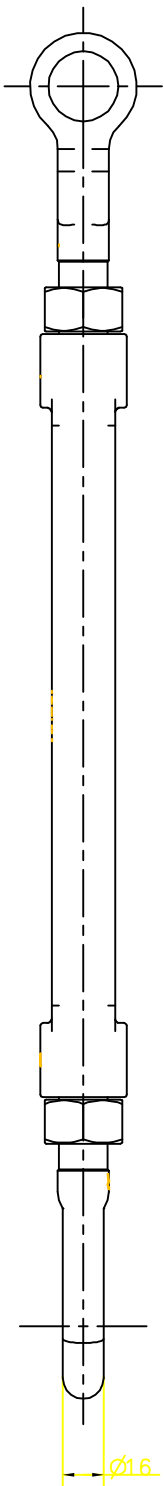
1. MARKED : Manufacturer Name
MONTH/YEAR OF MANUFACTURE
2. MIN. UTS. OF DEAD END SHALL BE NOT LESS THAN 95% BEFORE COMP.
3. SLEEVE SHALL BE FACTORY PRE FILLED WITH OXIDE INHIBITING COMPOUND AND SEALED
4. ALL FERROUS METAL PARTS SHALL BE HOT-DIP GALVANIZED IN ACCORDANCE WITH ASTM A 153.

ITEM 1

AFTER COMP.

3	1	PLASTIC CAP	PLASTIC
2	1	EYE TAIL	GALV. FORGED STEEL
1	1	BODY	ALUMINIUM ALLOY
ITEM	QTY	DESIGNATION	MATERIAL

National Transmission & Despatch Company			Design NTDC
Drawn	-	NAME EYE COMP DEAD END HAWTHORN AAC STRANDING 61/3.551	This document is pr
Checked	-		
Approved	-		
Chief Engineer Design NTDC			
Scale: -		Date: -	
Drawing No.: - 11			

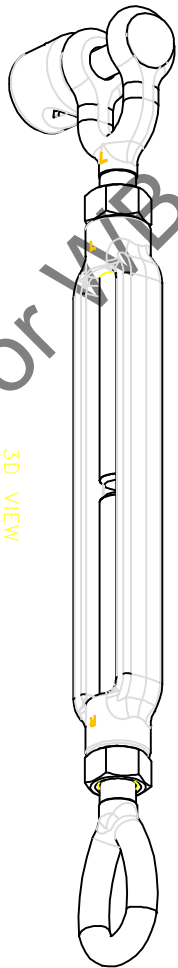
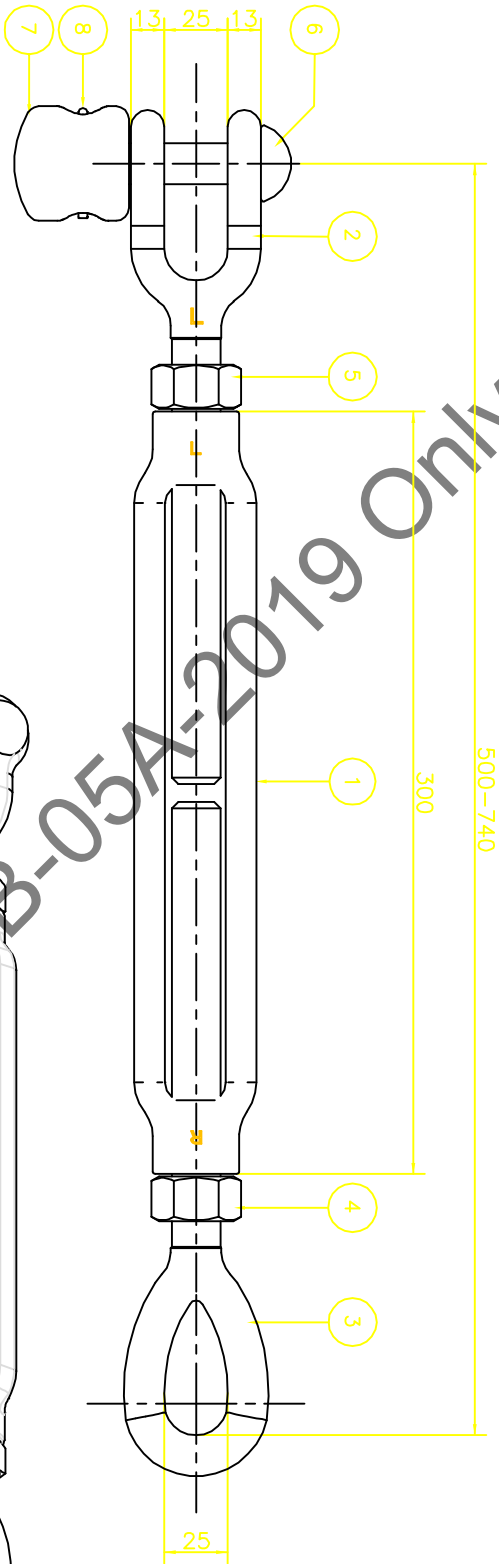
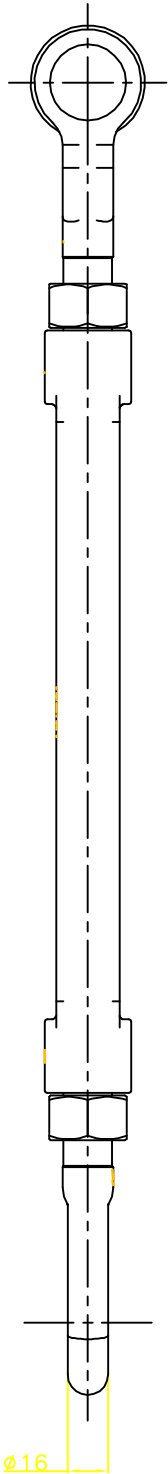


3D VIEW

- NOTES
- OF MANUFACTURE
1. MARKED : Manufacturer Name
- MONTH/YEAR
2. MIN. UTS. 125 KN. (12,700 KG.)
3. CLEVIS & EYE THREADS $\frac{1}{2}$ D EXTEND AFTER INSTALLATION.
4. ALL FERROUS METAL PARTS SHALL BE HOT-DIP GALVANIZED IN ACCORDANCE WITH ASTM A 153
5. SAME AS DRAWING NO

8	1	SPLIT PIN	STAINLESS STEEL
7	1	PLAIN WASHER M16	GALV. STEEL
6	1	RIVET Ø6mm, LENGTH 72mm	GALV. STEEL
5	1	HEX NUT 3/4" LEFT HAND THREAD	GALV. STEEL, GRADE 8
4	1	HEX. NUT 3/4"	GALV. STEEL, GRADE 8
3	1	EYE TAIL Ø19 RIGHT HAND THREAD	GALV. FORGED STEEL
2	1	CLEVIS TAIL Ø19 LEFT HAND THREAD	GALV. FORGED STEEL
1	1	BODY	GALV. FORGED STEEL
ITEM	QTY	DESIGNATION	MATERIAL

National Transmission & Despatch Company			Design
			NTDC
Drawn	-	NAME	
Checked	-	16MM (RIVET TYPE)	
Approved	-	EYE-CLEVIS TURNBUCKLE	
Chief Engineer Design NTDC		Scale: -	Date: -
		Drawing No.: - 13	



