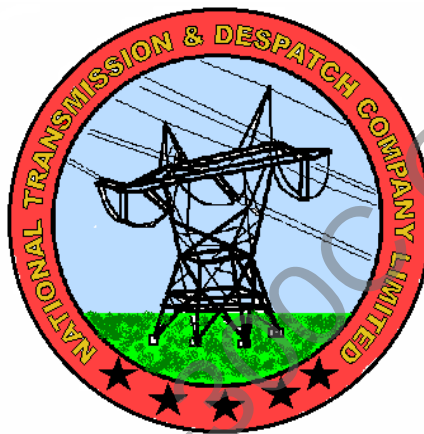


NATIONAL TRANSMISSION AND DESPATCH COMPANY

SPECIFICATION P-176: 2011



CONNECTORS FOR 500/220/132 kV GRID STATIONS

DESIGN DEPARTMENT

CONTENTS

- 0. Foreword**
- 1. Scope**
- 2. Climatic Conditions**
- 3. Requirements**
- 4. Material**
- 5. Tests**
- 6. Packaging**
- 7. Tender Data**
- 8. Approval of Drawings**
- 9. 500 kV Connectors**

PRINTING HISTORY

First approved on April 1980

Amendment No. 1 on September 1980

Second revision on November 2007

Third revision on April 2011

SPECIFICATION P-176: 2011

CONNECTORS FOR GRID STATIONS

0 FOREWORD

- 0.1** This specification has been prepared by Design NTDC.
- 0.2** This specification is intended for the procurement of material and does not include all the necessary provisions of a contract.
- 0.3** This specification is subject to revision as and when required.

1 SCOPE

- 1.1** This specification describes the connectors suitable for installations on 500, 220 and 132 kV Grid Stations under climatic conditions mentioned in clause 2.0.

- 1.2** The connectors shall be of the type described in the following clauses:

1.2.1 Monometallic Connectors

The monometallic connectors shall be of the following types and designation as per drawings attached and as per Table-I(A), I(B), I(C) and I(D).

TABLE-I(A) TEE-CONNECTORS

Description	Designation	Drawing No.	Dia Run (mm)	Dia Tap (mm)
Tee-connector 2x600/3.0	TDMHP3.0	PDW/DF-405R	88.9	2X32
Tee-connector 484/2x600	TDMRH	PDW/DF-406R	2X29.6	2X32
Tee-connector 600/5.0	TMHP5.0	PDW/DF-395R	141.3	32
Tee-connector 2X600/2X600	TDMHH	PDW/DF-409R	2X32	2X32
Tee-connector 2X600/3.0	TDMHP3.0	PDW/DF-405R	88.9	2X32
Tee-connector 2X600/3.5	TDMHP3.5	PDW/DF-405R	101.6	2X32
Tee-connector 2X600/5.0	TDMHP5.0	PDW/DF-405R	141.3	2X32
Tee-connector 2X455/3.0	TDMAP3.0	PDW/DF-405R	88.9	2X27.72
Tee-connector 2X484/3.0	TDMRP3.0	PDW/DF-405R	88.9	2X29.6
Tee-connector 484/2X455	TDMAR	PDW/DF-406R	29.6	2X27.72
Tee-connector 2X484/2X484	TDMRR	PDW/DF-409R	2X29.6	2X29.6

Tee-connector 600/600	TMHH	PDW/DF-388R	32	32
Tee-connector 484/600	TMRH	PDW/DF-388R	29.6	32
Tee-connector 183/600	TMLH	PDW/DF-388R	20	32

TABLE-I(B) ANGLE TEE-CONNECTORS

Description	Designation	Drawing No.	Dia Run (mm)	Dia Tap (mm)
Angle Tee-connector 3.0/2x2.5	TDMP3.0, P 2.5	PDW/DF-389R	88.9	2X73
Angle Tee-connector 3.0/2.5	TMP 3.0, P 2.5	PDW/DF-392R	88.9	73
Angle Tee-connector 3.5/2x2.5	TDMP3.5, P 2.5	PDW/DF-389R	101.6	2x73
Angle Tee-connector 3.5/2.5	TMP 3.5, P 2.5	PDW/DF-392R	101.6	2X32
Angle Tee-connector 5.0/2x2.5	TDMP5.0, P 2.5	PDW/DF-389R	141.3	2x73
Angle Tee-connector 5.0/2.5	TMP 5.0, P 2.5	PDW/DF-392R	141.3	73

TABLE-I(C) STRAIGHT CONNECTORS

Description	Designation	Drawing No.	Dia Run (mm)	Dia Tap (mm)
Straight connector -2x600/3.0	ODMHP3.0	PDW/DF-398R	2X32	88.9
Straight connector -2x600/3.5	ODMHP3.5	PDW/DF-398R	2X32	101.6
Straight connector -2x600/5.0	ODMHP5.0	PDW/DF-398R	2X32	141.3
Straight connector - 2x484/3.0	ODMRP3.0	PDW/DF-398R	2X29.6	88.9
Straight connector - 455/3.0	OMSP 3.0	PDW/DF-439R	28	88.9
Straight connector - 600/5.0	OMHP 5.0	PDW/DF-439R	32	141.3
Straight connector - 2x600/Flat	ODMHF	PDW/DF-438R	2x32	Flat
Straight connector - 3.0/Flat	OMP3.OF	PDW/DF-430R	Flat	88.9
Straight connector - 3.5/Flat	OMP3.5F	PDW/DF-430R	Flat	101.6

TABLE-I(D) SUPPORTING CONNECTORS

Description	Designation	Drawing No.	Dimensions
PG clamp 484 – 484	PGRR	PDW/DF-415R	29.6 each grove
PG clamp 600 – 600	PGHH	PDW/DF-415R	32 each grove
PG clamp 887 – 887	PGJJ	PDW/DF-415R	39 each grove
Slide bus support for 3" pipe size	SBSP3.0	PDW/DF-431R	88.9
Slide bus support for 3.5" pipe size	SBSP3.5	PDW/DF-431R	101.6
Slide bus support for 5" pipe size	SBSP5.0	PDW/DF-431R	141.3
Fixed bus support for 3" pipe size	BSP3.0	PDW/DF-436R	88.9
Fixed bus support for 3.5" pipe size	BSP3.5	PDW/DF-436R	101.6

Fixed bus support for 5" pipe size	BSP5.0	PDW/DF-436R	141.3
Expansion bus support for coupling 3" pipe size	EBSP3.0	PDW/DF-434R	88.9
Expansion bus support for coupling 3.5" pipe size	EBSP3.5	PDW/DF-434R	101.6
Expansion bus support for coupling 5" pipe size	EBSP5.0	PDW/DF-434R	141.3
T-slide bus support for 3" pipe size	T-SBSP3.0	PDW/DF-432R	88.9
T-slide bus support for 3.5" pipe size	T-SBSP3.5	PDW/DF-432R	101.6
Monometallic spacer	SH100	PDW/DF-401R	32 each
Monometallic spacer	SH200	PDW/DF-401R	32 each
Monometallic spacer	SH400	PDW/DF-401R	32 each
Bus support	BSHH	PDW/DF-437R	2X32
Cap for 3" pipe size	Cap 3.0	PDW/DF-433R	88.9
Cap for 3.5" pipe size	Cap 3.5	PDW/DF-433R	101.6
Cap for 5" pipe size	Cap 5.0	PDW/DF-433R	141.3

1.2.2 Bimetallic Connectors

The bimetallic connector shall be made of separate Copper and Aluminum alloy bodies joined by a suitable bimetallic joint to prevent galvanic action. These shall be of the following types and according to the drawings attached and as per Table – II (A) and II (B)

TABLE-II(A) STRAIGHT CONNECTORS

Description	Designation	Drawing No.	Dia Conductor (mm)	Dia Terminal (mm)
Straight connector-2X600/F	ODBHF	PDW/DF-407R	2X32	88.9
Straight connector - 3.0/60	OBEP3.0,60	PDW/DF-393R	88.9	60
Straight connector - 3.0/F	OBEP3.0,F	PDW/DF-394R	88.9	Flat
Straight connector - 3.5/60	OBEP3.5,60	PDW/DF-393R	101.6	60
Straight connector - 3.5/F	OBEP3.5,F	PDW/DF-394R	101.6	Flat
Straight connector-2X600/60	ODBH60	PDW/DF-397R	2x32	60
Straight connector - 5.0/60	OBEP5.0,60	PDW/DF-393R	141.3	60
Straight connector - 5.0/F	OBEP5.0,F	PDW/DF-394R	141.3	Flat
Straight connector - 3.0/60	OBP 3.0,60	PDW/DF-428R	88.9	60
Straight connector - 3.0/F	OBP 3.0,F	PDW/DF-429R	88.9	Flat
Straight connector - 2X484/60	ODBR60	PDW/DF-397R	2x29.6	60
Straight connector - 2X455/60	ODBA60	PDW/DF-397R	2x27.72	60

Straight connector - 3.5/60	OBP 3.5,60	PDW/DF-428R	101.6	60
-----------------------------	------------	-------------	-------	----

TABLE-II (A) STRAIGHT CONNECTORS

Description	Designation	Drawing No.	Dia Conductor (mm)	Dia Terminal (mm)
Straight connector - 3.5/F	OBP 3.5,F	PDW/DF-429R	101.6	Flat
Straight connector - 600/40	ODBH40*	PDW/DF-397R	32	40
Straight connector - 600/F	ODBHF*	PDW/DF-407R	32	Flat
Straight connector - 5.0/40	OBP5.0,40	PDW/DF-428R	141.3	40
Straight connector - 5.0/F	OBP 5.0,F	PDW/DF-428R	141.3	40

TABLE-II (B) – 90° CONNECTORS

Description	Designation	Drawing No.	Dia Conductor (mm)	Dia Terminal (mm)
90° connector -3.0/60	90BEP3.0,60	PDW/DF-396R	88.9	60
90° connector -3.5/60	90BEP3.5,60	PDW/DF-396R	101.6	60
90° connector -5.0/60	90BEP5.0,60	PDW/DF-396R	141.3	60
90° connector -600/40	90BH40*	PDW/DF-435R	32	40
90° connector -600/60	90BH60	PDW/DF-435R	32	60
90° connector -3.0/40	90BEP3.0,40	PDW/DF-396R	3.0	40
90° connector -5.0/40	90BEP5.0,40	PDW/DF-396R	5.0	60
90/T connector -2X600/F	90/TDBHF	PDW/DF-402R	2X32	Flat
90/T connector -3.0/60	90/TBP3.0,60	PDW/DF-427R	88.9	60
90/T connector -2X600/60	90/TDBH60	PDW/DF-408R	2X32	60
90/T connector -2X600/30	90/TDBH30	PDW/DF-408R	2X32	30
90/T connector -2X455/60	90/TDBA60	PDW/DF-408R	2X27.72	60
90/T connector -2X455/30	90/TDBA30	PDW/DF-408R	2X27.27	30
90/T connector -2X484/60	90/TDBR60	PDW/DF-408R	2X29.6	60
90/T connector -2X484/30	90/TDBR30	PDW/DF-408R	2X29.6	30
90/T connector -3.0/30	90/TBP3.0,30	PDW/DF-427R	88.9	30
90/T connector -3.5/60	90/TBP3.5,60	PDW/DF-427R	101.6	60
90/T connector -3.5/30	90/TBP3.5,30	PDW/DF-427R	101.6	30
90/T connector -5.0/40	90/TBP5.0,40	PDW/DF-427R	141.3	40
90/T connector -5.0/30	90/TBP5.0,40	PDW/DF-427R	141.3	30
90/T connector -2X600/40	90/TDBH40*	PDW/DF-408R	2X32	40
90/T connector -2X600/30	90/TDBH30*	PDW/DF-408R	2X32	30

* Connectors for 132 kV Busbar

2. CLIMATIC CONDITIONS

2.1 Connectors of all types shall be suitable for satisfactory operation under the following conditions:

2.2 Ambient Temperature

Maximum	50 ⁰ C
Maximum mean over any 24 hours	45 ⁰ C
Mean in any year	30 ⁰ C
Minimum	-10 ⁰ C

2.3 Humidity

The relative humidity may range from 0 to 100%. The maximum values of the ambient temperature and humidity however do not occur simultaneously. During the monsoon, high humidity may persist for many days at a time along with temperature ranging from 30⁰ C to 40⁰ C.

2.4 Altitude

Installation up to 1000 m above Sea level.

2.4 Atmospheric Conditions

It may be assumed that the air is not normally heavily polluted by dust, smoke, aggressive gases, vapors, or salt spray. At certain times of year severe dust storm may be experienced.

3 REQUIREMENTS

3.1 The connectors shall be so designed that there are no sharp corners or edges which may damage the conductor or cause radio interference, and corona. The connector shall not become loose due to vibrations, or temperature variations.

3.2 The connectors shall be of bolted type and should be able to develop adequate electrical contact between the conductors and or terminals and between all wires of the stranded conductor.

Connectors with single bolt technology may be considered for connection on tube only; if the design of the product is submitted for approval along with type test reports giving evidence of covering the following performances:

- Electrical ageing test as per ANSI 119.4 (Class C).
- Bending test (applicable loading must be obtained by calculation by implementing boundary condition on the busbar system).
- Short circuit test as per IEC 694

3.3 The temperature rise of the connector shall not exceed the temperature rise of the conductor with which it is intended to be used.

3.4 The temperature rise of the connector, which connects conductors of varying sizes shall not exceed the temperature rise of the conductor having highest temperature rise.

3.5 The resistance of a conductor including connectors shall not exceed the resistance of an equal length of the identical conductor without connectors by more than 110 percent of all sizes of conductor.

3.6 The resistance measurement shall be made by milli volt drop, accurate resistance bridge or other suitable means.

- 3.7** The condition specified in clause 3.3, 3.4 and 3.5 above, shall be for the minimum rated current specified in Table-III.

TABLE – III

Conductor	Area mm ²	Rated Current A
Arvidal	455.7	925
Snap-dragon	456.26	925
Hawthorn	604	1085
Coreopsis	811	1300
Jessamine	887	1350
Aluminium pipe 2.5" nominal dia	1096.85	1550
Aluminium pipe 3.0" nominal dia	1437.70	1890
Aluminium pipe 3.5" nominal dia	1728.70	2170
Aluminium pipe 5" nominal dia	2772.60	3080
Aluminium pipe 6" nominal dia	2900	4000
Copper stud 30 mm dia	-	1250
Copper stud 40 mm dia	-	1600
Copper stud 60 mm dia	-	2000
Copper stud flat (125 x 125 x 16 mm)	-	2000

- 3.8** The pull out strength of the connectors shall not be less than that indicated in Table – IV

TABLE - IV

Connector	Minimum Pullout kg. (per connector)
All connectors for Ardival conductor	1000
All connectors for snap-Dragon conductor	1000
All connectors for Hawthorn conductor	1000
All connectors for Rail conductor	1200
All connectors for Coreopsis conductor	1300
Connector	
All connectors for Jessamine conductor	1400

All connectors for 2½" pipe size snap-Dragon conductor	1400
All connectors for 3" pipe size snap-Dragon conductor	1800
All connectors for 3½" pipe size snap-Dragon conductor	2200
All connectors for 5" pipe size snap-Dragon conductor	3500
All connectors for 6" pipe size snap-Dragon conductor	4000

- 3.9** The monometallic connectors and Aluminum portion of Bimetallic connectors shall be made from corrosion proof Aluminum alloy conforming to clause 4.1. The Copper based Aluminum alloys shall not be acceptable.
- 3.10** The bimetallic connectors shall have separate Copper and Aluminum bodies joined by a suitable bimetal strip joint with 2mm of thickness. The bimetallic connectors using pin type design shall not be accepted. Bimetallic connectors employing bimetallic shims shall not be accepted.
- 3.11** The Copper portion of the bimetallic joints shall be made of Copper alloy conforming to clause 4.3
- 3.12** The nuts, bolts and washers shall be conforming to clause 4.2.
- 3.13** The number and size for bolts nuts shall be adequate for the design of connectors to fulfill the requirements of contact pressure, temperature rise and resistance etc.
- 3.14** The dimensions of the connector shall be submitted for approval. The tolerance on the dimensions shall be plus or minus 3 percent from that of the approved one.
- 3.15** For connectors with flat terminals, the flat portion shall have holes drilled in it as per respective drawing. The numbers of bolts, nuts and washers as per clause 3.13 shall be supplied with each flat type connector.
- 3.16** Each connector drawing should clearly indicate the grade of material being used, the weight of Copper and Aluminum parts, separately and tightening torque of bolts.
- 3.17** The current carrying capacity of the connectors shall be twice the current rating of the respective conductor(s) / pipe for which it is to be used.