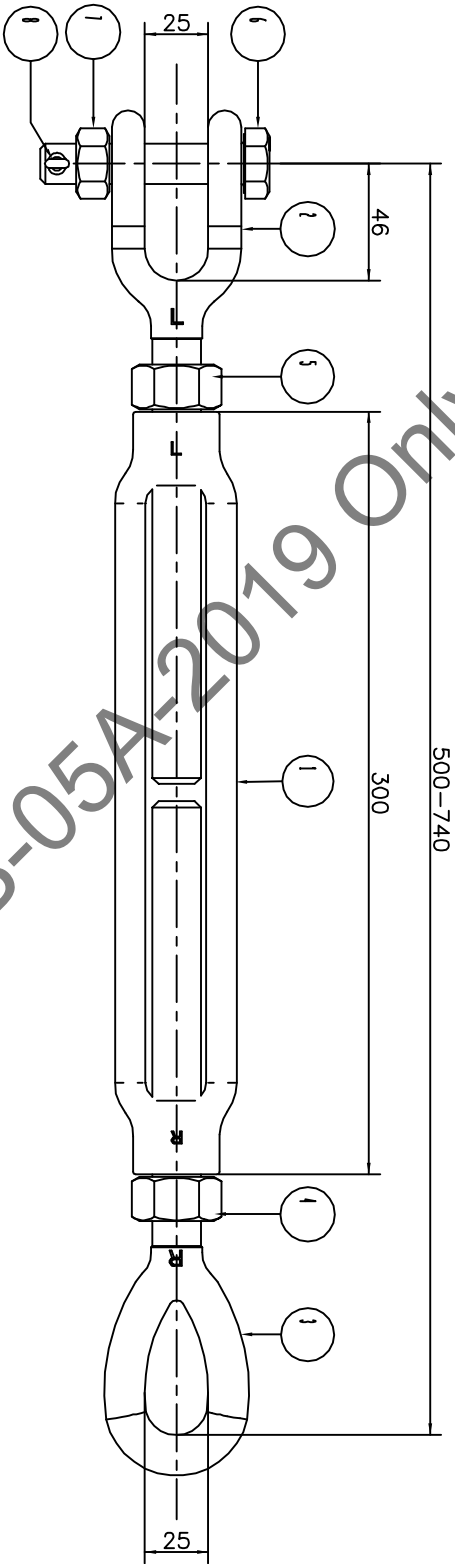
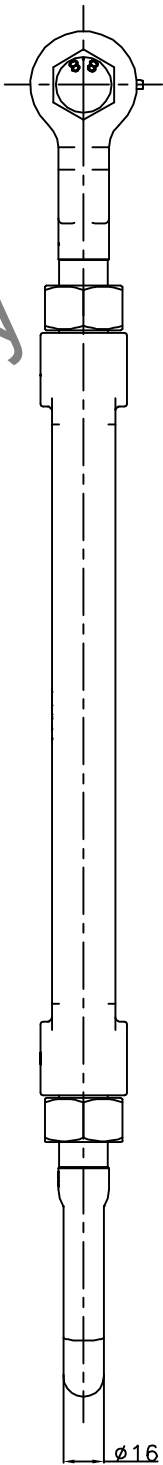
3D VIEW

NOTES

1. MARKED : Manufacturer Name
MONTH/YEAR OF MANUFACTURE
2. MIN. UTS. 125 KN. (12,700 KG.)
3. CLEVIS & EYE THREADS TO EXTEND APPROX 10 mm OUTSIDE AFTER INSTALLATION.
4. ALL FERROUS METAL PARTS SHALL BE HOT-DIP GALVANIZED IN ACCORDANCE WITH ASTM A 153
5. SAME AS DRAWING NO A3DD06412T EXCEPT WITH DOME NUT IN CLEVIS

8	1	SPLIT PIN (CORDOVA FREE)	STAINLESS STEEL
7	1	CORDOVA FREE NUT M16	GALV. CAST IRON
6	1	CORDOVA FREE BOLT M16-80-30	GALV. STEEL GRADE 88
5	1	HEX NUT 3/4" LEFT HAND THREAD	GALV. STEEL GRADE 8
4	1	HEX. NUT 3/4"	GALV. STEEL GRADE 8
3	1	EYE TAIL Ø19 RIGHT HAND THREAD	GALV. FORGED STEEL
2	1	CLEVIS TAIL Ø19 LEFT HAND THREAD	GALV. FORGED STEEL
1	1	BODY	GALV. FORGED STEEL
ITEM	QTY	DESIGNATION	MATERIAL

National Transmission & Despatch Company			Design NTDC
Drawn	-	NAME 16MM (DOME NUT TYPE) EYE-CLEVIS TURNBUCKLE	This document is pr
Checked	-		
Approved	-		
Chief Engineer Design NTDC			
Scale: -		Date: -	
Drawing No: - 13 a (220 kV - BTH) - Drg No. 13			



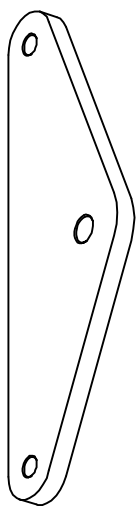
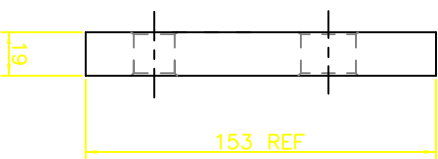
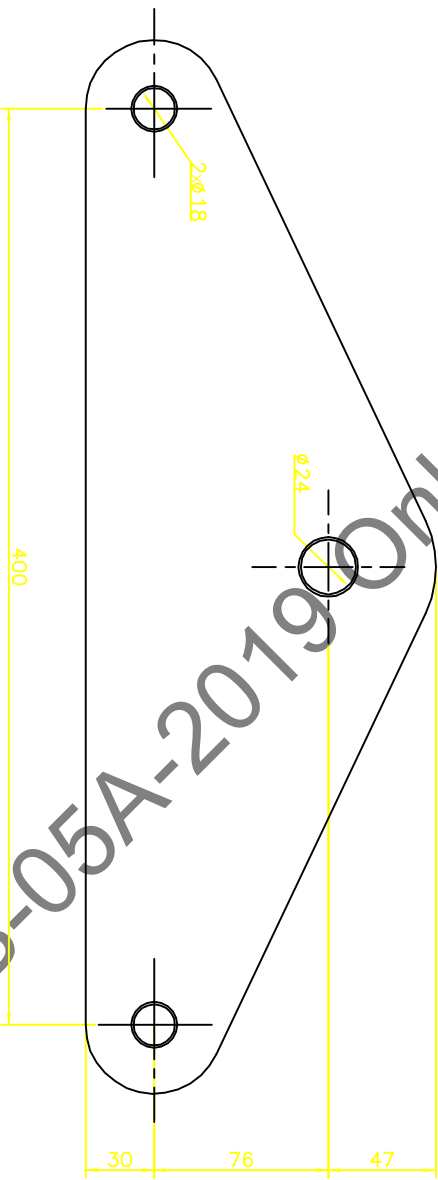
3D VIEW

NOTES

1. MARKED : Manufacturer Name
MONTH/YEAR OF MANUFACTURE
2. MIN. UTS. 120 KN (12,230 KG).
3. BOLTS THREADS TO EXTEND APPROX 10 mm OUTSIDE AFTER INSTALLATION.
4. ALL FERROUS METAL PARTS SHALL BE HOT-DIP GALVANIZED IN ACCORDANCE WITH ASTM A153

8	1	SPLIT PIN	STAINLESS STEEL
7	1	HEX. NUT M6	GALV. STEEL GRADE 8
6	1	HEX. BOLT M6-80-27 DRILL Ø5.5	GALV. STEEL GRADE 88
5	1	HEX NUT 3/4" LEFT HAND THREAD	GALV. STEEL GRADE 8
4	1	HEX. NUT 3/4"	GALV. STEEL GRADE 8
3	1	EYE TAIL Ø19 RIGHT HAND THREAD	GALV. FORGED STEEL
2	1	CLEVIS TAIL Ø19 LEFT HAND THREAD	GALV. FORGED STEEL
1	1	BODY	GALV. FORGED STEEL
ITEM	QTY	DESIGNATION	MATERIAL

National Transmission & Despatch Company			Design NTDC
Drawn	-	NAME	
Checked	-	EYE-CLEVIS TURNBUCKLE	
Approved	-	Scale: -	
Chief Engineer	-	Date: -	
Design NTDC	-	Drawing No.: - 14	

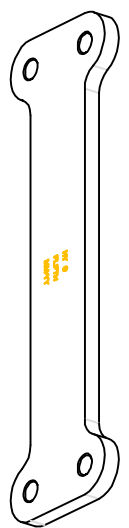
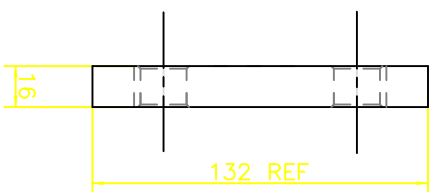
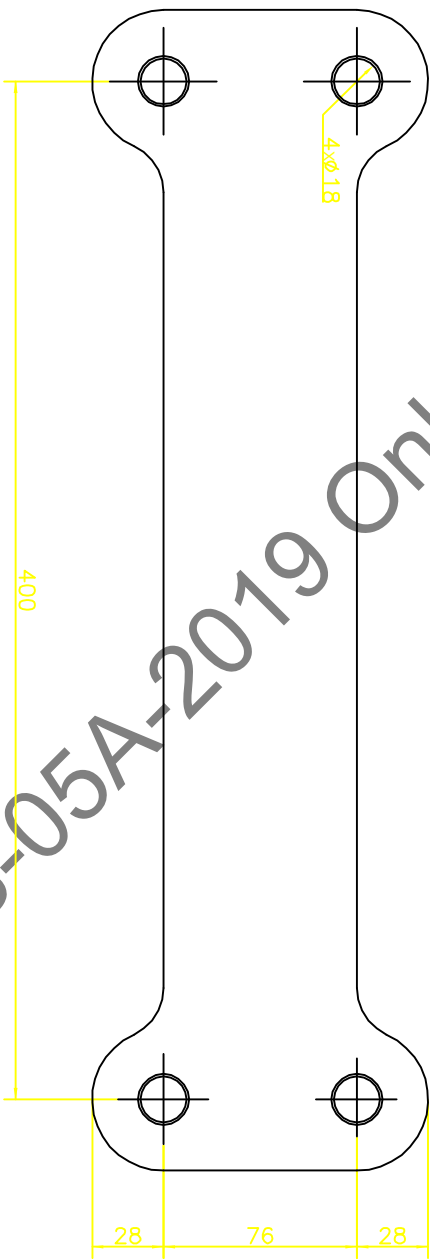


3D VIEW

- NOTES
- 1. MARKED : Manufacturer Name
MONTH/YEAR OF MANUFACTURE
 - 2. MIN. UTS. 210 KN. (21,400 KG)
 - 3. ALL FERROUS METAL PARTS SHALL BE HOT-DIP GALVANIZED IN ACCORDANCE WITH ASTM A 153.

ITEM	QTY	TRIA. YOKE PLATE	GALV. STEEL
		DESIGNATION	MATERIAL

National Transmission & Despatch Company			Design
			NTDC
Drawn	-	NAME	
Checked	-	19MM TRIA YOKE PLATE	
Approved	-		
Chief Engineer Design NTDC		Scale: -	Date: -
		Drawing No.: - 15	

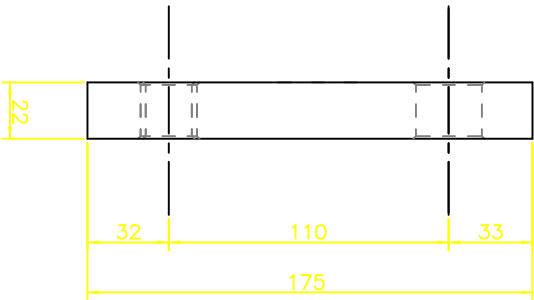
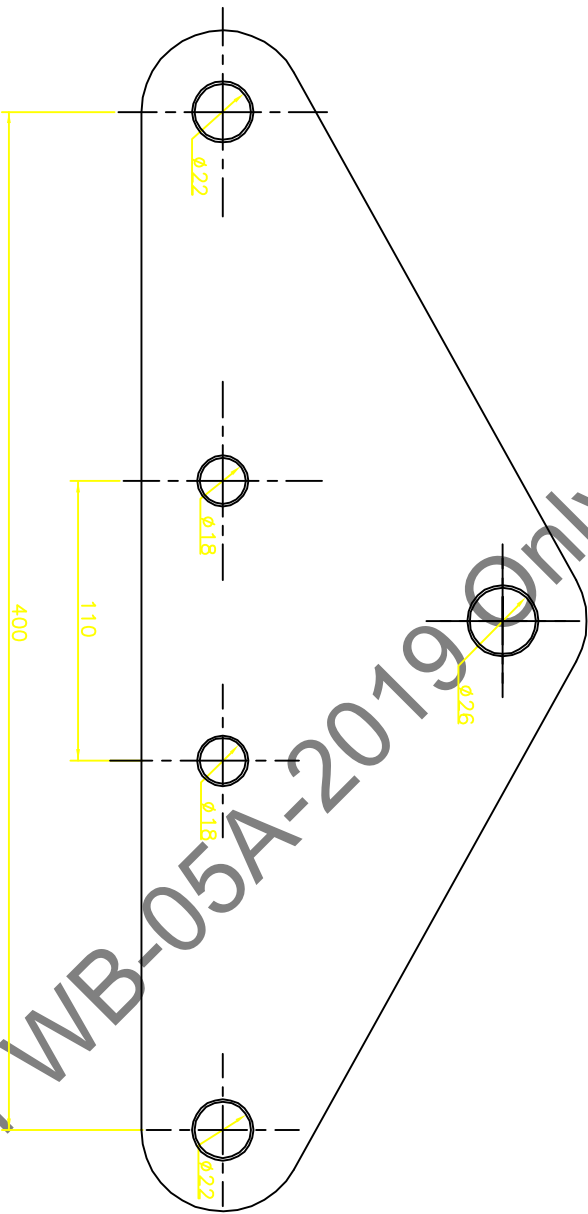
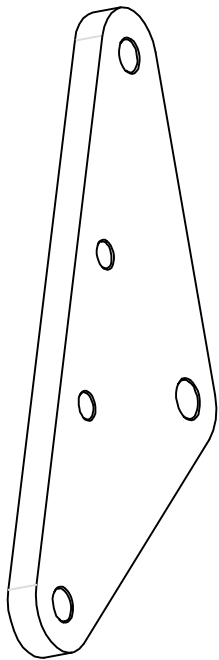


3D VIEW

- NOTES
- 1. MARKED : Manufacturer Name
MONTH/YEAR OF MANUFACTURE
 - 2. MIN. UTS. 200 KN.
 - 3. ALL FERROUS METAL SHALL BE HOT-DIP GALVANIZED
IN ACCORDANCE WITH ASTM A153.