4 MATERIAL

- 4.1** The material and composition of the Aluminum alloy used on monometallic connectors and the Aluminum portion of the bimetallic connectors shall be as per details below:

S. No.	Technical characteristics	EN AC 42100 (For body)	EN AC 42200 (For keeper)	Applicable standard
1	Ultimate tensile strength , min	230 N/mm ²	320 N/mm ²	EN 1706-1998
2	Yield strength, 0.2% off set, min	190 N/mm ²	240 N/mm ²	EN 1706-1998
3	Elongation, min	2%	3%	EN 1706-1998
4	Electrical conductivity, min	38% of IACS	38% of IACS	EN 1706-1998
5	Brinell hardness, min	75 HB	100 HB	EN 1706-1998

Al alloy characteristics as per EN AC 42100 and 42200 to be submitted for approval. The alloy will be properly heat treated. Additionally, keepers, components, which are subjected to high forces during services, will be obtained by gravity die casting

- 4.2** The bolts, nuts and washers shall be of stainless steel type A2-70 minimum as per ISO 3506 standard having following properties:

Breaking strength, min	=	65 kg/ mm ²
Yield strength, min	=	40 kg/mm ²
Brinell hardness, min	=	140 HB

- 4.3** The material and composition of the Copper alloy in the bimetallic connectors shall be submitted for approval. The Copper alloy will be from the Copper/Nickel base family CuNi2Si having minimum of 96.4% of Copper and 3.6% other alloy in order to guarantee high conductivity properties as well as high strengths characteristics. Copper alloy shall be heat-treated.

- 4.4** The Copper alloy must be developed and defined in accordance with mechanical and electrical properties indicated in clause 4.3 of P-176:2011. This Copper alloy must be heat treated to reach the electrical and mechanical requirement as per clause 4.3. The chemical composition should be in accordance with the following standards:

ASTM B411 – alloy reference C64700

DIN 17673 – alloy reference 17678

BSS 4577 – alloy reference A3/2

The Copper alloy shall have the following characteristics:

Ultimate tensile strength Rm (min)	=	20 kg/ mm ² , (196.2) N/mm ² , (196.2) MPa
Yield strength Re 0.2% min	=	10 kg/mm ² , (98.1) N/mm ² , (98.1) MPa
Elongation (min)	=	18% on 50 mm scale
Electrical conductivity at 20°C (%IACS) (min)	=	32% IACS

5 TESTS

5.1 Sample Tests

- 5.1.1** The following sample tests are required to be carried out on connectors:

- visual inspection and dimension test
- Temperature rise test
- Resistance test
- Strength test

5.1.2 Visual Inspection and Dimensions

Each batch offered for acceptance shall be divided into lots of 500 connectors. Samples shall be selected at random from each lot for test.

The number of connectors in the sample shall be 50 for visual inspection and verification of dimensions.

If the number of defective connectors in any sample is three or less, the entire lot shall be accepted. If it is more than 10, the entire lot shall be rejected.

If the number of the defective connectors is 4 to 10 inclusive, a second sample of 100 connectors shall be selected at random from the same lot (but excluding the first sample) and these shall be inspected and the number of the defective units in the second sample determined.

If the total number of defective units from the first and second sample together is 10 or less, the entire lot shall be accepted. If it is more than 10 than the entire lot shall be rejected.

Individual items shall be visually examined for the defects given below:

Sr.No.	Examination	Defects
1.	Construction	i. Not of proper dimensions ii. Not of correct material iii. Any crack on the material
2.	Finish	i. Not free from roughness, sharp edges and projections which will interfere with the proper use of the article ii. Corner edges not rounded

5.1.3 **Temperature Rise Test**

Connectors of each type being offered shall be subject to temperature rise test. For this purpose a circuit diagram/loop containing at least two connectors of each type shall be formed by using the relevant conductor/tube.

The test shall be performed according to NEMA CC1.

The temperature rise of the connectors shall not exceed the temperature rise of the conductor with which it is intended to be used.

The temperature rise of the connectors, which connects conductors of varying sizes, shall not exceed the temperature rise of the conductor having highest temperature rise.

5.1.4 **Resistance Test**

The resistance of each connector shall not exceed 110% of the reference conductor resistance.

5.2 **Type Tests**

5.2.1 The following type tests shall be carried out on connector bodies, bolts, nuts and washers.

- i) Material composition test
- ii) Tensile strength test
- iii) Elongation test
- iv) Brinell hardness test
- v) Heat Cycle Test
- vi) Conductivity test
- vii) Radio interference voltage and corona tests

5.2.2 Subject to approval, the type test reports can be submitted in lieu of actual tests. Copies in English Language of appropriate test methods shall be submitted with the type test report.

5.2.3 Cost of type tests shall be separately indicated by the bidder.

6 **PACKING**

6.1 Each connector shall be packed in a polythene bag. Nuts, bolts and washers supplied as per clause 3.15 shall also be packed therein.

6.2 The connector shall be packed in wooden cases with 100 connectors in each case. The wooden cases shall be strong enough to withstand the rigors of transportation. Each package shall have marked on two sides the connector types designations as per clause 1.2.

7 TENDER DATA

The manufacturer shall submit with the tender the following information:

- a) The details of materials, its composition and materials, its composition and mechanical characteristics.
- b) Manufacturer catalogue number along with the catalogues.
- c) Copies of type test reports on the connectors along with English version of the relevant specifications, to which the connectors are manufactured and tested.
- d) Fully dimensioned drawings of the connectors.

8. APPROVAL DRAWINGS.

Four sets of the drawings and one set of reproducible shall be submitted for approval. The drawings shall show all dimensions, alloy designation and catalogue number.

500 kV CONNECTOR

9 SCOPE

The aim of this specification is to provide technical recommendations for selection of clamps and connectors used in 500 kV substations for transmission systems. HV connectors need to be selected carefully as they are one of the most critical functions within the substation and by consequence for the grid.

This document covers all connection functions as well as mechanical support and spacers required for phase conductors (cables and tubes).

10 QUALITY REQUIREMENTS

Clamps and connectors when manufactured by casting process are produced with aluminum alloys first melt with new ingots. Ingots will be delivered to the casting plant with its certificate of conformity as per the relevant standard requirement. Alloys and applicable standards are listed in the hereunder paragraphs.

Traceability from the components to the poured alloy will be provided by the supplier through his quality system, which has to be ISO 9001 (Edition 2000) certified.

11 GENERAL DESIGN OF CONNECTORS

The connectors will be designed such as they comply with the performances indicated in the paragraph 5 ("performances of the connectors"). Additionally the design of the products will comply with the following requirements.

11.1 The connectors shall be so designed that there are no sharp corners or edges, which may damage the conductor or cause radio interference, and corona.

11.2 The connectors shall be of bolted type and should be able to develop adequate electrical contact.

The quantity of keepers and bolts per connector body and conductor attachment will correspond at least at the following requirements.

Conductor type	Number of Keepers	Number of Bolts
Stranded conductor	3 minimum	6 minimum
Stud	1 minimum	4 minimum
Tube	2 minimum	4 minimum

Connectors with single bolt technology are permitted for connection on tube only; but the design of the product must be submitted to approval with type test reports evidence covering the following performances:

- Electrical ageing test: ANSI 119.4 (Class C).
- Bending test (applicable loading must be obtained by calculation by implementing boundary condition on the busbar system).
- Short circuit test: IEC 62271-1 (2007)

11.3 Bolts and washers will be made in stainless steel grade A2-70 minimum as per the ISO 3506 standard.

Item	Technical characteristics	Requirements	Applicable standard
Stainless steel bolts	Ultimate tensile strength minimum	700 N/mm ²	ISO 3506
	Hardness minimum	140 HB	

The maximum torques to be applied on the bolts is defined in the following table.

	M10	M12	M14	M16	M20
Torque (Nm)	37	60	80	110	200

11.4 The connectors shall be made from corrosion proof aluminum alloy: Silicon based \aluminum alloy.

11.5 The material and composition of the Aluminum alloy used on monometallic connectors and the Aluminum portion of the bimetallic connectors shall be as per details below:

S. No.	Technical characteristics	EN AC 42100 (For body)	EN AC 42200 (For keeper)	Applicable standard
1	Ultimate tensile strength, min	230 N/mm ²	320 N/mm ²	EN 1706-1998
2	Yield strength, 0.2% off set, min	190 N/mm ²	240 N/mm ²	EN 1706-1998
3	Elongation, min	2%	3%	EN 1706-1998
4	Electrical conductivity, min	38% of IACS	38% of IACS	EN 1706-1998
5	Brinell hardness, min	75 HB	100 HB	EN 1706-1998

Al alloy characteristics as per EN AC 42100 and 42200 to be submitted for approval. The alloy will be properly heat treated. Additionally, keepers, components, which are subjected to high forces during services, will be obtained by gravity die casting

12 TYPE TEST

The connectors shall be subjected to the type test and meet the requirements given below:

Type tests	Applicable standard	Requirement performance
Tensile Test	NEMA CC1 (edition 2005)	8896N per stranded conductor
Cantilever test	NEMA CC1 (edition 2005)	8896N orthogonally applied to supports and busbar connectors.
Electrical resistance test	NEMA CC1 (edition 1984)	$R \leq 110\%$ of conductor reference
Temperature rise test	NEMA CC1 (edition 2005)	$T^\circ(K)$ of the connector lower than the higher $T^\circ(K)$ of the connected conductors.
Ageing cycling test	ANSI C119.4 (edition 2004)	125 Cycles minimum
Short Circuit test	IEC 62271-1 (Edition 2007)	40kA/1Sec 63 kA/1Sec
		No cracks and no melt on the tested connectors. $T^\circ \text{ Max} < 200^\circ\text{C}$ after testing.
R.I.V test	IEC 62271-1 (Edition 2007)	2500 μV at U_n
Corona test	IEC 62271-1 (Edition 2007)	Extinction at U_n
Corrosion test	EN 60068-2-11 (edition 1999)	500 Hours in Salt fog
Tightening torque test	NEMA CC1 (edition 2005)	1.5 time nominal torque
		No damage of the connector and the fasteners
Bending test (2)		Applicable loading must be obtained by calculation by implementing boundary condition on the busbar system
		No damage of the connector and the fasteners
Mechanical oscillation test (3)	NEMA CC1 1984 (for measurement method of the resistance)	Resistance deviation every 10 000 cycles. Number of cycles: 100 000
		Max deviation allowed: 10% from original resistance

(1) Not applicable for shear head bolts.

(2) Applicable on connectors use single bolt technology.

(3) Applicable on multi-angular connectors.

SCHEDULE OF TECHNICAL DATA FOR 132 kV GRID STATION CONNECTORS

		Value Required for Body	Value offered for Body	Value Required for Keeper	Value offered for Keeper	Unit
A	Monometallic Connectors					
1	Applicable standard	EN 1706-1998		EN 1706-1998		
2	Type/grade of alloy	EN AC 42100		EN AC 42200		
3	Ultimate tensile strength (Rm), min	230		320		N/mm ²
4	Yield strength, 0.2% off set (Rp0.2), min	190		240		N/mm ²
5	Elongation, min	2		3		%
6	Brinell hardness, min	75		100		HB
7	Electrical conductivity (min)	38		38		% IACS
8	Pull out strength	According to Conductor		According to Conductor		N
9	No. of Keepers			2		Nos.

B	Bimetallic Connectors					
2	Applicable standard	ASTM B411 – alloy reference C64700, DIN 17673 - alloy reference 17678, BS 4577 - alloy reference A3/2		ASTM B411 – alloy reference C64700, DIN 17673 - alloy reference 17678, BS 4577 - alloy reference A3/2		
3	Type/grade of alloy	Copper Alloy		Copper Alloy		
4	Material Composition	CuNi2Si		CuNi2Si		
5	% age of each metal	96.4 % of Copper		96.4 % of Copper		
6		3.6% other metals		3.6% other metals		
7	Ultimate tensile strength	196.2		196.2		N/mm ²
8	Yield strength, 0.2% off set (min)	98.1		98.1		N/mm ²
9	Elongation	18		18		%
10	Brinell hardness (min.)	74		74		HB
11	Electrical conductivity (min)	32		32		% IACS
12	Pull out strength	According to Conductor		According to Conductor		N
13	No. of Keepers	2		2		Nos.

C	Bolts, Nuts and Washers				
1	Applicable standard	ISO 3506	ISO 3506		
2	Type/grade of alloy	Stainless Steel A2-70 & A4-70			
3	Breaking strength (min.)	637.65			N/mm ²
4	Yield strength (min)	392.4			N/mm ²
5	Brinell hardness	140			HB
D	P.G. Clamp				
1	Applicable standard	EN 1706-2010			
2	Type/grade of alloy	EN AC 42100			

FOR ADB-300C ONLY

SCHEDULE OF TECHNICAL DATA FOR 220 kV GRID STATION CONNECTORS

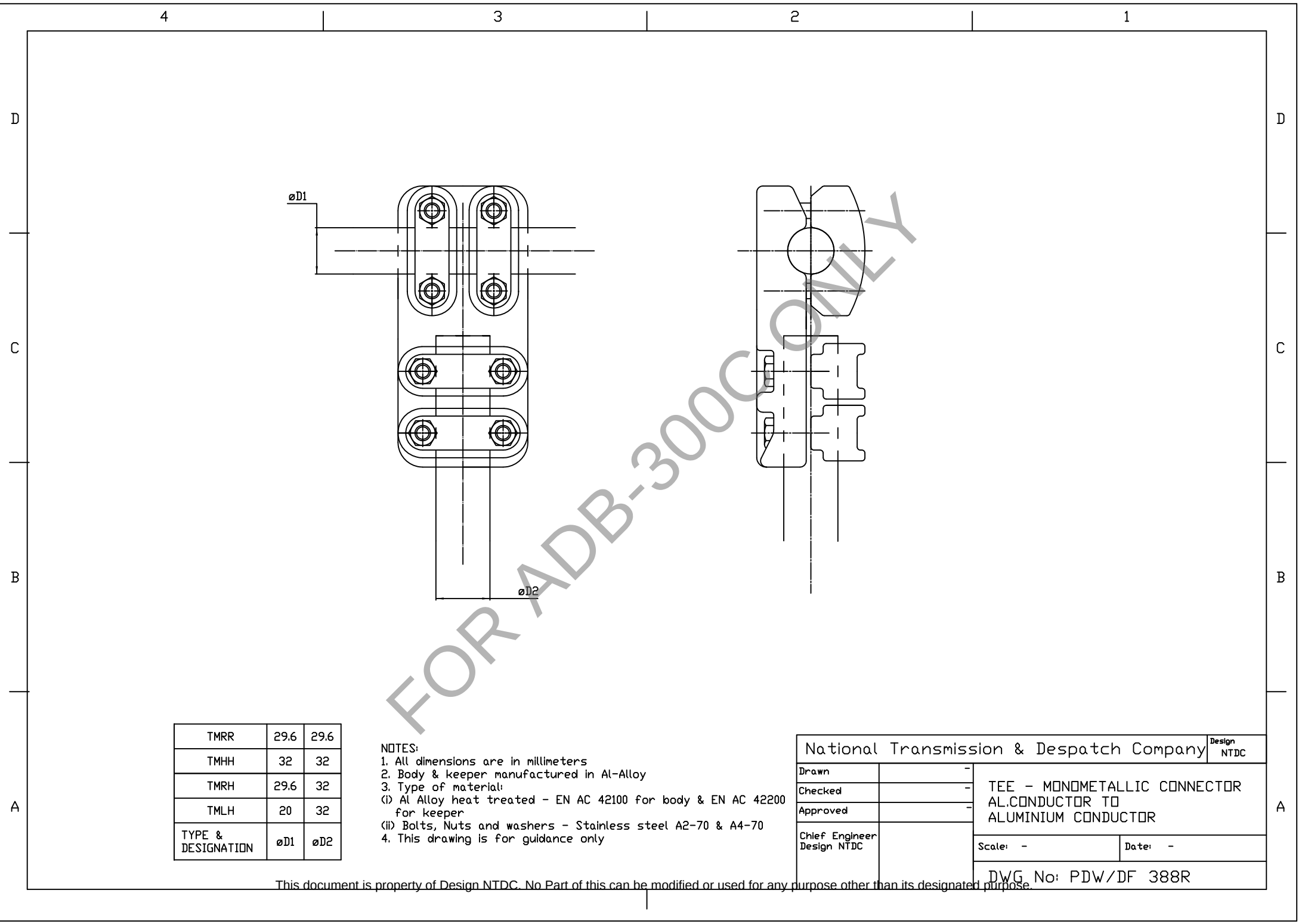
		Value Required for Body	Value offered for Body	Value Required for Keeper	Value offered for Keeper	Unit
A	Monometallic Connectors					
1	Applicable standard	EN 1706-1998		EN 1706-1998		
2	Type/grade of alloy	EN AC 42100		EN AC 42200		
3	Ultimate tensile strength (Rm), min	230		320		N/mm ²
4	Yield strength, 0.2% off set (Rp0.2), min	190		240		N/mm ²
5	Elongation, min	2		3		%
6	Brinell hardness, min	75		100		HB
7	Electrical conductivity (min)	38		38		% IACS
8	Pull out strength	According to Conductor		According to Conductor		N
9	No. of Keepers			2		Nos.
B	Bimetallic Connectors					
1	Applicable standard	ASTM B411 – alloy reference C64700, DIN 17673 - alloy reference 17678, BS 4577 - alloy reference A3/2		ASTM B411 – alloy reference C64700, DIN 17673 - alloy reference 17678, BS 4577 - alloy reference A3/2		
2	Type/grade of alloy	Copper Alloy		Copper Alloy		
3	Material Composition % age of each metal	CuNi2Si 96.4 % of Copper		CuNi2Si 96.4 % of Copper		
4	Ultimate tensile strength	196.2		196.2		N/mm ²
5	Yield strength, 0.2% off set (min)	98.1		98.1		N/mm ²
6	Elongation	18		18		%
7	Brinell hardness (min.)	74		74		HB
8	Electrical conductivity (min)	32		32		% IACS
9	Pull out strength	According to Conductor		According to Conductor		N
10	No. of Keepers	2		2		Nos.