1	1	BODY	GALV. STEEL
ITEM QTY		DESIGNATION	MATERIAL

National Transmission & Despatch Company			Design NTDC
Drawn	-	NAME	
Checked	-	16MM 'H' TYPE YOKE PLATE	
Approved	-		
Chief Engineer Design NTDC		Scale:-	Date:-
		Drawing No:- Drg No. 16	

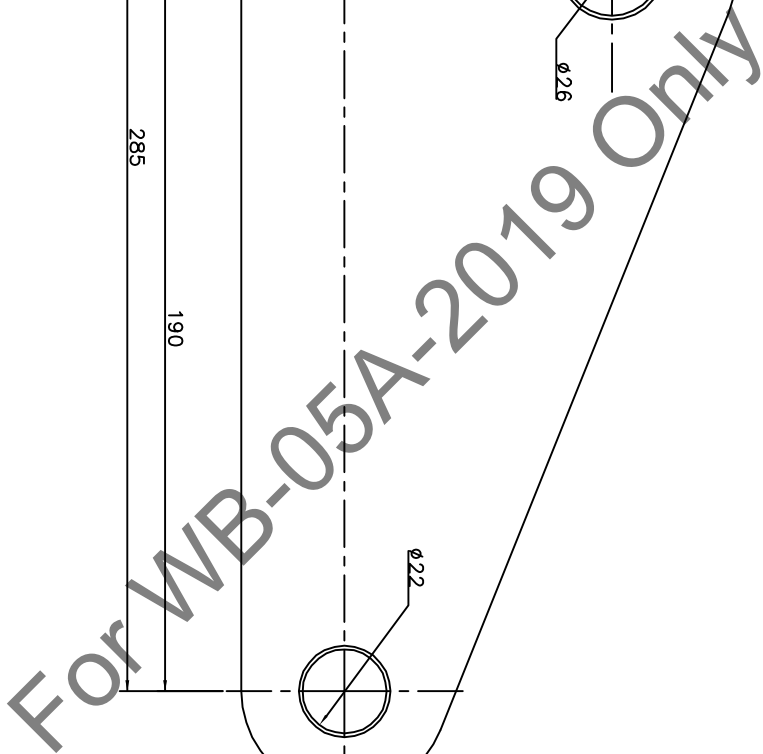


NOTES

1. MARKING NO. Manufacturer Name
MONTH/YEAR OF MANUFACTURE
2. MIN. UTS. 320 KN. (32,600 KG.)
3. ALL FERROUS METAL SHALL BE HOT-DIP GALVANIZED
IN ACCORDANCE WITH ASTM A 153.

1	1	YOKE PLATE	GALV. STEEL
ITEM QTY		DESIGNATION	MATERIAL

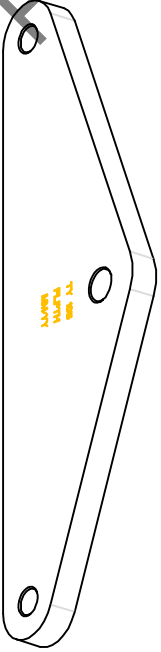
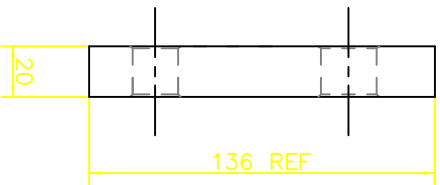
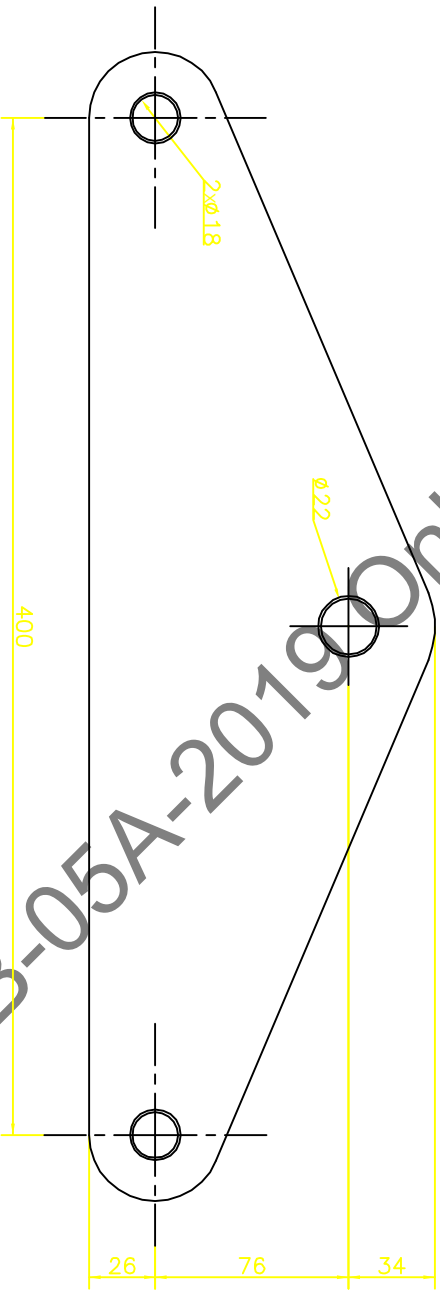
National Transmission & Despatch Company			Design NTDC
Drawn	-	NAME 22MM. TRIA. YOKE PLATE FOR ARCING HORN	This document is pro
Checked	-		
Approved	-		
Chief Engineer Design NTDC			
Scale: -		Date: -	
Drawing No: - 17			



Manufacturer Name
MONTH / YEAR OF MANUFACTURE

National Transmission & Despatch Company		Design NTDC
Drawn	-	NAME 22 MM. TRIA YOKE PLATE TY 130
Checked	-	
Approved	-	
Chief Engineer Design NTDC		
Scale: -		Date: -
Drawing No: - 18		

This document is property of Design NTDC. No Part of this can be modified or used for any purpose other than its designated purpose.

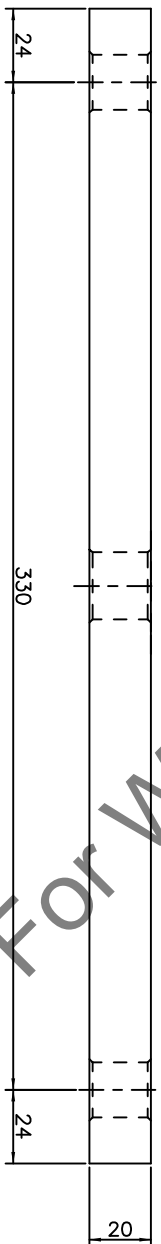
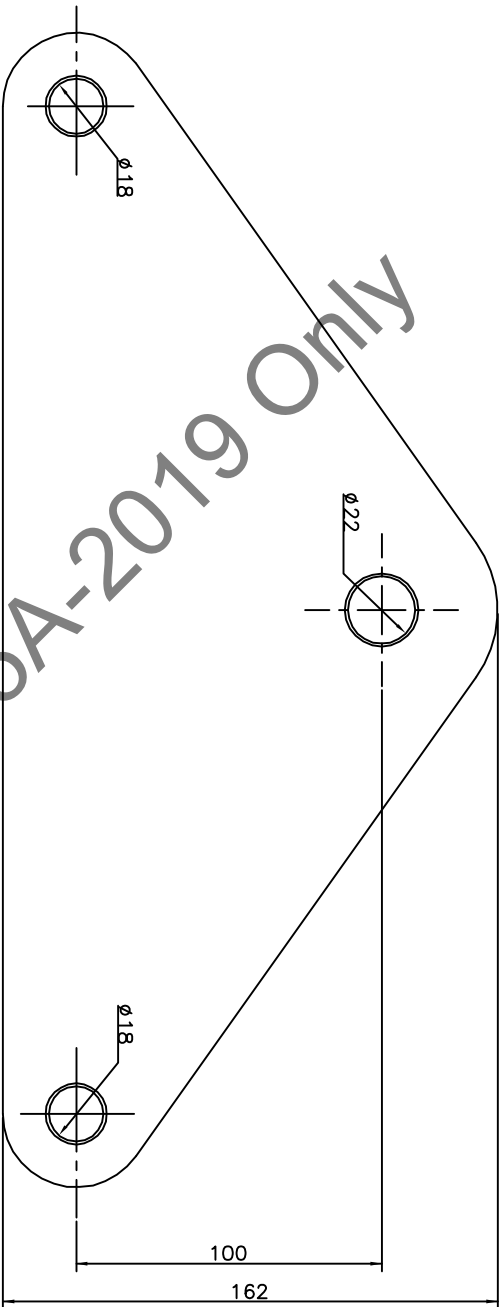


3D VIEW

- NOTES
1. MARKED : Manufacturer Name
MONTH/YEAR OF MANUFACTURE
 2. MIN. UTS. 200 KN.
 3. ALL FERROUS METAL SHALL BE HOT-DIP GALVANIZED
IN ACCORDANCE WITH ASTM A153.

1	1	TRIA. YOKE PLATE	GALV. STEEL
ITEM QTY		DESIGNATION	MATERIAL

National Transmission & Despatch Company			Design
			NTDC
Drawn	-	NAME	
Checked	-		
Approved	-		
Chief Engineer Design NTDC			
		20MM TRIA YOKE PLATE	
Scale: -		Date: -	
Drawing No.: - 19			

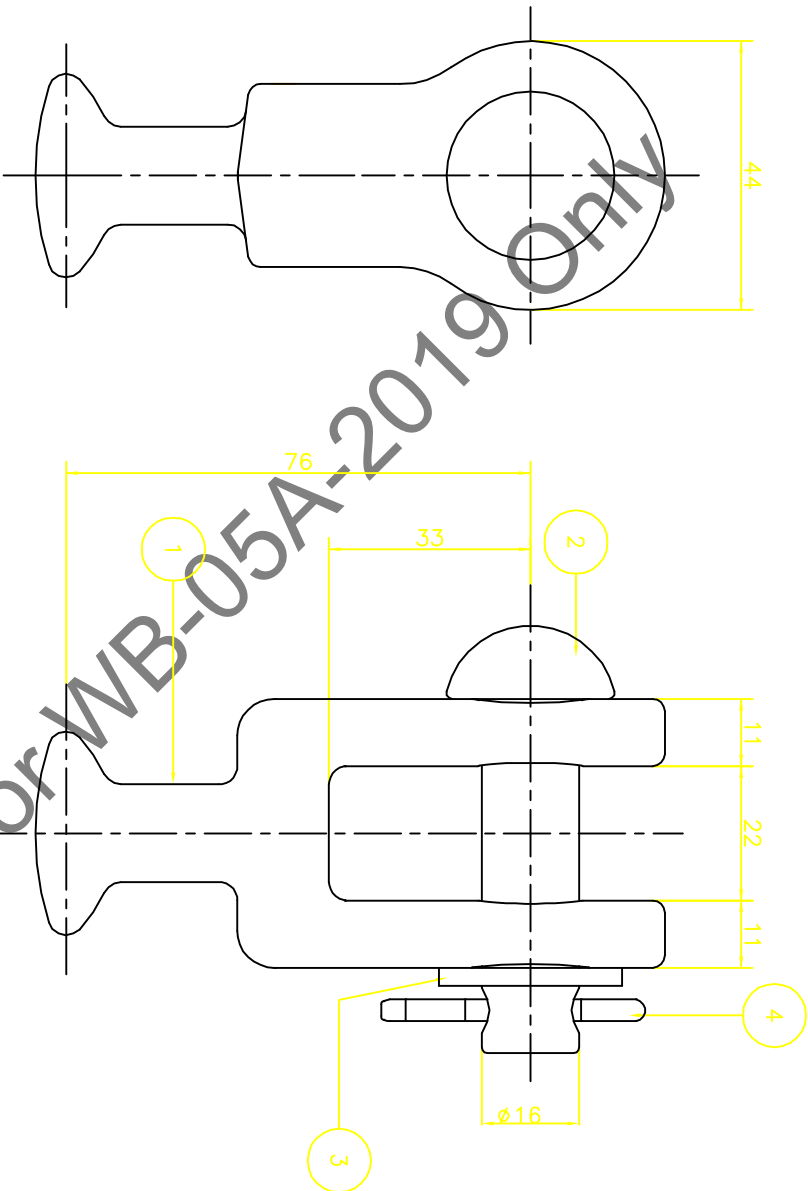
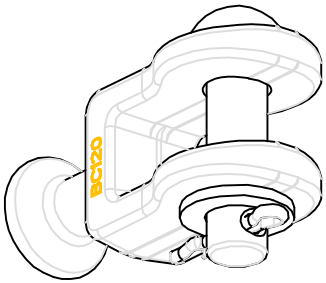


NOTES:

1. MIN. UTS. 160 KN (16,300 KG)
2. REMOVE ALL SHARP EDGES AND CORNERS BEFORE GALVANIZING
3. CHAMFER 1 ± 0.5x45° ALL THE HOLES
4. MARKING ND. : Manufacturer Name
MONTH / YEAR OF MANUFACTURE

ITEM	QTY	DESIGNATION	MATERIAL
1	1	20MM. TRIA. YOKE PLATE	GALV. STEEL GRADE SS400

National Transmission & Despatch Company			Design
NAME			NTDC
Drawn	-	20 MM. TYOKE PLATE TY 129	
Checked	-		
Approved	-		
Chief Engineer Design NTDC		Scale: -	Date: -
		Drawing No.: - 19	

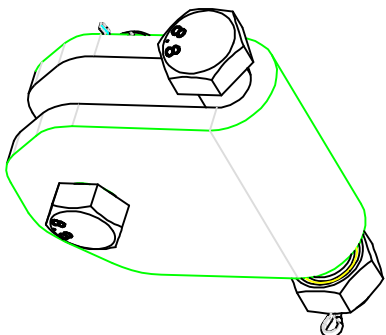
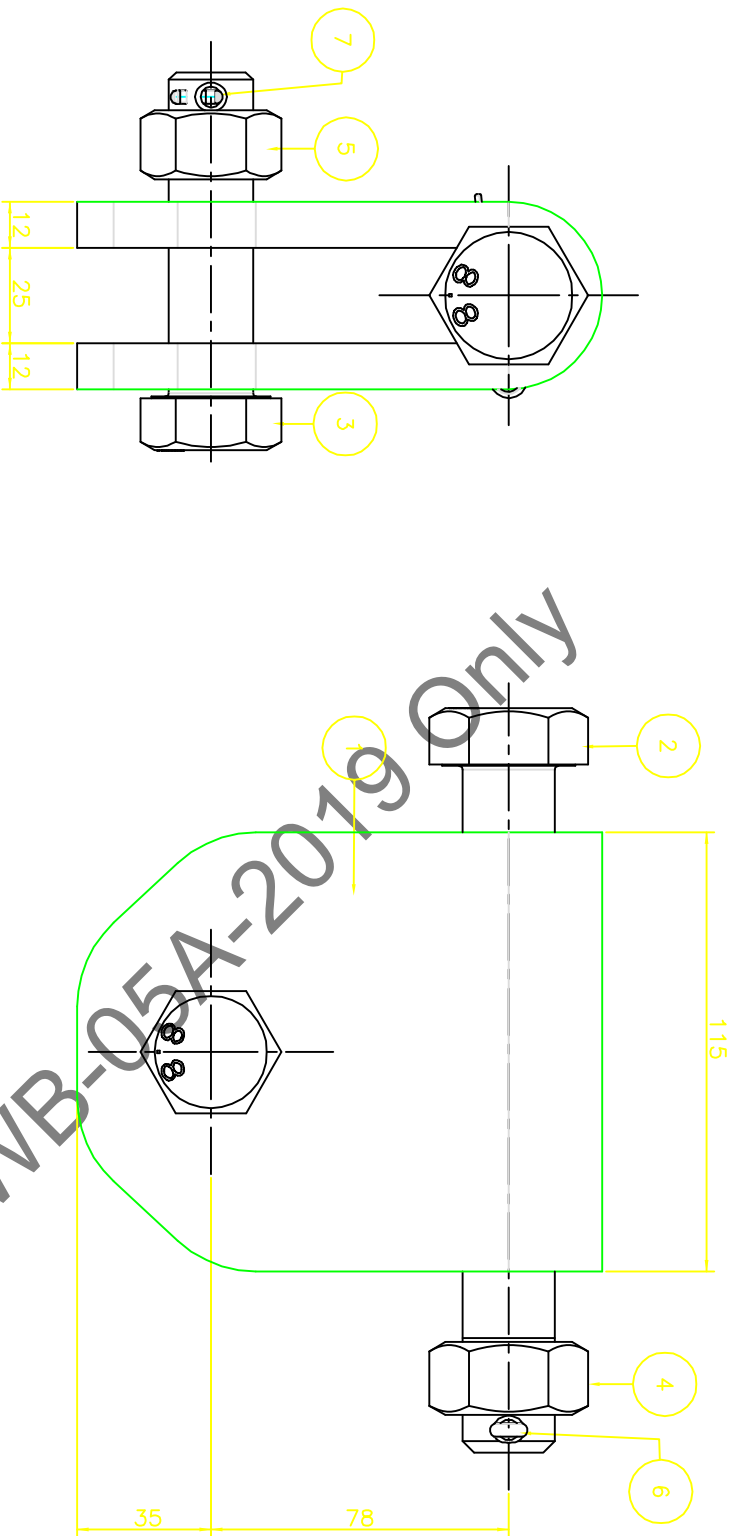