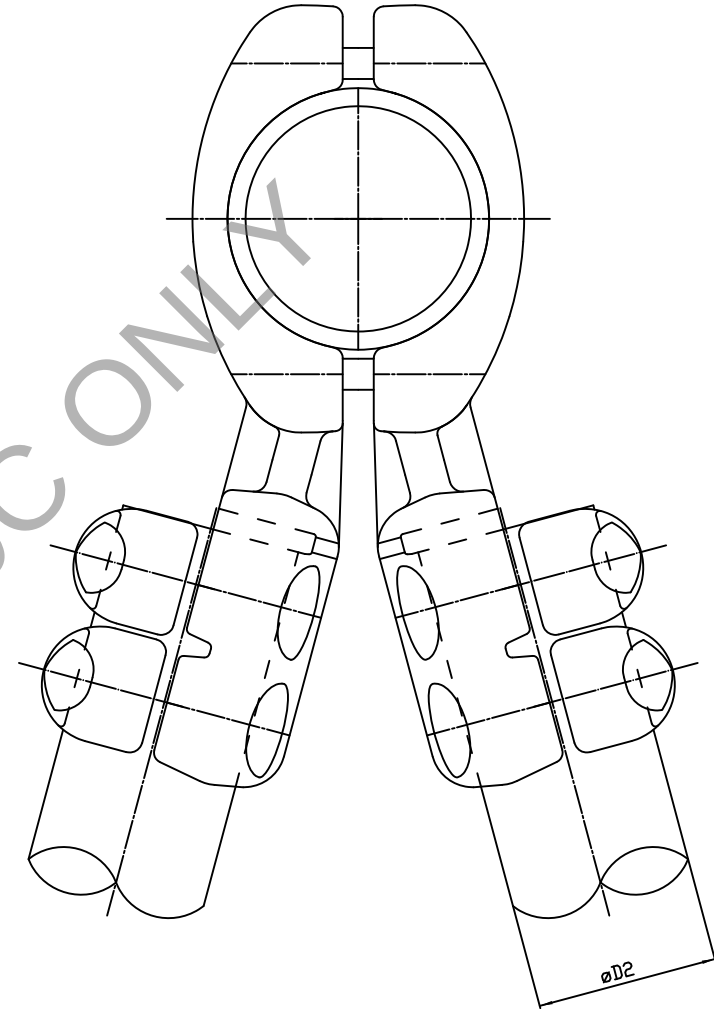
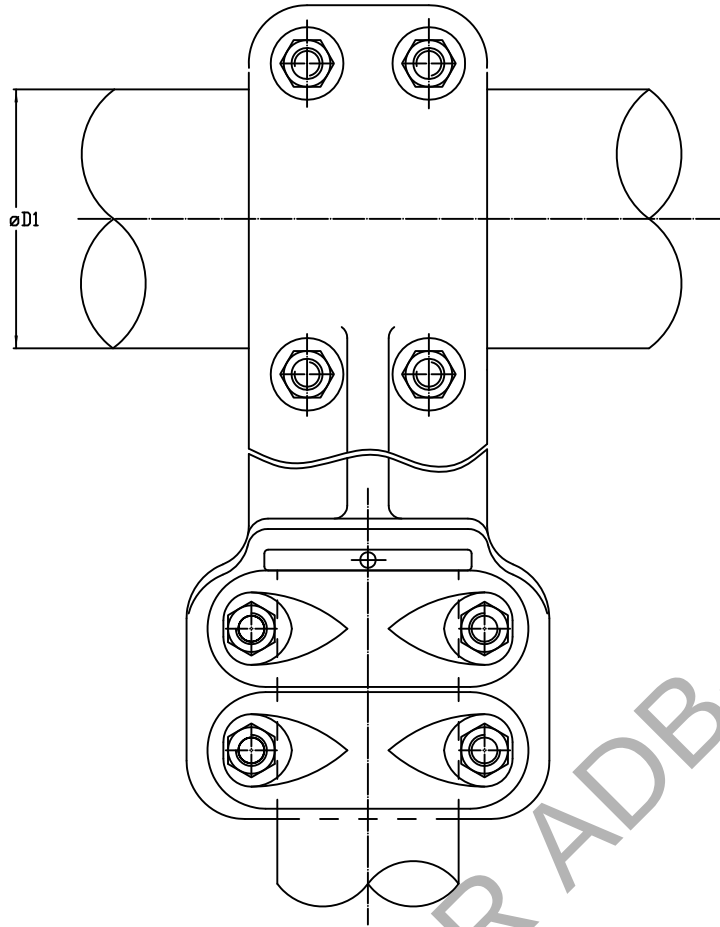
C	Bolts, Nuts and Washers			
1	Applicable standard	ISO 3506		
2	Type/grade of alloy	Stainless Steel A2-70 & A4-70		
3	Breaking strength (min.)	637.65		N/mm ²
4	Yield strength (min)	392.4		N/mm ²
5	Brinell hardness	140		HB

D	P.G. Clamp	Offered		
2	Applicable standard	EN 1706-1998		
3	Type/grade of alloy	EN AC 42100		

SCHEDULE OF TECHNICAL DATA FOR 500 kV GRID STATION CONNECTORS

		Value Required for Body	Value offered for Body	Value Required for Keeper	Value offered for Keeper	Unit
A	Monometallic Connectors					
2	Applicable standard	EN 1706-2010		EN 1706-2010		
3	Type/grade of alloy	EN AC 42100		EN AC 42200		
4	Ultimate tensile strength (Rm), min	230		320		N/mm ²
5	Yield strength, 0.2% off set (Rp0.2), min	190		240		N/mm ²
6	Elongation, min	2		3		%
7	Brinell hardness, min	75		100		HB
8	Electrical conductivity (min)	38		38		% IACS
10	Pull out strength	According to Conductor		According to Conductor		N
11	No. of Keepers			3		Nos.
B	Bolts, Nuts and Washers					
1	Applicable standard	ISO 3506		ISO 3506		
2	Type/grade of alloy	Stainless Steel A2-70 & A4-70				
3	Breaking strength (min.)	637.65				N/mm ²
4	Yield strength (min)	392.4				N/mm ²
5	Brinell hardness	140				HB
C	P.G. Clamp					
1	Manufacturer's Name and Address					
2	Applicable standard	EN 1706-2010				
3	Type/grade of alloy	EN AC 42100				





TDMP3.0,P2.5	88.9	73
TDMP3.5,P2.5	101.6	73
TDMP5.0,P2.5	141.3	73
TDMP5.0,P3.5	141.3	101.6
TYPE & DESIGNATION	$\phi D1$	$\phi D2$

NOTES:

1. All dimensions are in millimeters
2. Body & keeper manufactured in Al-Alloy
3. Type of material:
 - (i) Al Alloy heat treated - EN AC 42100 for body & EN AC 42200 for keeper
 - (ii) Bolts, Nuts and washers - Stainless steel A2-70 & A4-70
4. This drawing is for guidance only

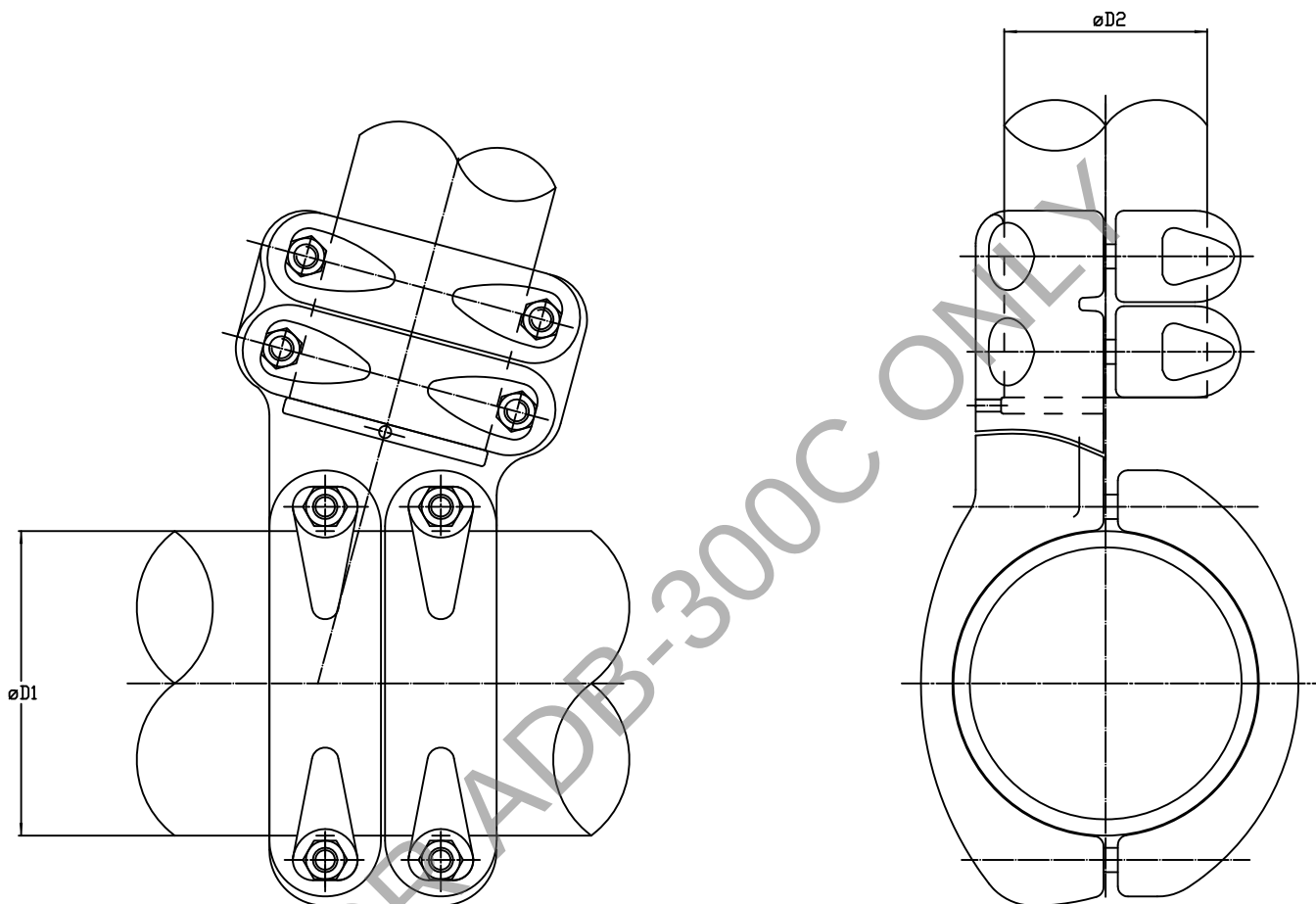
National Transmission & Despatch Company			Design
			NTDC
Drawn	-	THREE WAY ANGLE CONNECTOR 3", 3 1/2" & 5 AL PIPE TO 2 1/2", 3 1/2" AL PIPE TAP	
Checked	-		
Approved	-		
Chief Engineer Design NTDC		Scale: -	Date: -
DWG. No: PDW/DF 389R			

4

3

2

1

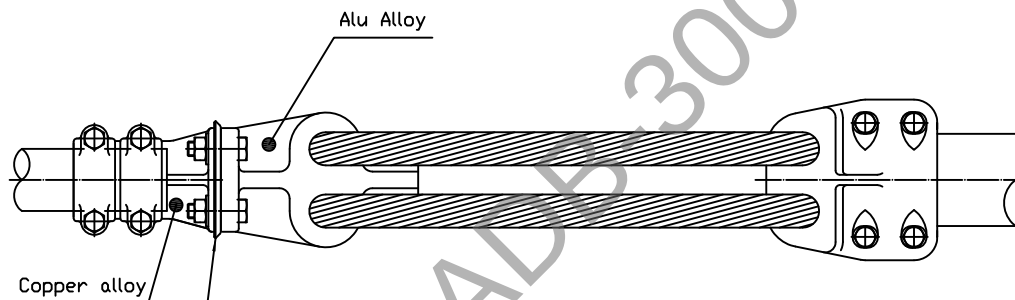
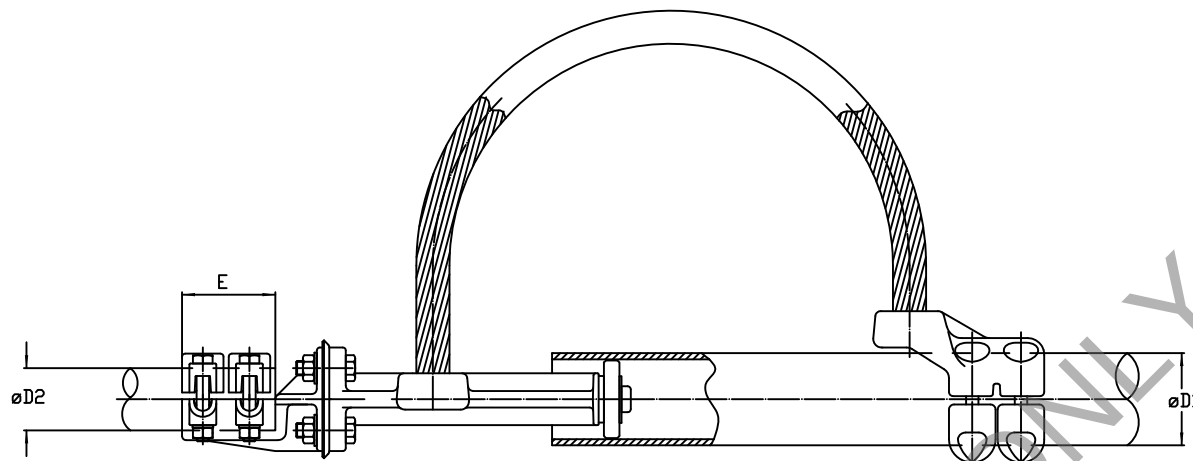


TMP3.0P2.5	88.9	73
TMP3.5P2.5	101.6	73
TMP5.0P2.5	141.3	73
TMP5.0P3.5	141.3	101.6
TYPE & DESIGNATION	$\phi D1$	$\phi D2$

NOTES:

1. All dimensions are in millimeters
2. Body & keeper manufactured in Al-Alloy
3. Type of material:
 - (i) Al Alloy heat treated - EN AC 42100 for body & EN AC 42200 for keeper
 - (ii) Bolts, Nuts and washers - Stainless steel A2-70 & A4-70
4. This drawing is for guidance only

National Transmission & Despatch Company		Design NTDC
Drawn	-	ANGLE TEE CONNECTORS AL 3", 3 1/2" & 5" PIPE TO 2 1/2", 3 1/2" AL PIPE TAP
Checked	-	
Approved	-	
Chief Engineer Design NTDC		Scale: - Date: -
DWG. No: PDW/DF 392R		



Bimetallic sheet Alu Alloy/Copper
Thickness 2mm

DBEP3.0,60	88.9	60	90
DBEP3.5,60	101.6	60	90
DBEP5.0,60	141.3	60	90
TYPE & DESIGNATION	$\phi D1$	$\phi D2$	E

NOTES:

- All dimensions are in millimeters
- Body manufactured in Al-Alloy and Copper Alloy.
Keeper for Cu alloy portion of connector in Cu alloy
- Type of material:
 - Al Alloy heat treated - EN AC 42100 for body & EN AC 42200 for keeper
 - Copper alloy-Copper / Nikel base family CuNi2Si, 96.4% copper+3.6% other alloy (Heat Treated)
 - Bolts, Nuts and washers - Stainless steel A2-70 & A4-70
- This drawing is for guidance only

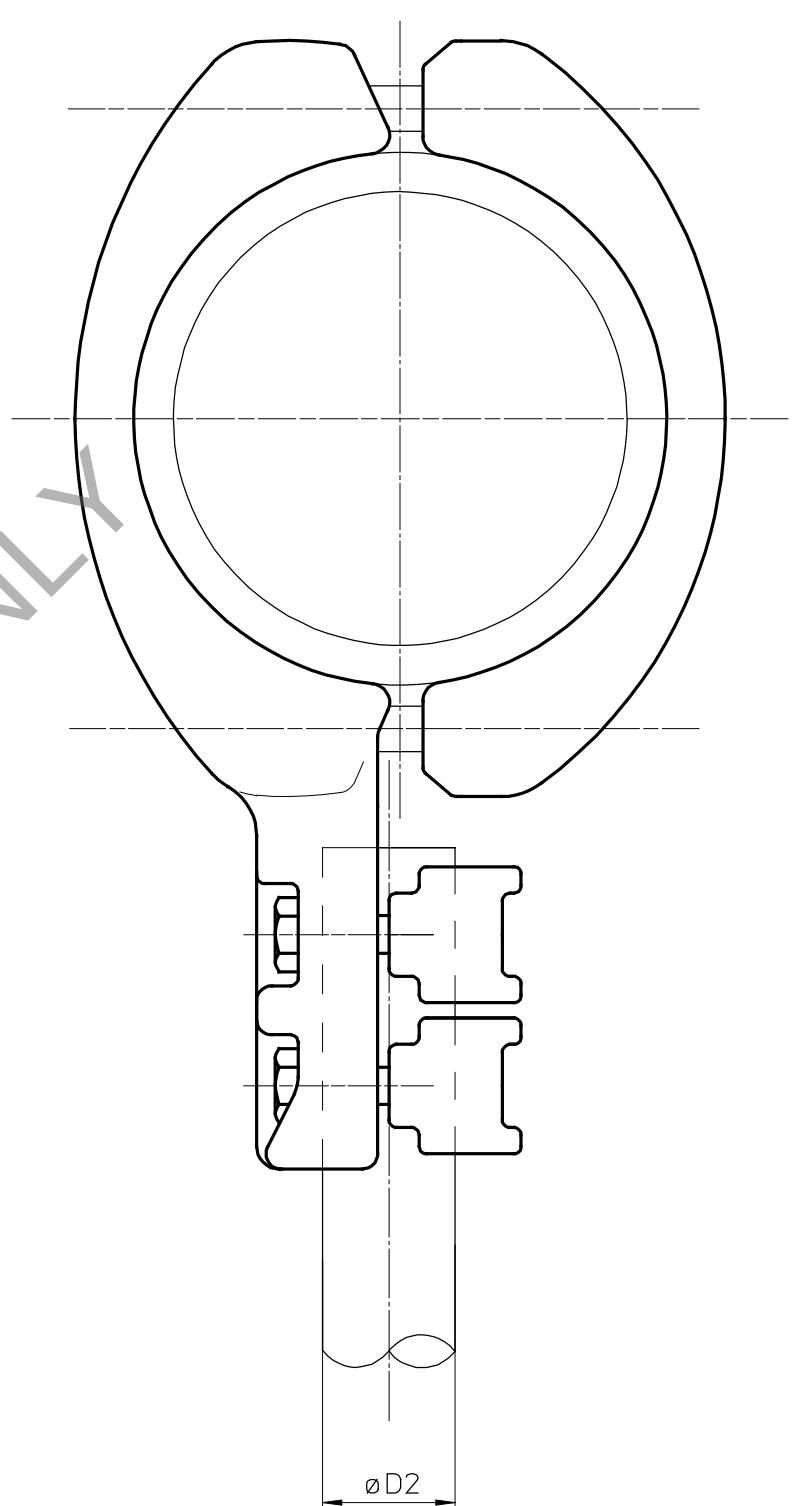
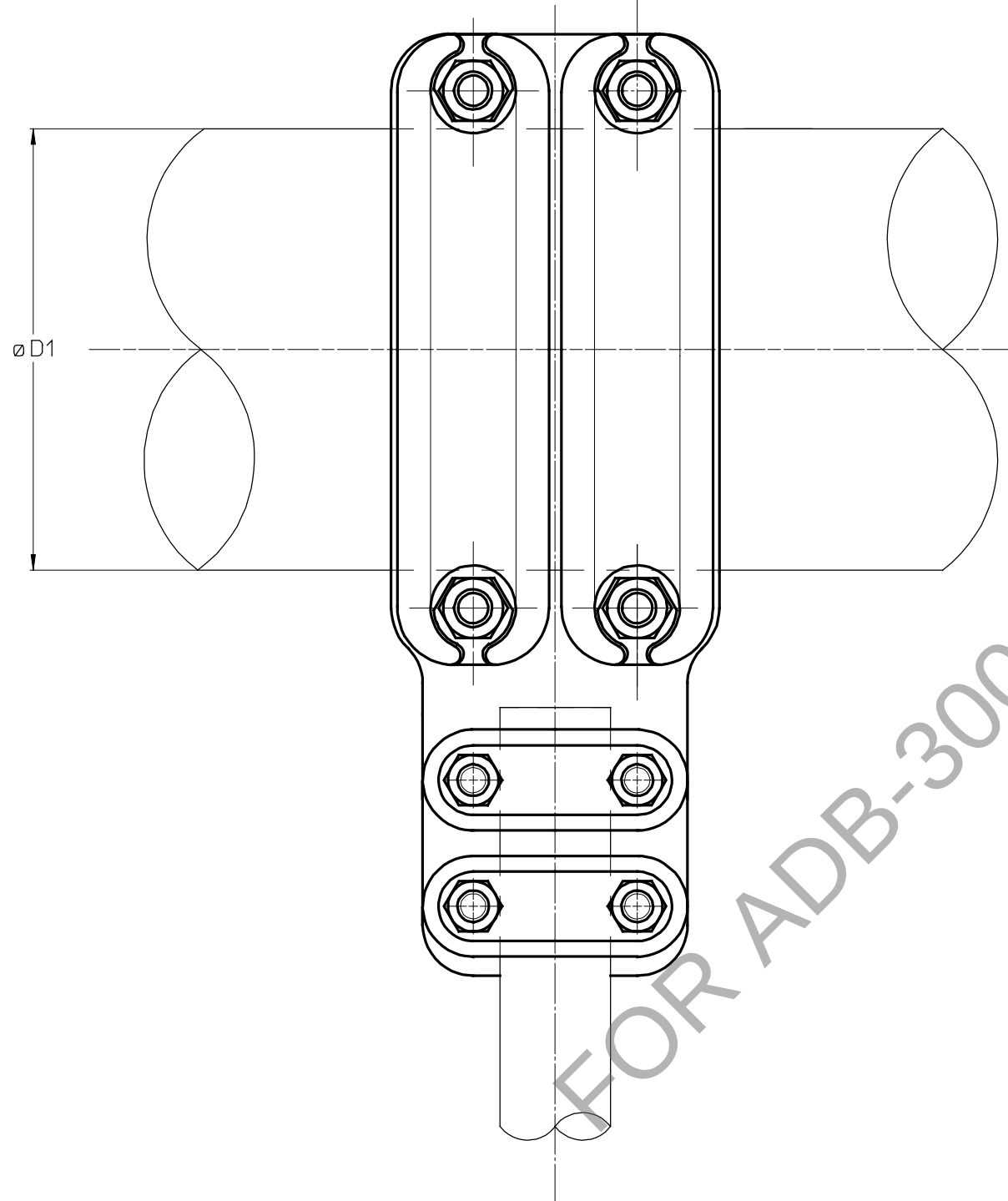
National Transmission & Despatch Company			Design NTDC
Drawn	-	STRAIGHT BIMETALLIC EXPANSION CONNECTOR AL-PIPE TO COPPER TERMINAL	
Checked	-		
Approved	-		
Chief Engineer Design NTDC		Scale: -	Date: -
DWG No: PDW/DF 393R			

4

3

2

1



NOTES:

1. All dimensions are in millimeters
2. Body manufactured in Al-Alloy
3. Type of material:
 - (i) Al Alloy - EN AC-serial 42000
 - (ii) Bolts, Nuts and washers - Stainless steel A2-70 & A4-70
4. This drawing is for guidance only

TMHP5.0	141.3	32
TYPE & DESIGNATION	øD1	øD2

National Transmission & Despatch Company		Design NTDC
Drawn		TEE MONOMETALLIC CONNECTOR AL.PIPE TO ALUMINIUM HAWTHORN CONDUCTOR
Checked		
Approved		
Chief Engineer Design NTDC		Scale: - Date: -
DWG No: PDW/DF 395R		

4

3

2

1

D

D

C

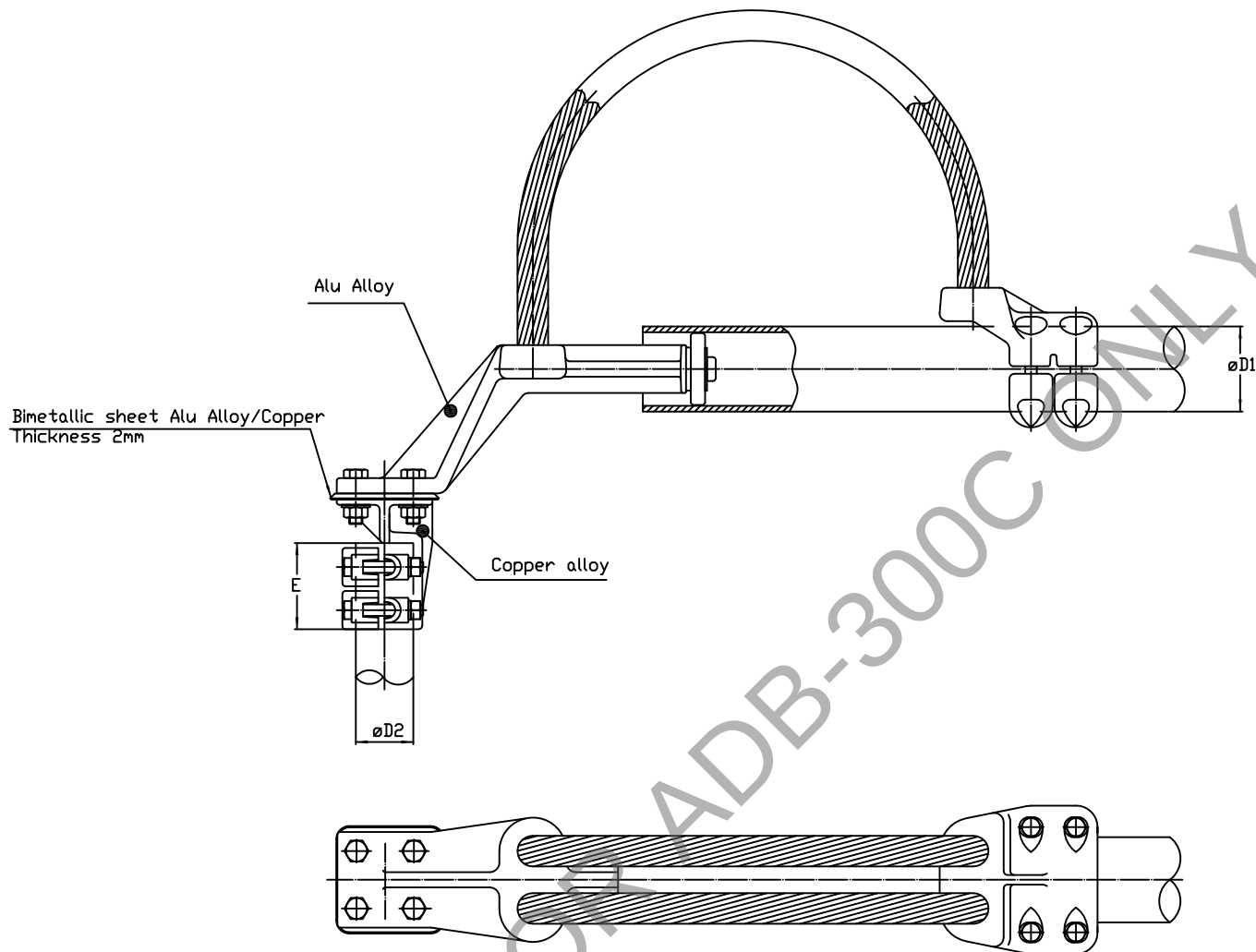
C

B

B

A

A

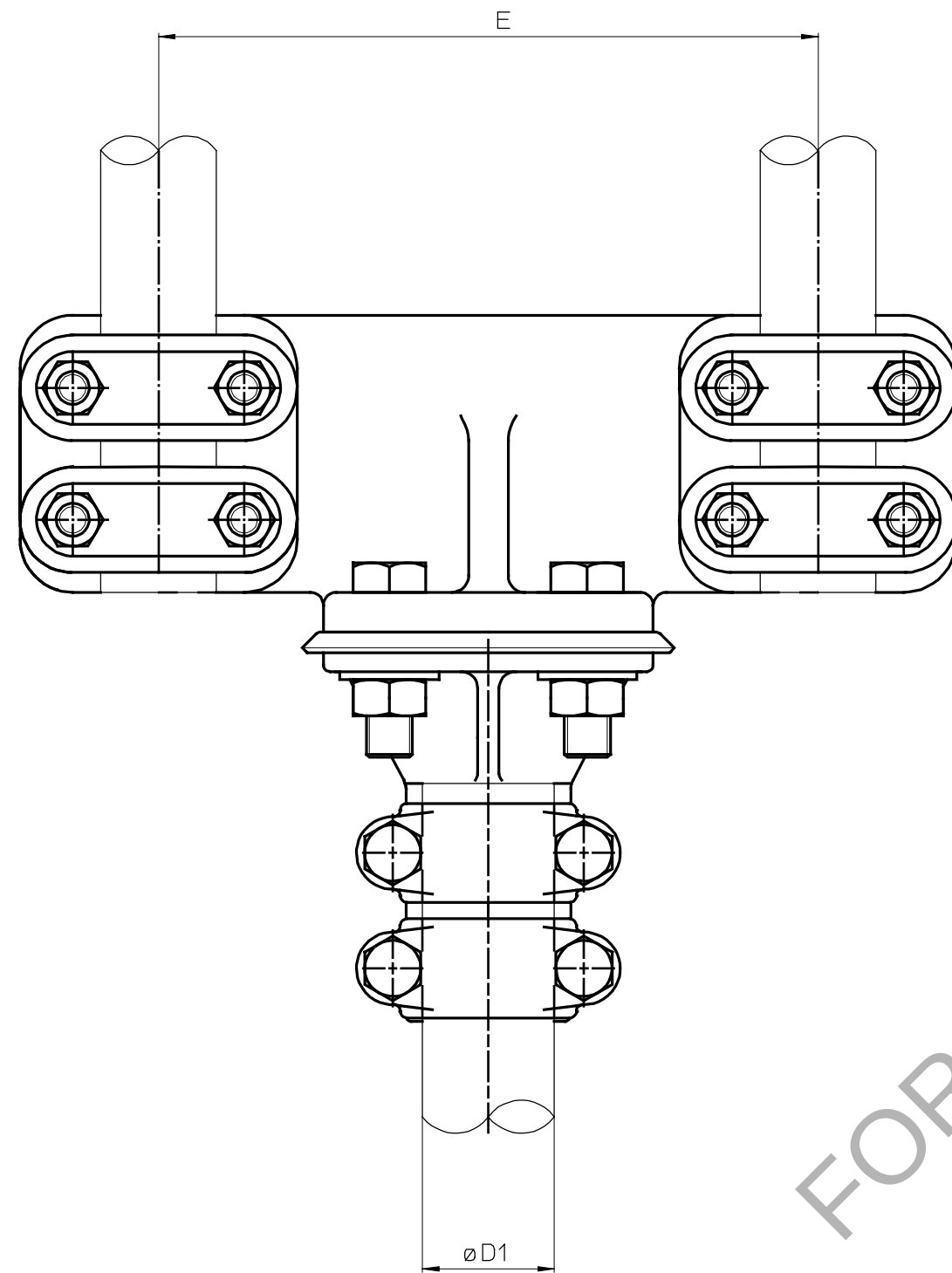


90°BEP3.0,60	88.9	60	90
90°BEP3.5,60	101.6	60	90
90°BEP5.0,60	141.3	60	90
90°BEP3.0,40	88.9	40	72
90°BEP5.0,40	141.3	40	72
TYPE & DESIGNATION	$\phi D1$	$\phi D2$	E

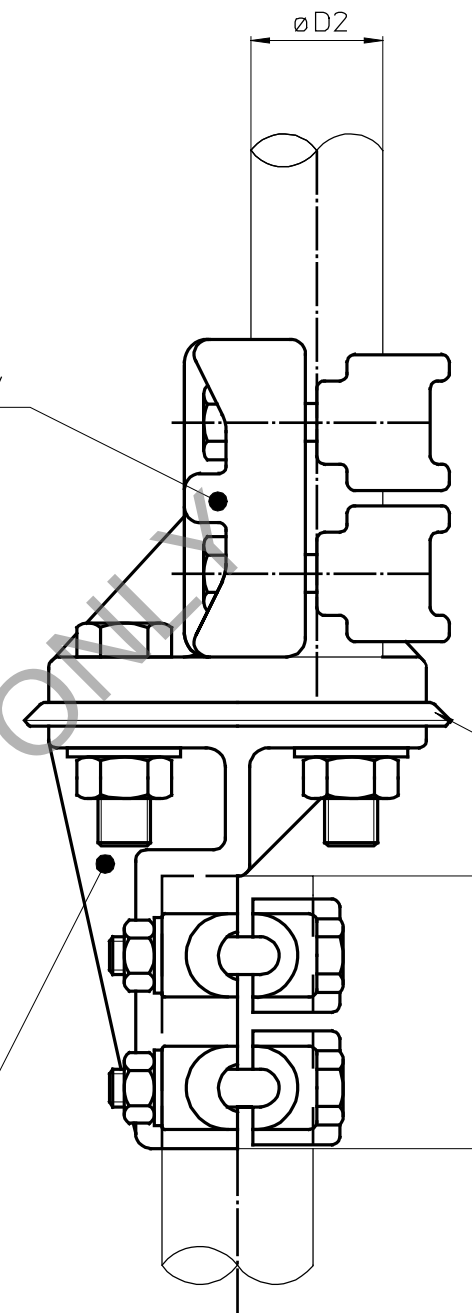
NOTES:

1. All dimensions are in millimeters
2. Body manufactured in Al-Alloy and Copper Alloy
Keeper for Cu alloy portion of connector in Cu alloy
3. Type of material:
(i) Al Alloy heat treated - EN AC 42100 for body & EN AC 42200 for keeper
(ii) Copper alloy-Copper / Nikel base family CuNi2Si,96.4% copper+3.6% other alloy (Heat Treated)
(iii) Bolts, Nuts and washers - Stainless steel A2-70 & A4-70
4. This drawing is for guidance only

National Transmission & Despatch Company			Design NTDC
Drawn	-	90° BIMETALLIC EXPANSION CONNECTOR FOR AL PIPE TO COPPER TERMINAL	
Checked	-		
Approved	-		
Chief Engineer Design NTDC		Scale: -	Date: -
DWG No: PDW/DF 396R			



Alu Alloy

Bimetallic sheet Alu Alloy/copper
Thickness 2mm

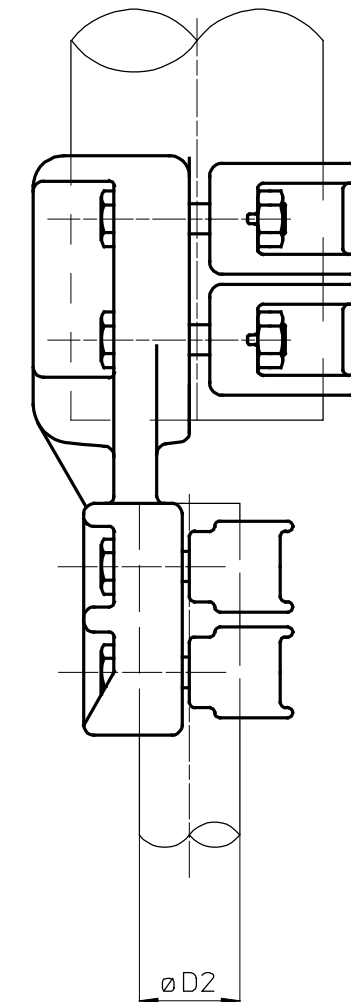
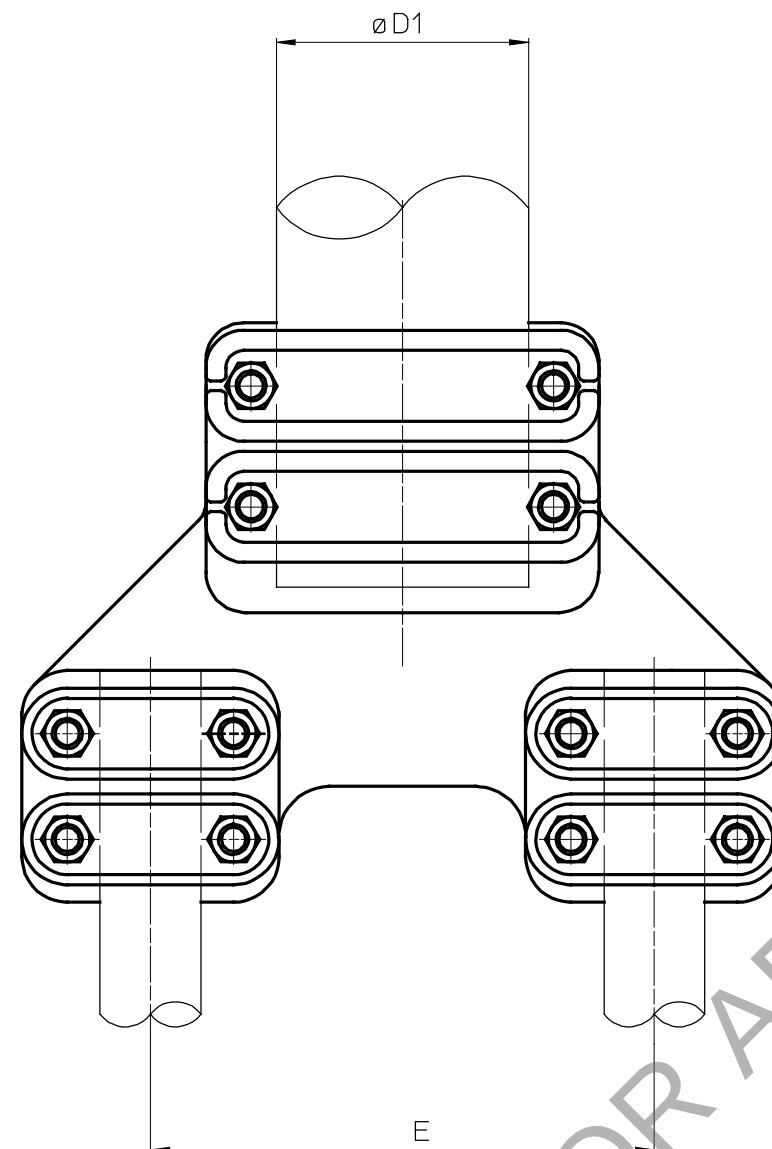
Copper alloy

ODBH60	60	32	200	90
ODBR60	60	29.6	200	90
ODBA60	60	27.72	200	90
ODBH40	40	32	200	72
TYPE & DESIGNATION	$\phi D1$	$\phi D2$	E	F

NOTES:

1. All dimensions are in millimeters
2. Body manufactured in Al-Alloy and Copper Alloy
3. Type of material:
 - (i) Al Alloy - EN AC-series 42000
 - (ii) Copper alloy-Copper / Nikel base family CuNi2Si,96.4% copper +3.6% other alloy (Heat Treated)
 - (iii) Bolts, Nuts and washers - Stainless steel A2-70 & A4-70
4. This drawing is for guidance only

National Transmission & Despatch Company			Design NTDC
Drawn	-	STRAIGHT BIMETALLIC CONNECTOR COPPER TERMINAL TO TWIN AL.CONDUCTOR	
Checked	-		
Approved	-		
Chief Engineer Design NTDC		Scale: -	Date: -
DWG No: PDW/DF 397R			

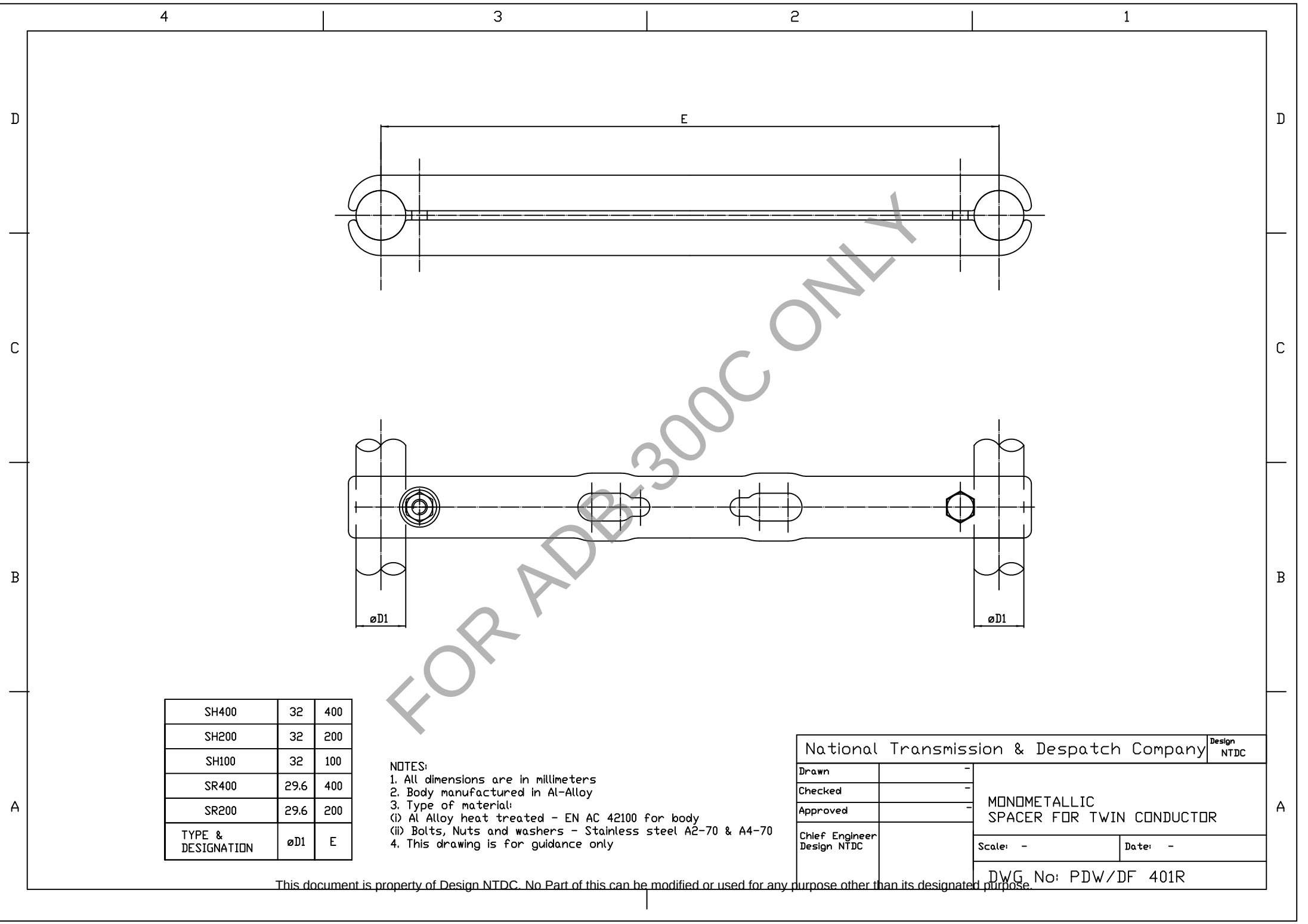


ODMHP3.0	88.9	32	200
ODMHP3.5	101.6	32	200
ODMHP5.0	141.3	32	200
ODMRP3.0	88.9	29.6	200
TYPE & DESIGNATION	øD1	øD2	E

NOTES:

1. All dimensions are in millimeters
2. Body manufactured in Al-Alloy
3. Type of material:
 - (i) Al Alloy - EN AC-series 42000
 - (ii) Bolts, Nuts and washers - Stainless steel A2-70 & A4-70
4. This drawing is for guidance only

National Transmission & Despatch Company			Design NTDC
Drawn	-	STRAIGHT MONOMETALLIC CONNECTOR FOR TWIN AL.CONDUCTOR TO AL.PIPE	
Checked	-		
Approved	-		
Chief Engineer Design NTDC	-	Scale: -	Date: -
DWG No: PDW/DF 398R			

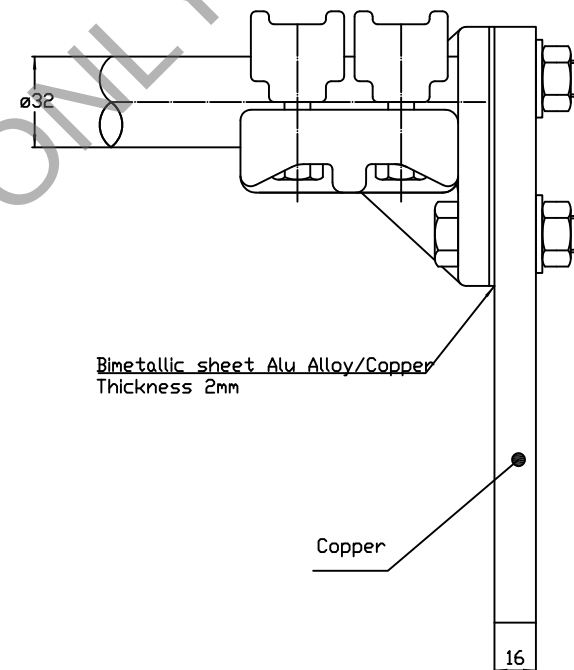
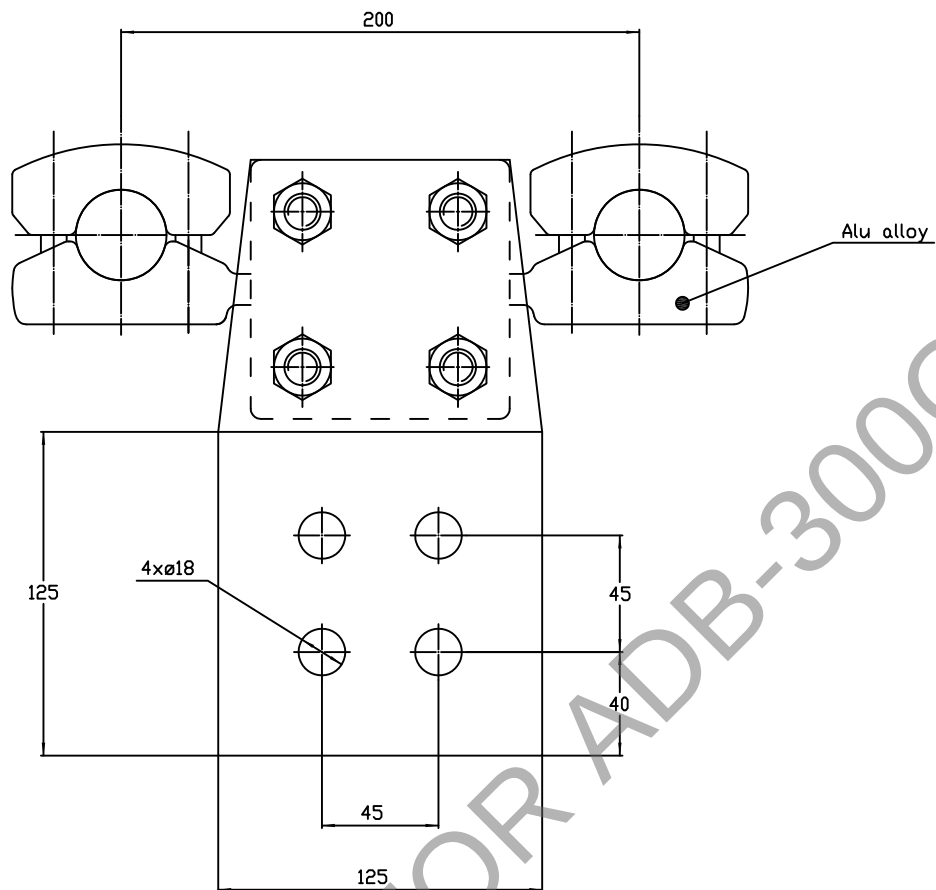


4

3

2

1



NOTES:

1. All dimensions are in millimeters
2. Body manufactured in Al-Alloy and Copper
3. Type of material:
 - (i) Al Alloy heat treated - EN AC 42100 for body & EN AC 42200 for keeper
 - (ii) Copper Cu-ETP
 - (iii) Bolts, Nuts and washers - Stainless steel A2-70 & A4-70
4. This drawing is for guidance only

90DBHF

TYPE &
DESIGNATION

National Transmission & Despatch Company

Design
NTDC

Drawn

Checked

Approved

Chief Engineer
Design NTDC90° BIMETALLIC CONNECTOR
COPPER FLAT TO TWIN
ALUMINIUM CONDUCTOR