NOTES

1. MARKED : Manufacturer Name
SUPPLIER IDENTIFICATION
MONTH/YEAR OF MANUFACTURE
2. MIN. UTS. 120 KN. (12,300 KG.)
3. BALL & SHANK DIMENSIONS ARE AS PER BS 3288 PART 3: 1989
OR IEC PUB 120 – 16
4. ALL FERROUS METAL PARTS SHALL BE HOT-DIP GALVANIZED
IN ACCORDANCE WITH ASTM A153.

4	1	SPLIT PIN	STAINLESS STEEL
3	1	PLAIN WASHER M6	GALV. STEEL
2	1	RIVET Ø6mm LENGTH 50mm	GALV. STEEL
1	1	BODY	GALV. FORGED STEEL
ITEM	QTY	DESIGNATION	MATERIAL

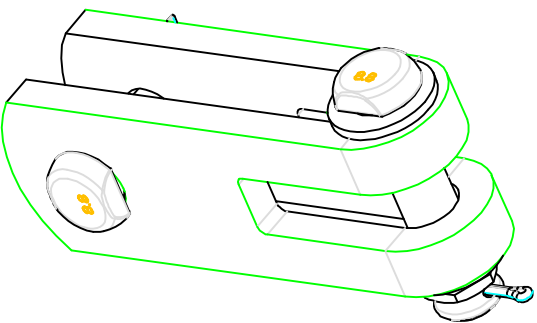
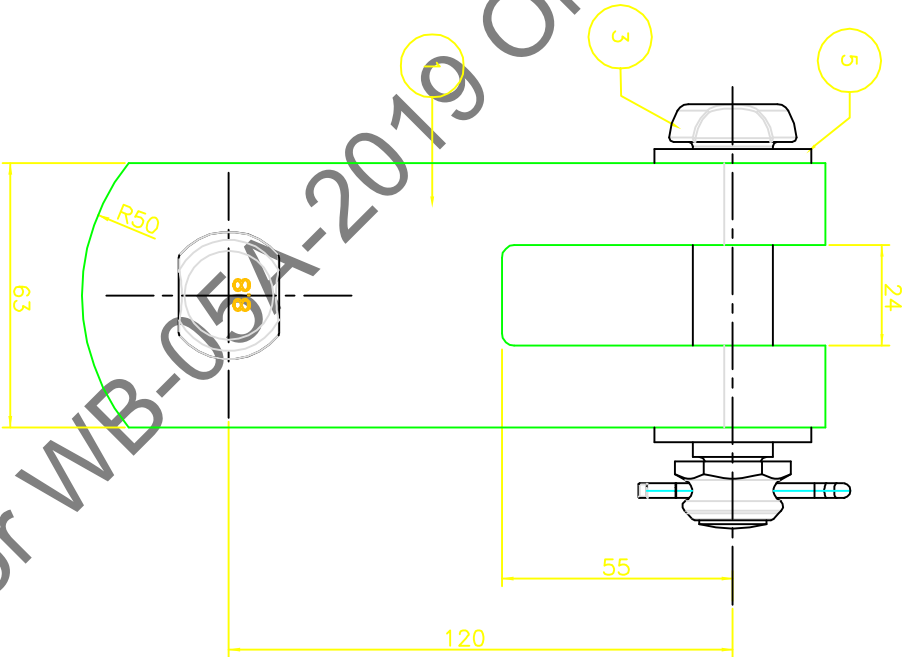
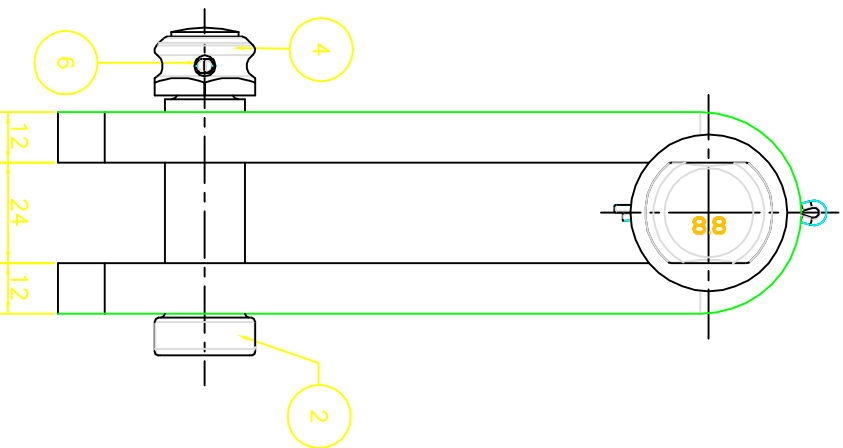
National Transmission & Despatch Company			Design NTDC
Drawn	-	NAME	
Checked	-	16MM BALL CLEVIS	
Approved	-		
Chief Engineer Design NTDC			
Scale: -		Date: -	
Drawing No: - 20			



- NOTES
1. MARKING NO. Manufacturer Name
MONTH/YEAR OF MANUFACTURE
 2. MIN. UTS. 160 KN. (16,300KG)
 3. ALL FERROUS METAL SHALL BE HOT-DIP GALVANIZED IN ACCORDANCE WITH ASTM A153.

7	1	SPLIT PIN $\phi 2mm$	STAINLESS STEEL
6	1	SPLIT PIN	STAINLESS STEEL
5	1	HEX. NUT M2	GALV. STEEL GRADE 8
4	1	HEX. NUT M2	GALV. STEEL GRADE 8
3	1	HEX. BOLT M2 - 65-35 DRILL $\phi 5.5$	GALV. STEEL GRADE 8.8
2	1	HEX. BOLT M2 - 180-30 DRILL $\phi 5.5$	GALV. STEEL GRADE 8.8
1	1	BODY	GALV. STEEL
ITEM	QTY	DESIGNATION	MATERIAL

National Transmission & Despatch Company		Design NTDC
Drawn	-	NAME
Checked	-	12 MM. HINGE
Approved	-	Scale: -
Chief Engineer Design NTDC		Date: -
		Drawing No.: - 21