Scale: -

Date: -

DWG No: PDW/DF 402R

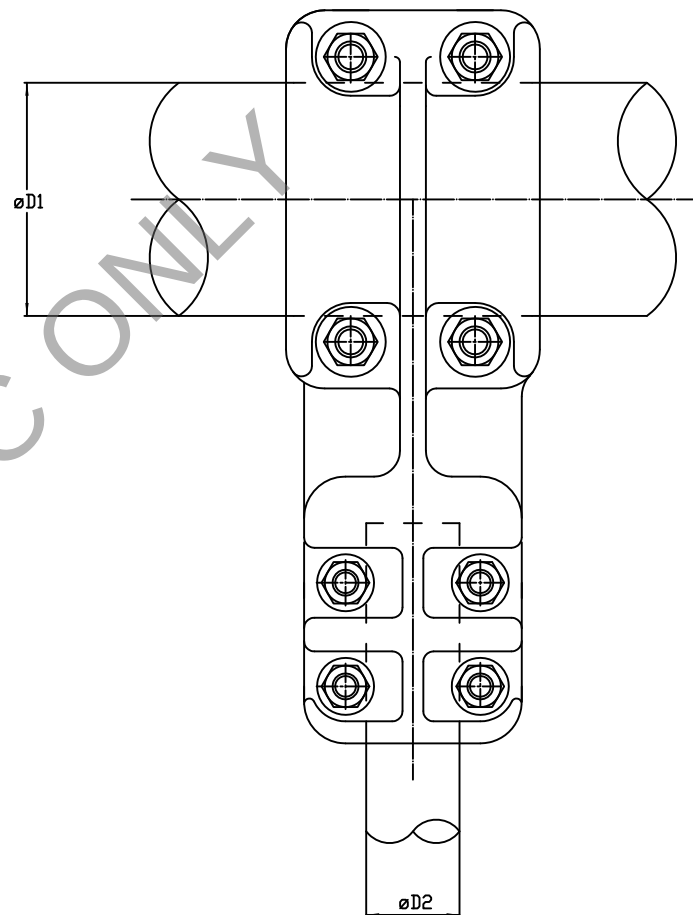
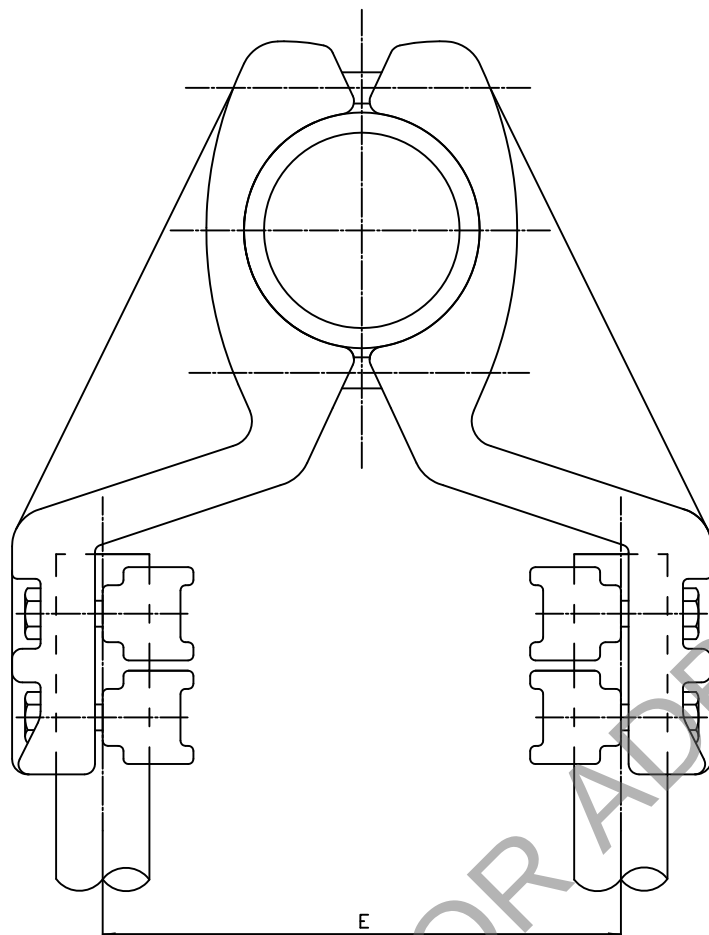
This document is property of Design NTDC. No Part of this can be modified or used for any purpose other than its designated purpose.

4

3

2

1



TDMHP5.0	141.3	32	100
TDMHP3.5	101.6	32	200
TDMAP3.0	88.9	27.72	200
TDMRP3.0	88.9	29.6	200
TYPE & DESIGNATION	ØD1	ØD2	E

NOTES:

1. All dimensions are in millimeters
2. Body manufactured in Al-Alloy
3. Type of material:
 - (i) Al Alloy heat treated - EN AC 42100 for body & EN AC 42200 for keeper
 - (ii) Bolts, Nuts and washers - Stainless steel A2-70 & A4-70
4. This drawing is for guidance only

National Transmission & Despatch Company		Design
		NTDC
Drawn	-	TEE MONOMETALLIC CONNECTOR TWIN AL. CONDUCTOR TO AL PIPE
Checked	-	
Approved	-	
Chief Engineer Design NTDC		Scale: - Date: -
DWG No: PDW/DF 405R		

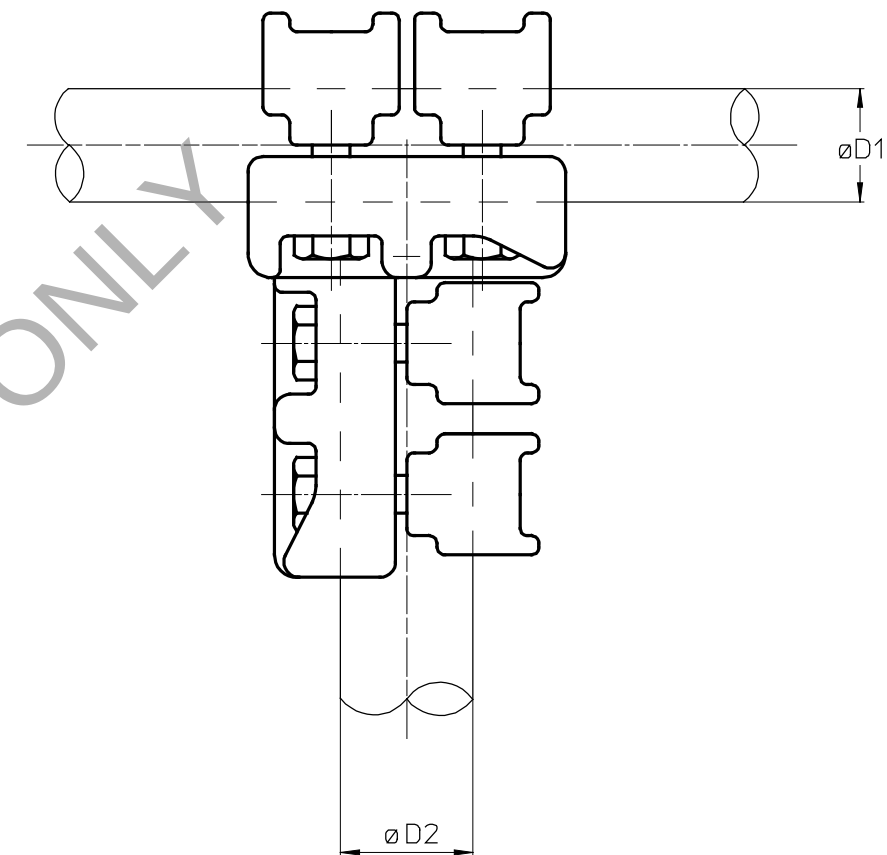
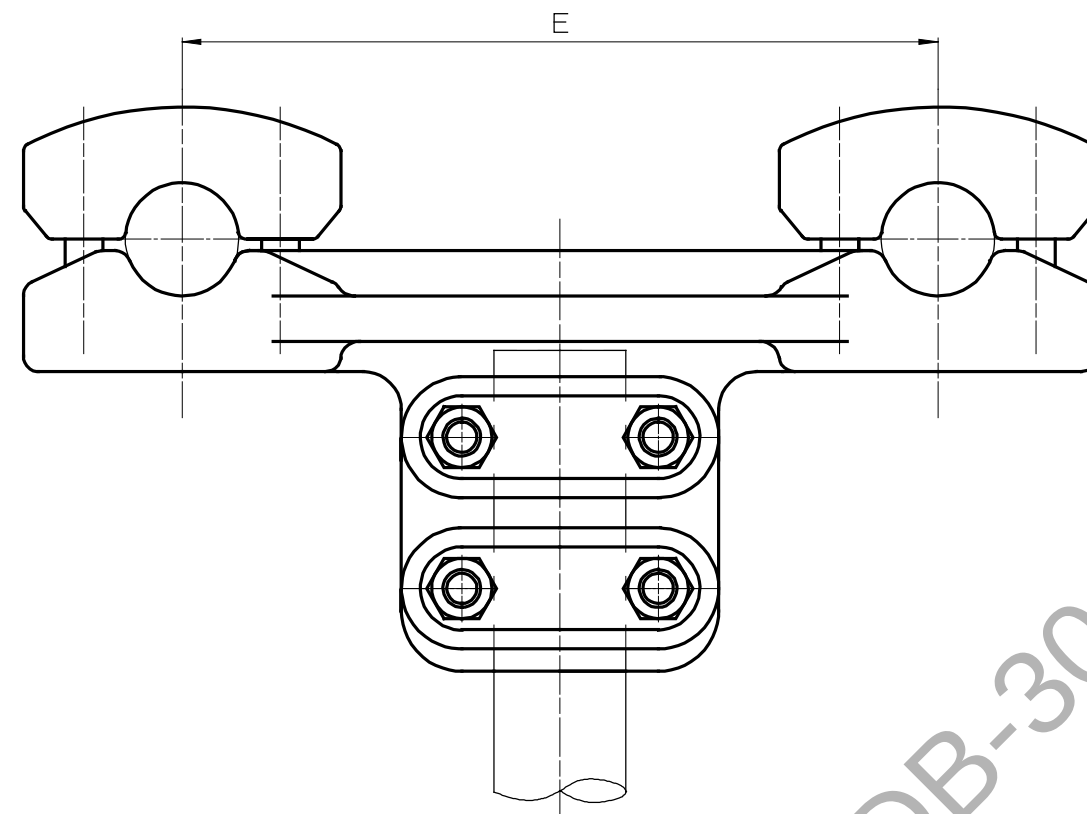
This document is property of Design NTDC. No Part of this can be modified or used for any purpose other than its designated purpose.

4

3

2

1



FOR ADB-300C ONLY

TDMHH	32	32	200
TDMRH	29.6	32	200
TDMRA	29.6	27.72	200
TYPE & DESIGNATION	øD1	øD2	E

NOTES:

1. All dimensions are in millimeters
2. Body manufactured in Al-Alloy
3. Type of material:
 - (i) Al Alloy - EN AC-serial 42000
 - (ii) Bolts, Nuts and washers - Stainless steel A2-70 & A4-70
4. This drawing is for guidance only

National Transmission & Despatch Company		Design NTDC
Drawn	-	TEE MONOMETALLIC CONNECTOR TWIN ALUMINIUM CONDUCTOR TO ALUMINIUM CONDUCTOR
Checked	-	
Approved	-	
Chief Engineer Design NTDC		Scale: - Date: -
DWG No: PDW/DF 406R		

4

3

2

1

D

D

C

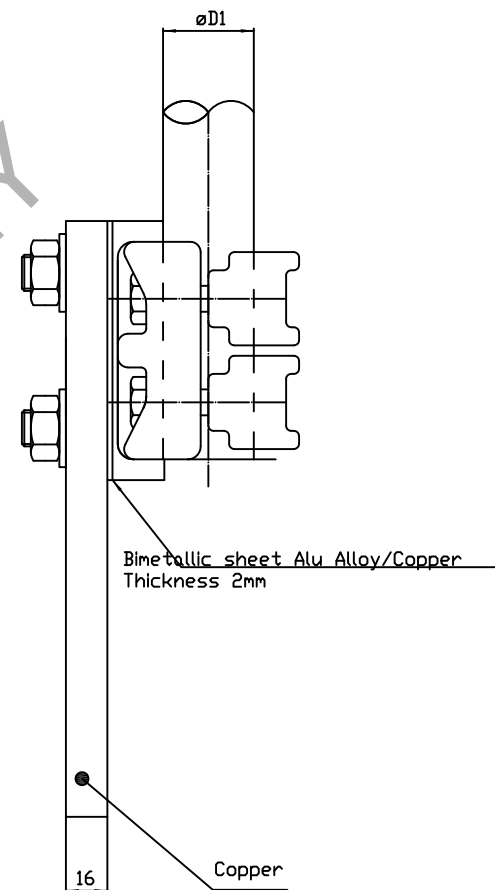
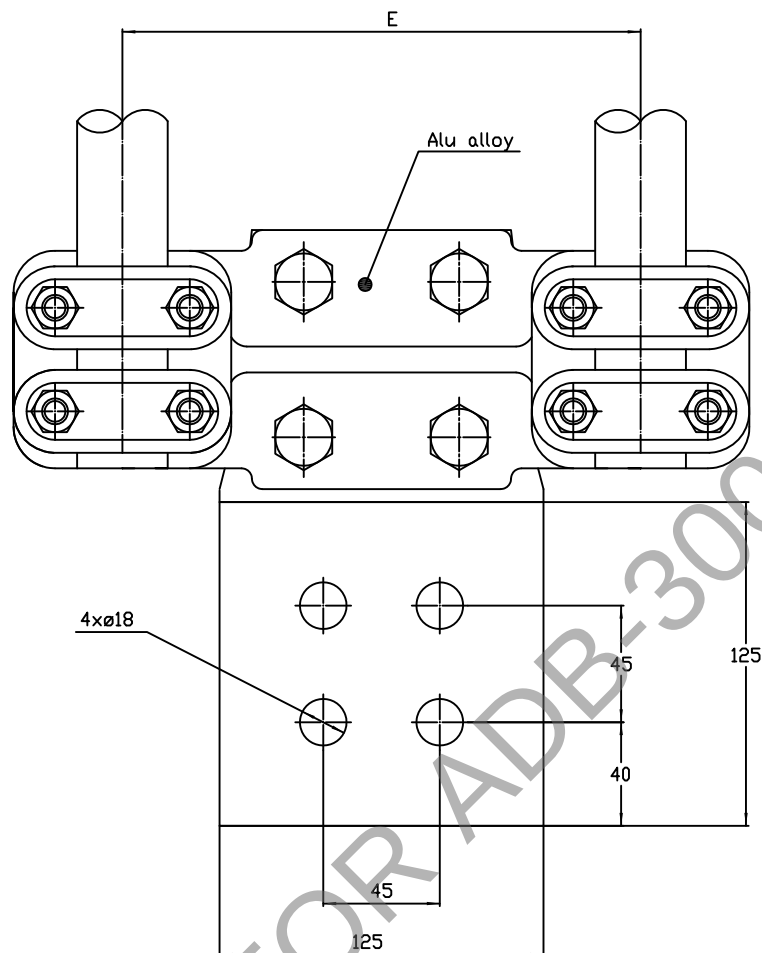
C

B

B

A

A



ØDBHF	32	200
ØDBHF	32	100
TYPE & DESIGNATION	øD1	E

NOTES:

1. All dimensions are in millimeters
2. Body manufactured in Al-Alloy and Copper
3. Type of material:
 - (i) Al Alloy heat treated - EN AC 42100 for body & EN AC 42200 for keeper
 - (ii) Copper Cu-ETP
 - (iii) Bolts, Nuts and washers - Stainless steel A2-70 & A4-70
4. This drawing is for guidance only

National Transmission & Despatch Company		Design NTDC
Drawn	-	STRAIGHT BIMETALLIC CONNECTOR COPPER FLAT TO AL.CONDUCTOR
Checked	-	
Approved	-	
Chief Engineer Design NTDC		Scale: - Date: -
DWG No: PDW/DF 407R		

4

3

2

1

D

D

C

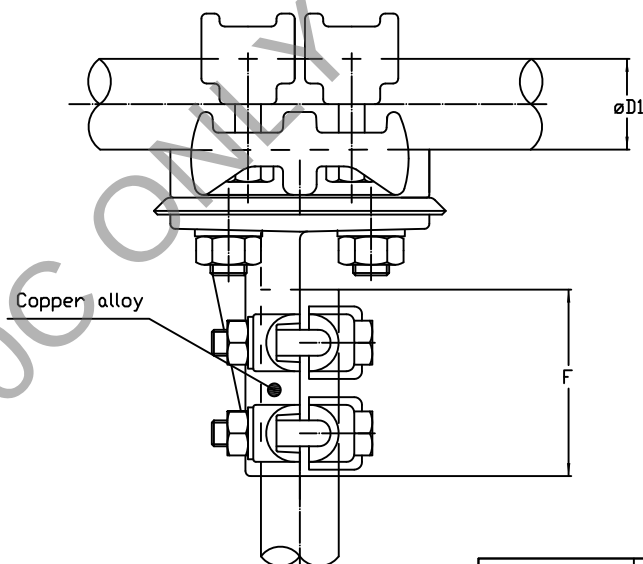
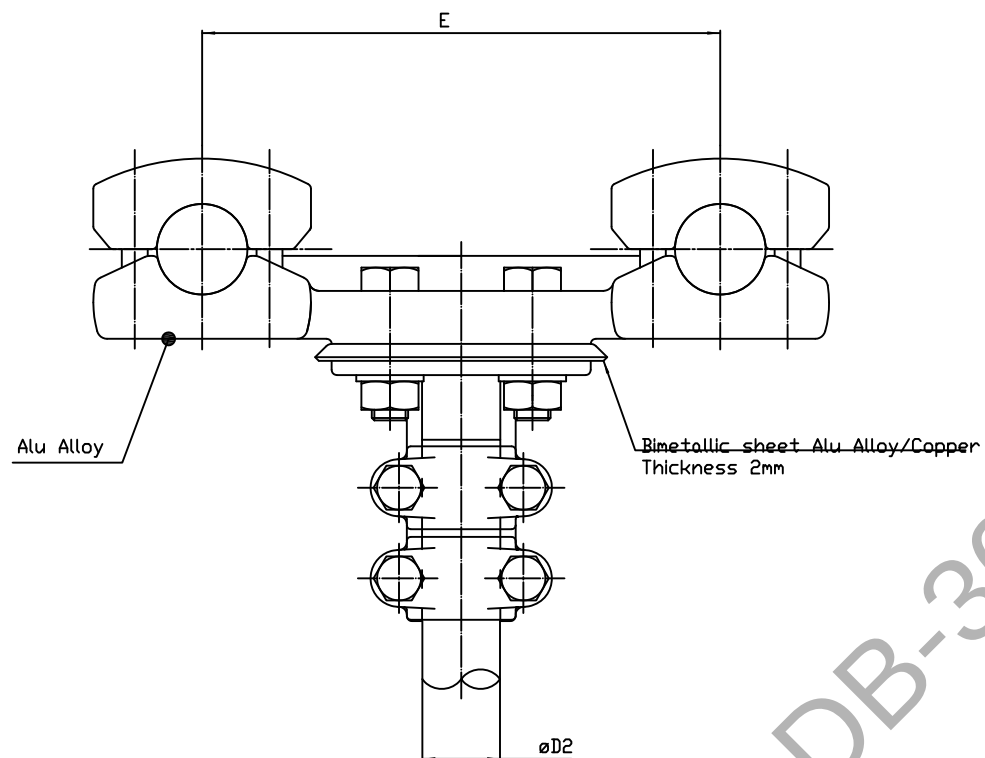
C