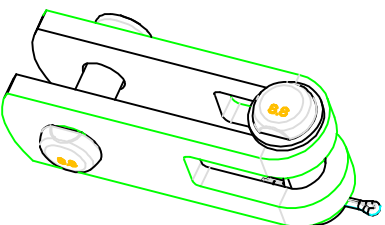
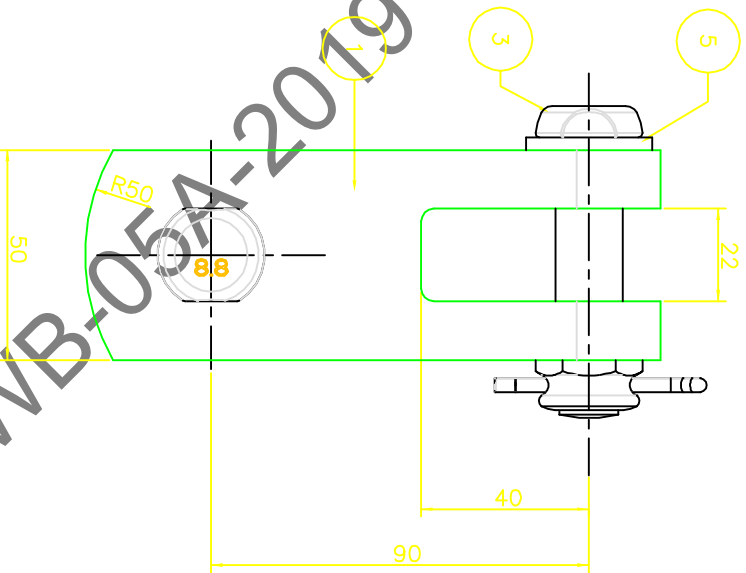
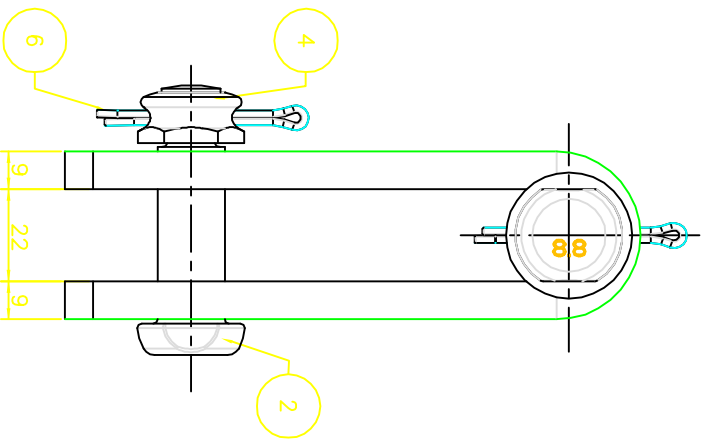


3D VIEW

- NOTES
1. MARKING NO. Manufacturer Name
MONTH/YEAR OF MANUFACTURE
 2. MIN. UTS. 160 KN. (16,300kg)
 3. ALL FERROUS METAL SHALL BE HOT-DIP GALVANIZED IN ACCORDANCE WITH ASTM A153.

6	2	SPLIT PIN	TIN PLATE COPPER
5	2	FLAT WASHER Ø9mm	GALV. STEEL
4	2	DIN NUT S19 : DIN 1441	GALV. STEEL GRADE 8
3	1	DIN BOLT S19-75 : DIN 48 073	GALV. STEEL GRADE 8.8
2	1	DIN BOLT S19-52 : DIN 48 073	GALV. STEEL GRADE 8.8
1	1	BODY	GALV. STEEL
ITEM	QTY	DESIGNATION	MATERIAL

National Transmission & Despatch Company			Design NTDC
Drawn	-	NAME TWISTED CLEVIS CLEVIS	Scale: - Date: -
Checked	-		
Approved	-		
Chief Engineer Design NTDC			Drawing No: - 23

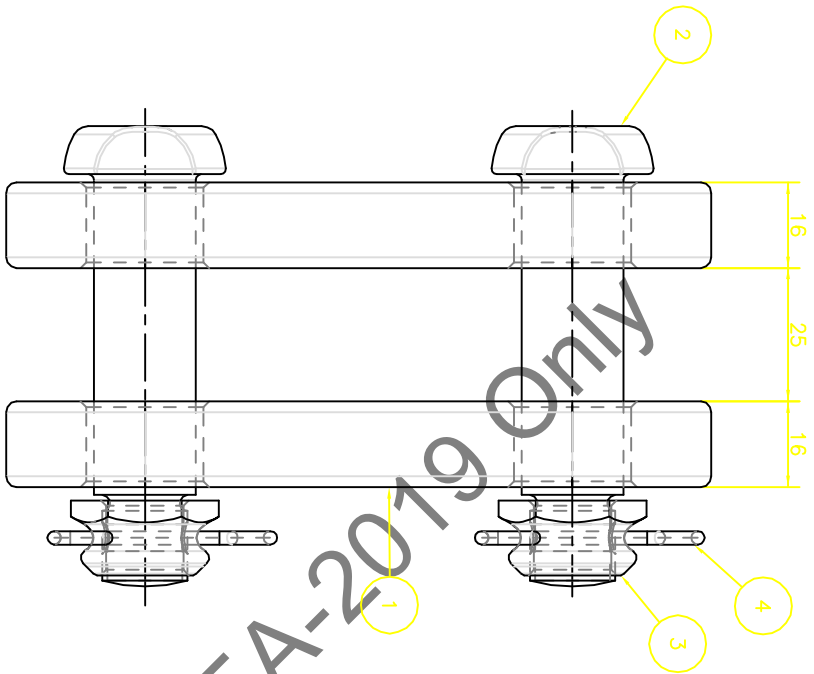


3D VIEW

- NOTES
1. MARKING NO. Manufacturer Name
MONTH/YEAR OF MANUFACTURE
 2. MIN. UTS. 120 KN. (12,300KG)
 3. ALL FERROUS METAL SHALL BE HOT-DIP GALVANIZED IN ACCORDANCE WITH ASTM A153.

6	2	SPLIT PIN	TIN PLATE COPPER
5	1	PLAIN WASHER M16	GALV. STEEL
4	2	DN NUT S16 : DN 1441	GALV. STEEL GRADE 8
3	1	DN BOLT S16-S2 : DN 48 073	GALV. STEEL GRADE 8.8
2	1	DN BOLT S16-42 : DN 48 073	GALV. STEEL GRADE 8.8
1	1	BODY	GALV. STEEL
ITEM	QTY	DESIGNATION	MATERIAL

National Transmission & Despatch Company			Design NTDC
Drawn	-	NAME TWISTED CLEVIS CLEVIS	
Checked	-		
Approved	-		
Chief Engineer Design NTDC		Scale: -	Date: -
		Drawing No: - 24	

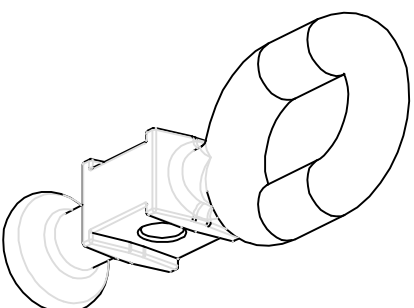
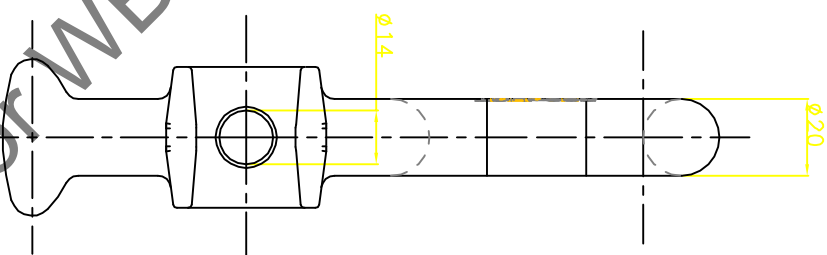
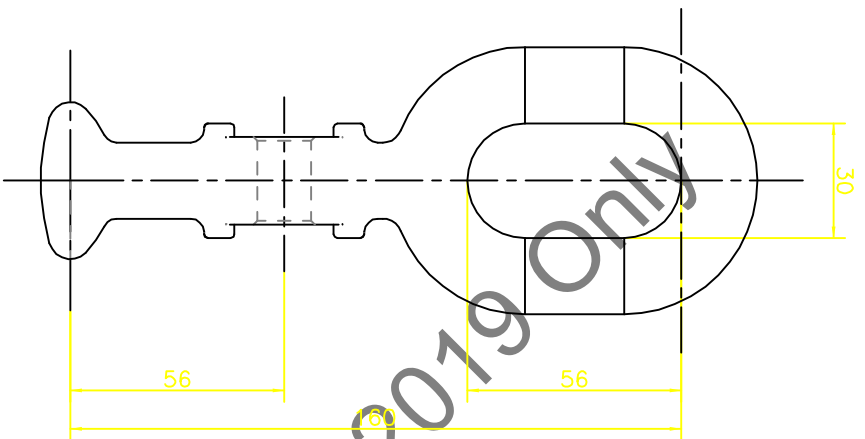


NOTES:

- 1. MIN. UTS. 160 KN (16,300 KG)
- 2. ALL FERROUS PARTS HOT DIP GALVANIZED
- 3. MARKING NO. : Manufacturer Name MONTH / YEAR OF MANUFACTURE

4	2	SPLIT PIN 4x40 : DIN 94	TIN PLATE COPPER
3	2	DIN NUT S19 : DIN 1441	GALV. STEEL GRADE 8
2	2	DIN BOLT S19-60 : DIN 48 073	GALV. STEEL GRADE 8.8
1	2	BODY	GALV. STEEL
ITEM	QTY	DESCRIPTION	MATERIAL

National Transmission & Despatch Company				Design NTDC	
Drawn	-	NAME CLEVIS CLEVIS			
Checked	-				
Approved	-				
Chief Engineer Design NTDC					
Scale: -		Date: -			
Drawing No: - 25					



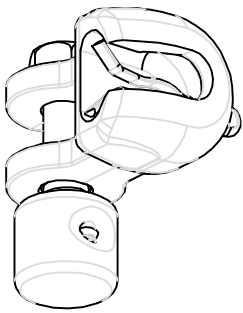
NOTES

1. MARKING NO. Manufacturer Name
MONTH/YEAR OF MANUFACTURE
2. MIN. UTS. 210 KN. (21,410 KG.)
3. BALL & SHANK DIMENSIONS ARE AS PER BS 3288 PART 3:1989
OR IEC PUB 120-20mm.
4. ALL FERROUS METAL SHALL BE HOT-DIP GALVANIZED
IN ACCORDANCE WITH ASTM A 153.

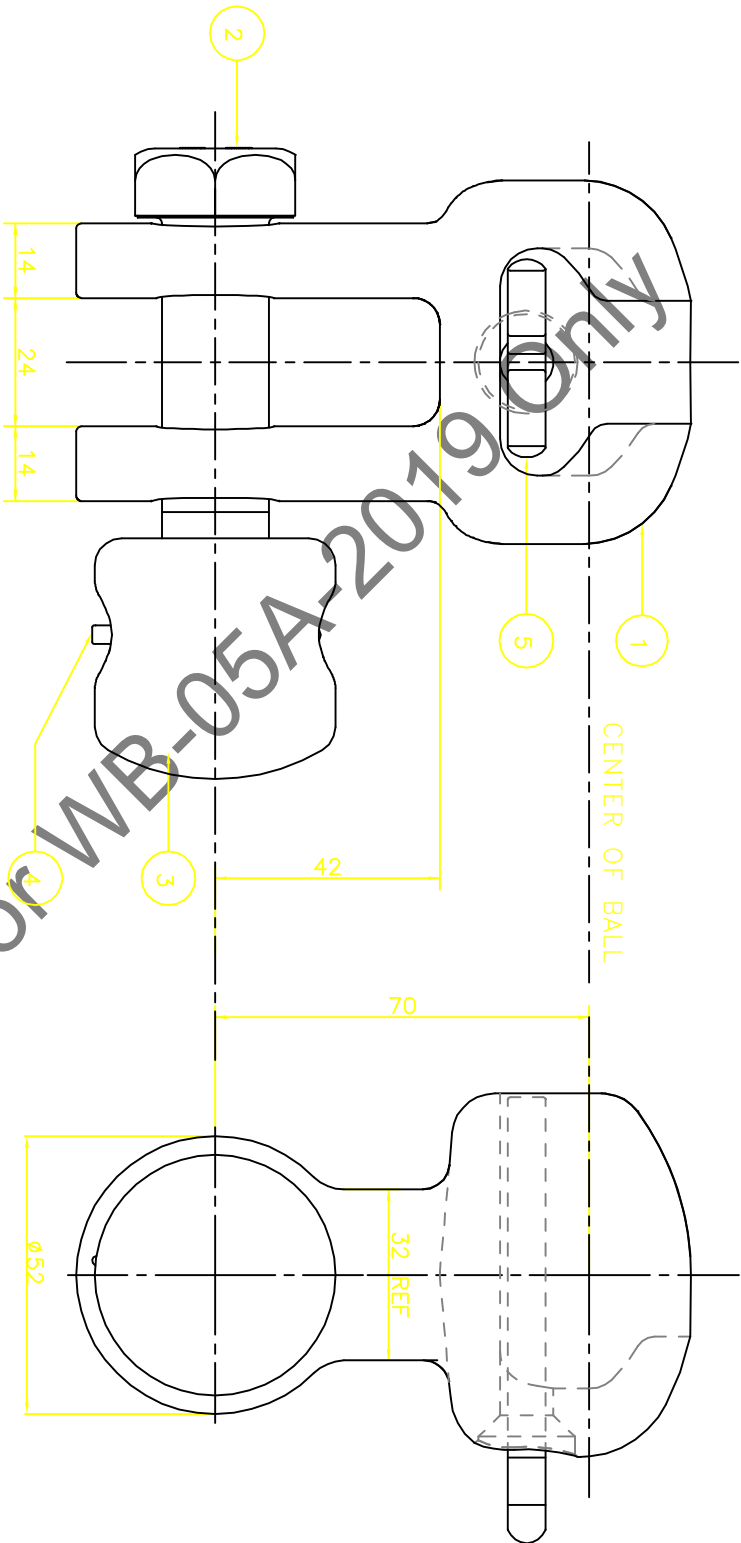
SCALE 0.400

1	1	BODY	GALV. FORGED STEEL
ITEM QTY	DESIGNATION	MATERIAL	

National Transmission & Despatch Company			Design NTDC
Drawn	-	NAME 20MM TWISTED BALL EYE LINK FOR ARCING HORN	This document is pro
Checked	-		
Approved	-		
Chief Engineer Design NTDC			
Scale: -		Date: -	
Drawing No: - 26			



3D VIEW



NOTES

1. MARKED : Manufacturer Name
MONTH/YEAR OF MANUFACTURE
2. SOCKET DIMENSIONS ARE AS PER BS 3288 PART 3 : 1989
OR IEC PUB 120-20mm.
3. MIN. UTS. 210 KN. (21,400 KG.)
4. ALL FERROUS METAL SHALL BE HOT-DIP GALVANIZED
IN ACCORDANCE WITH ASTM A 153

5	1	SECURITY CLIP	STAINLESS STEEL
4	1	SPLIT PIN (CORDON FREE)	STAINLESS STEEL
3	1	CORDON FREE NUT M20	GALV. CAST IRON
2	1	CORDON FREE HEX. BOLT M20X90X35	GALV. STEEL, GRADE 8.8
1	1	BODY	GALV. FORGED STEEL
ITEM	QTY	DESIGNATION	MATERIAL

National Transmission & Despatch Company			Design NTDC
Drawn	-	NAME	
Checked	-	20MM SOCKET CLEVIS	
Approved	-	Scale: -	
Chief Engineer Design NTDC		Date: -	
		Drawing No.: - 27	