B

B

A

A



90/TDBA30	27,72	30	200	72
90/TDBA60	27,72	60	200	90
90/TDBR30	29.6	30	200	72
90/TDBR60	29.6	60	200	90
90/TDBH30	32	30	200	72
90/TDBH60	32	60	200	90
TYPE & DESIGNATION	øD1	øD2	E	F

NOTES:

- All dimensions are in millimeters
- Body manufactured in Al-Alloy and Copper Alloy
Keeper for Cu alloy portion of connector in Cu alloy
- Type of material:
 - Al Alloy heat treated - EN AC 42100 for body & EN AC 42200 for keeper
 - Copper alloy-Copper / Nikel base family CuNi2Si, 96.4% copper+3.6% other alloy (Heat Treated)
 - Bolts, Nuts and washers - Stainless steel A2-70 & A4-70
- This drawing is for guidance only

National Transmission & Despatch Company

Design
NTDC

Drawn

Checked

Approved

Chief Engineer
Design NTDC90/T BIMETALLIC CONNECTOR
COPPER TERMINAL
TO ALUMINIUM TWIN CONDUCTOR

Scale: -

Date: -

DWG No: PDW/DF 408R

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

4

3

2

1

D

D

C

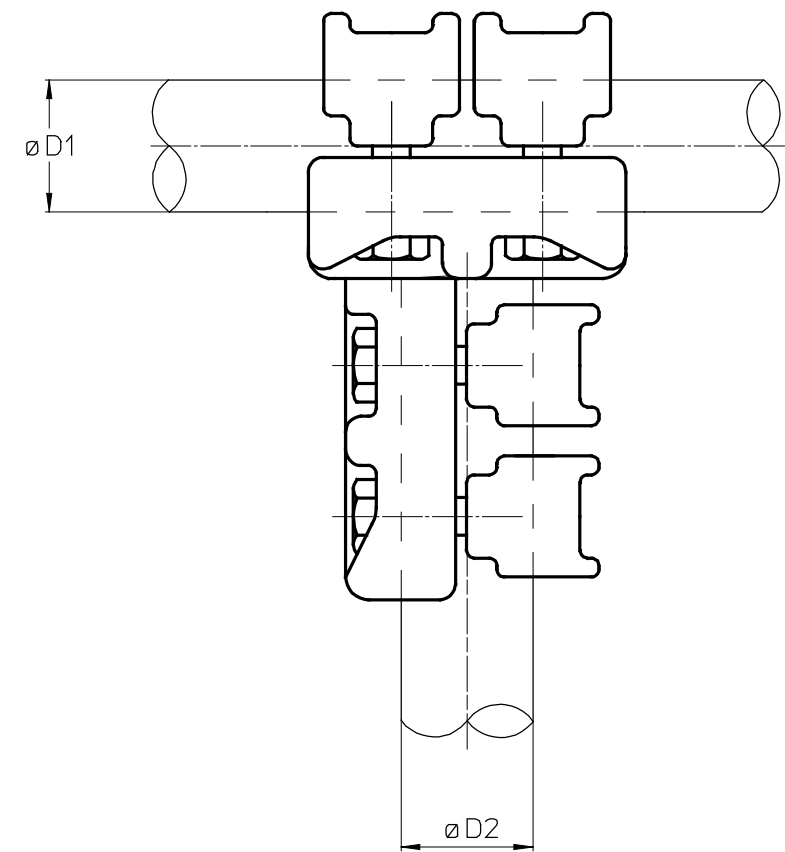
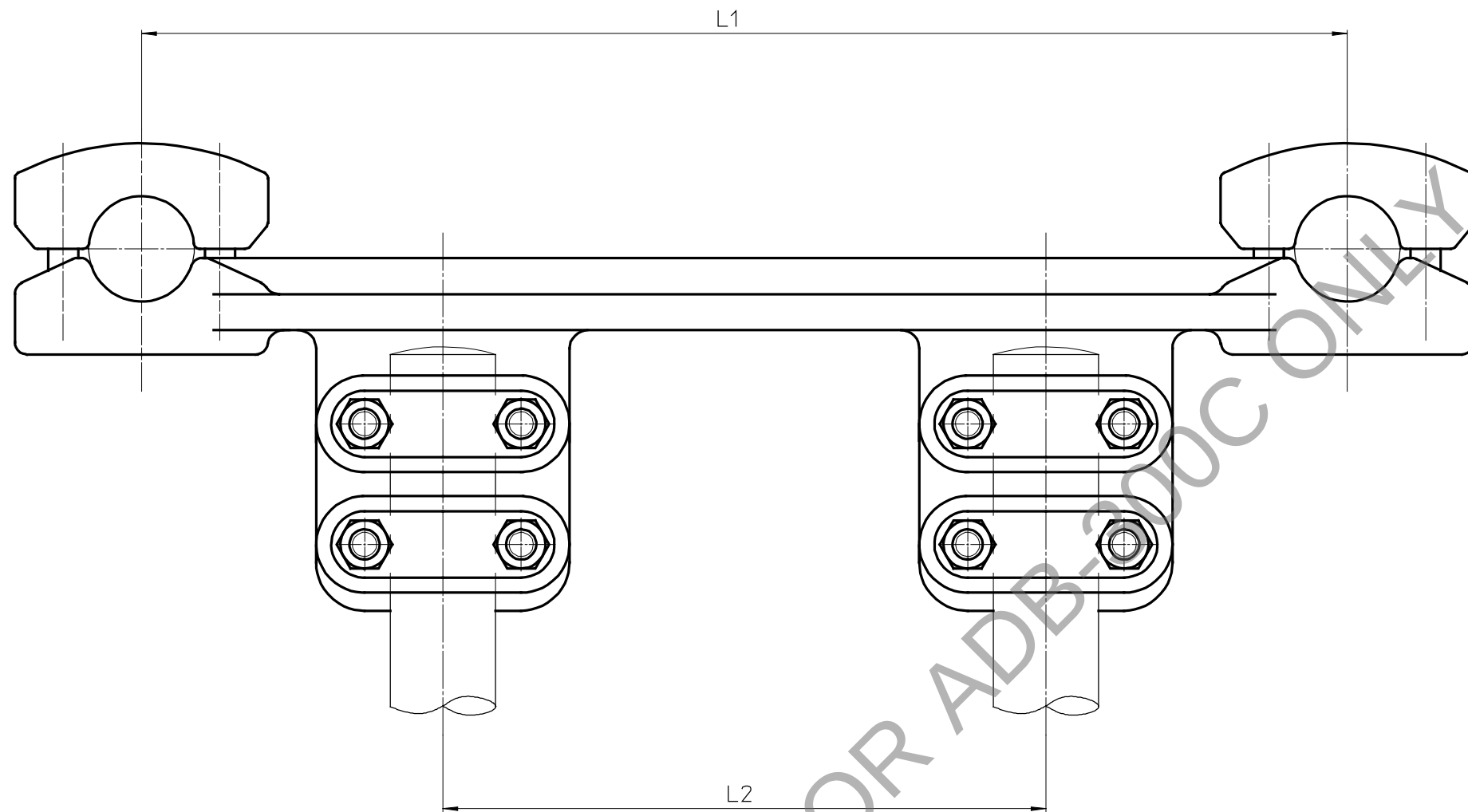
C

B

B

A

A



TDMHH	32	32	400	200
TDMRH	29.6	32	400	200
TYPE & DESIGNATION	øD1	øD2	L1	L2

NOTES:

1. All dimensions are in millimeters
2. Body manufactured in Al-Alloy
3. Type of material:
 - (i) Al Alloy - EN AC-series 42000
 - (ii) Bolts, Nuts and washers - Stainless steel A2-70 & A4-70
4. This drawing is for guidance only

National Transmission & Despatch Company			Design NTDC
Drawn	-	TEE DOUBLE MONOMETALLIC CONNECTOR TWIN AL.CONDUCTOR TO TWIN AL.CONDUCTOR	
Checked	-		
Approved	-		
Chief Engineer Design NTDC		Scale: -	Date: -
DWG No: PDW/DF 409R			

4

3

2

1

D

D

C

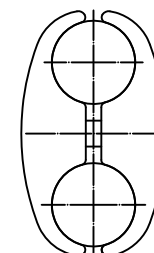
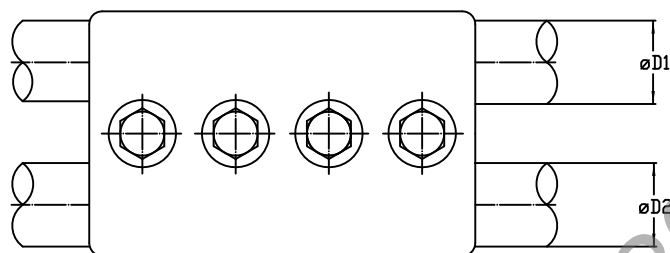
C

B

B

A

A



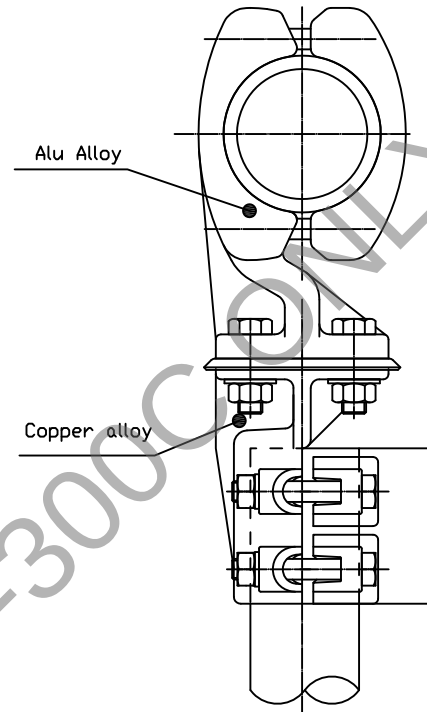
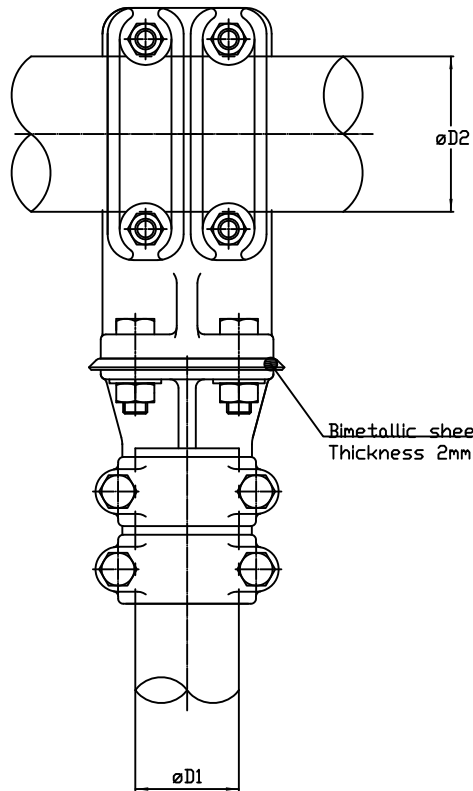
PGHH	32	32
PGJJ	39	39
PGRR	29.6	29.6
TYPE & DESIGNATION	øD1	øD2

NOTES:

1. All dimensions are in millimeters
2. Body manufactured in Al-Alloy
3. Type of material:
(i) Al Alloy heat treated - EN AC 42100 for body
(ii) Bolts, Nuts and washers - Stainless steel A2-70 & A4-70
4. This drawing is for guidance only

National Transmission & Despatch Company			Design NTDC
Drawn	-	PG CLAMP FOR AL CONDUCTOR	
Checked	-		
Approved	-		
Chief Engineer Design NTDC		Scale: -	Date: -
DWG No: PDW/DF 415R			

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



90/TBP3.0,60	60	88.9	90
90/TBP3.0,30	30	88.9	72
90/TBP3.5,60	60	101.6	90
90/TBP3.5,30	30	101.6	72
90/TBP5,40	40	141.3	72
90/TBP5,30	30	141.3	72
TYPE & DESIGNATION	$\phi D1$	$\phi D2$	E

NOTES:

- All dimensions are in millimeters
- Body manufactured in Al-Alloy and Copper Alloy
Keeper for Cu alloy portion of connector in Cu alloy
- Type of material:
 - Al Alloy heat treated - EN AC 42100 for body & EN AC 42200 for keeper
 - Copper alloy-Copper / Nikel base family CuNi2Si, 96.4% copper+3.6% other alloy (Heat Treated)
 - Bolts, Nuts and washers - Stainless steel A2-70 & A4-70
- This drawing is for guidance only

National Transmission & Despatch Company			Design NTDC
Drawn	-	90°T BIMETALLIC CONNECTOR ALUMINIUM PIPE TO COPPER TERMINAL	
Checked	-		
Approved	-		
Chief Engineer Design NTDC		Scale: -	Date: -
DWG No: PDW/DF 427R			

4

3

2

1

D

D

C

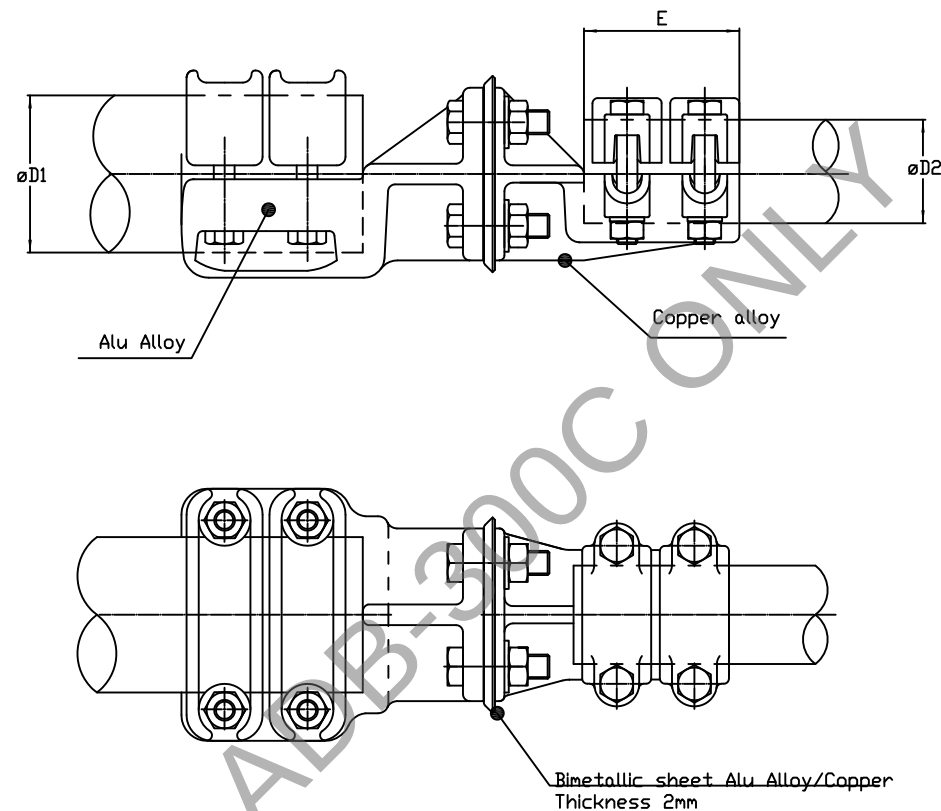
C

B

B

A

A



DBP3,0,60	88.9	60	90
DBP3,5,60	101.6	60	90
DBP5,0,40	141.3	40	72
TYPE & DESIGNATION	$\phi D1$	$\phi D2$	E

NOTES:

- All dimensions are in millimeters
- Body manufactured in Al-Alloy and Copper Alloy
Keeper for Cu alloy portion of connector in Cu alloy
- Type of material:
 - Al Alloy heat treated - EN AC 42100 for body & EN AC 42200 for keeper
 - Copper alloy-Copper / Nikel base family CuNi2Si, 96.4% copper+3.6% other alloy (Heat Treated)
 - Bolts, Nuts and washers - Stainless steel A2-70 & A4-70
- This drawing is for guidance only

National Transmission & Despatch Company			Design NTDC
Drawn	-	STRAIGHT BIMETALLIC CONNECTOR ALUMINIUM PIPE TO COPPER TERMINAL	
Checked	-		
Approved	-		
Chief Engineer Design NTDC		Scale: -	Date: -
DWG No: PDW/DF 428R			

4

3

2

1

D

D

C

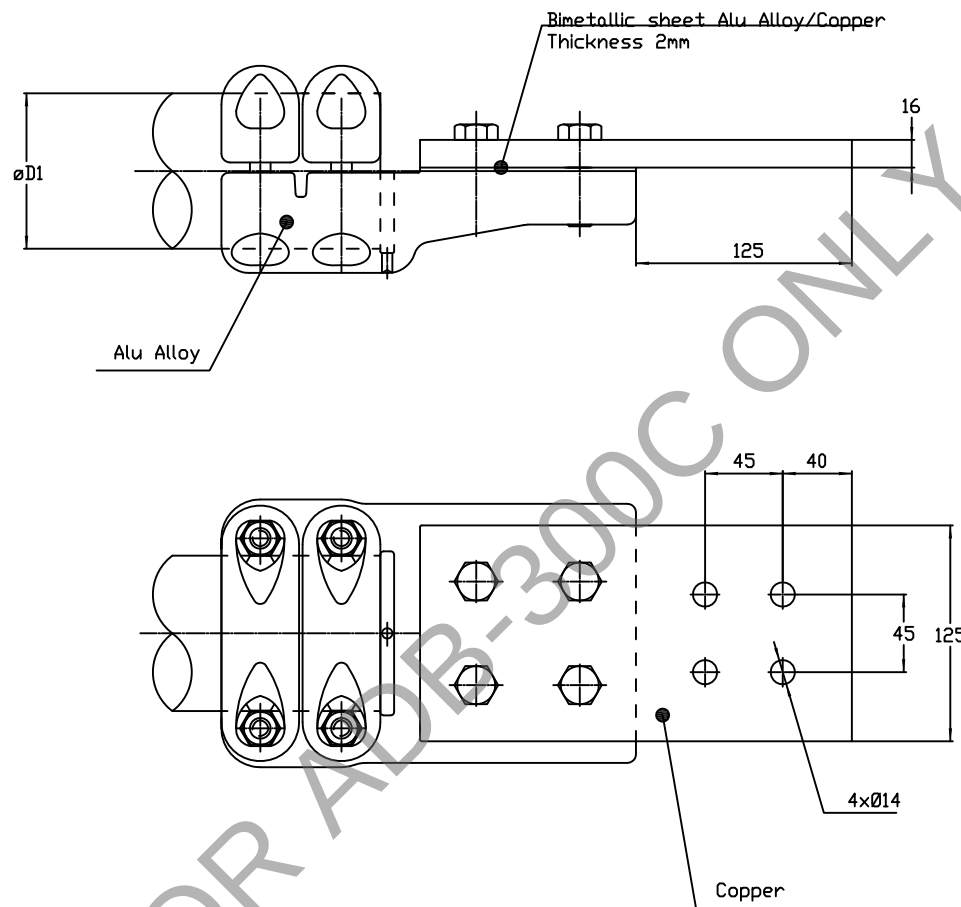
C

B

B

A

A



NOTES:

1. All dimensions are in millimeters
2. Body manufactured in Al-Alloy and Copper
3. Type of material:
 - (i) Al Alloy heat treated - EN AC 42100 for body & EN AC 42200 for keeper
 - (ii) Copper Cu-ETP
 - (iii) Bolts, Nuts and washers - Stainless steel A2-70 & A4-70
4. This drawing is for guidance only

DBP3.0F	88.9
DBP5.0F	141.3
TYPE & DESIGNATION	ØD1

National Transmission & Despatch Company

Design
NTDC

Drawn	-	STRAIGHT BIMETALLIC CONNECTOR ALUMINIUM PIPE TO FLAT COPPER TERMINAL
Checked	-	
Approved	-	
Chief Engineer Design NTDC		Scale: - Date: -

DWG No: PDW/DF 429R

4

3

2

1

D

D

C

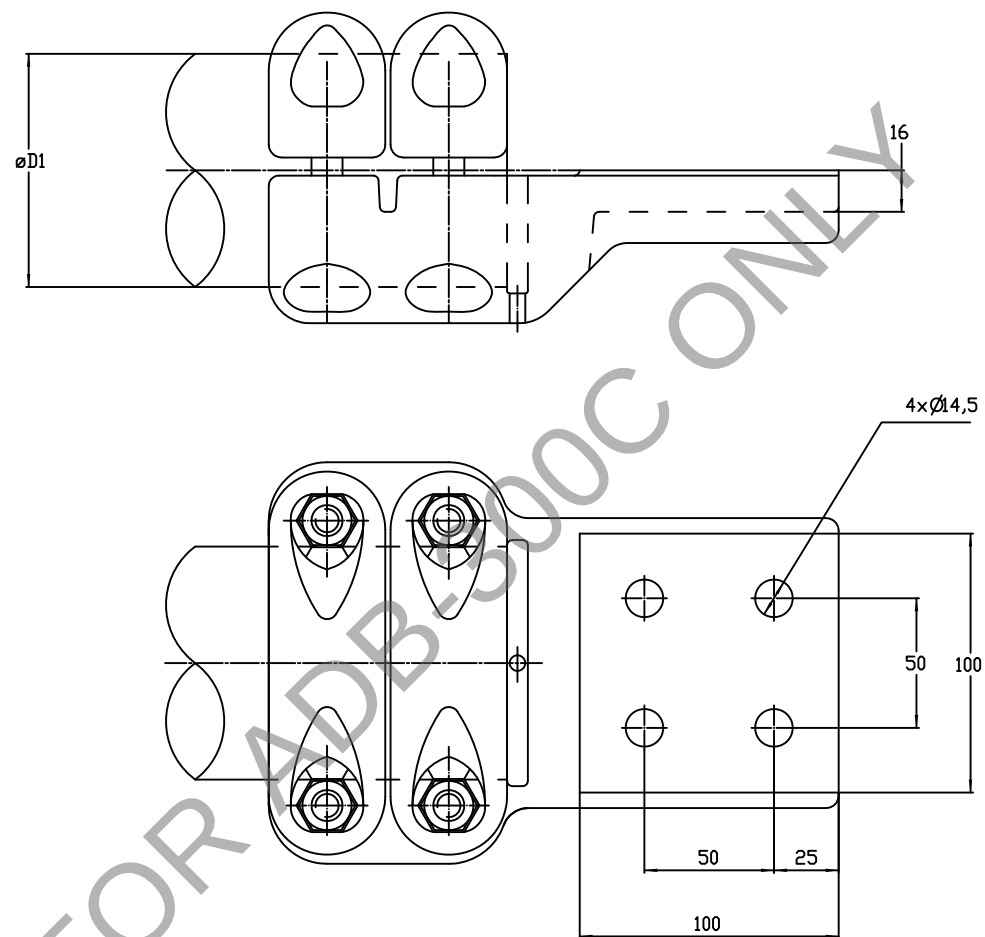
C

B

B

A

A



NOTES:

1. All dimensions are in millimeters
2. Body manufactured in Al-Alloy
3. Type of material:
 - (i) Al Alloy heat treated - EN AC 42100 for body & EN AC 42200 for keeper
 - (ii) Bolts, Nuts and washers - Stainless steel A2-70 & A4-70
4. This drawing is for guidance only

DMP3.0F	88.9
DMP3.5F	101.6
TYPE & DESIGNATION	$\phi D1$

National Transmission & Despatch Company

Design
NTDC

Drawn	-	STRAIGHT MONOMETALLIC CONNECTOR FOR ALUMINIUM PIPE TO FLAT ALUMINIUM TERMINAL
Checked	-	
Approved	-	
Chief Engineer Design NTDC		Scale: - Date: -

DWG No: PDW/DF 430R

4

3

2

1

D

D

C

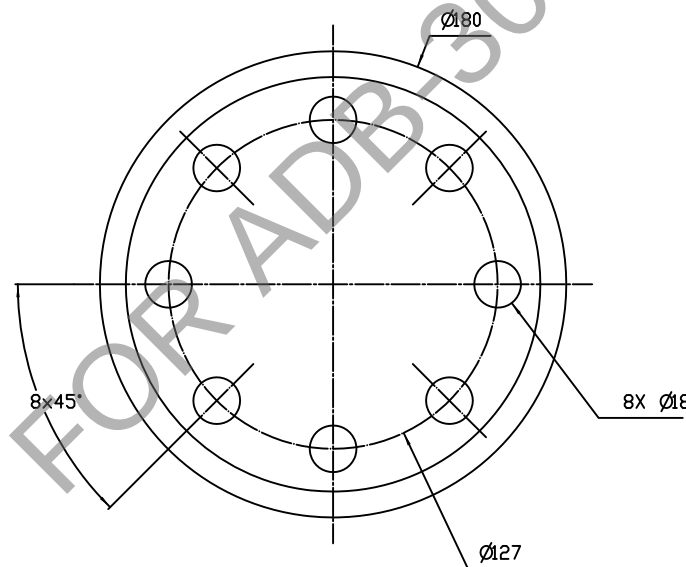
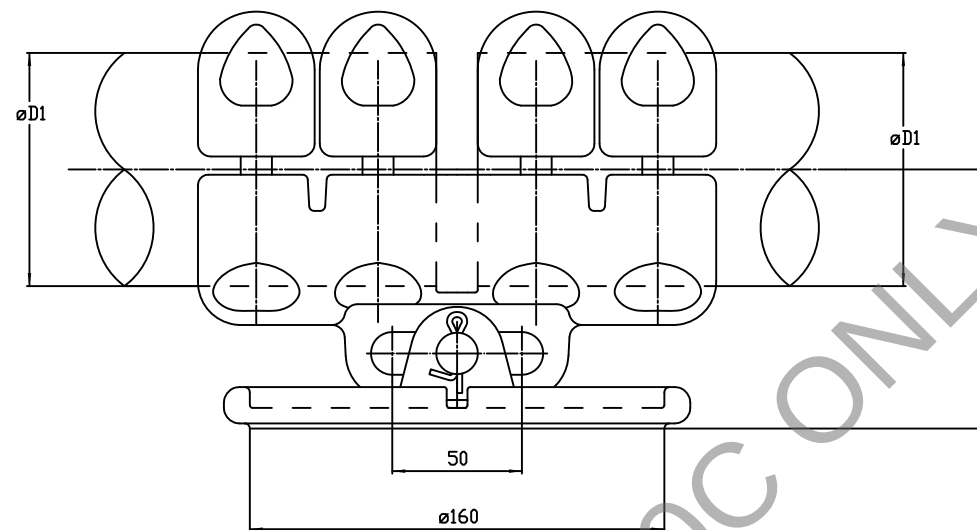
C

B

B

A

A



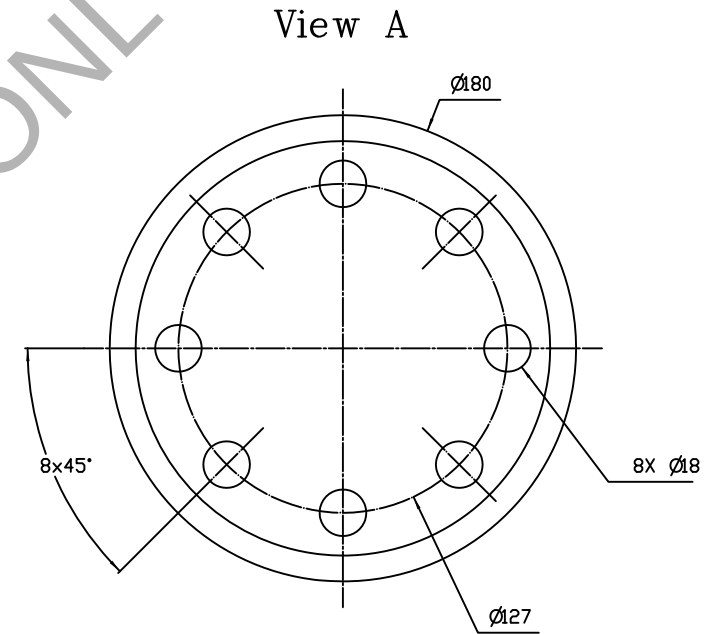
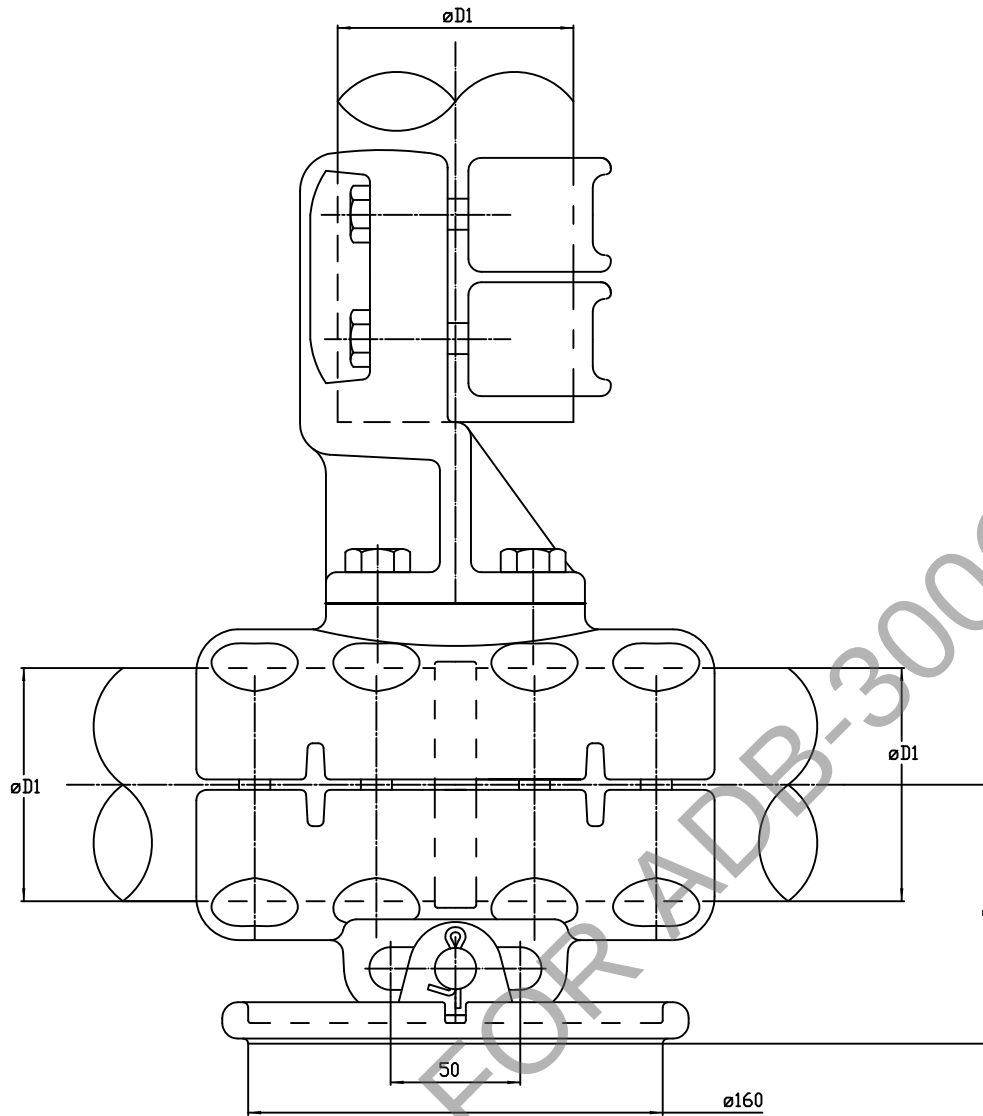
NOTES:

1. All dimensions are in millimeters
2. Body & keeper manufactured in Alloy
3. Type of material:
 - (i) Al Alloy heat treated - EN AC 42100 body & EN AC 42200 keeper
 - (ii) Bolts, Nuts and washers - Stainless steel A2-70 & A4-70
4. This drawing is for guidance only

SBSP3.0	88.9	100
SBSP3.5	101.6	105
SBSP5.0	141.3	125
TYPE & DESIGNATION	øD1	A

National Transmission & Despatch Company		Design
		NTDC
Drawn	-	MONOMETALLIC SLIDE SUPPORT FOR ALUMINIUM PIPE
Checked	-	
Approved	-	
Chief Engineer Design NTDC		Scale: - Date: -
DWG No: PDW/DF 431R		

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



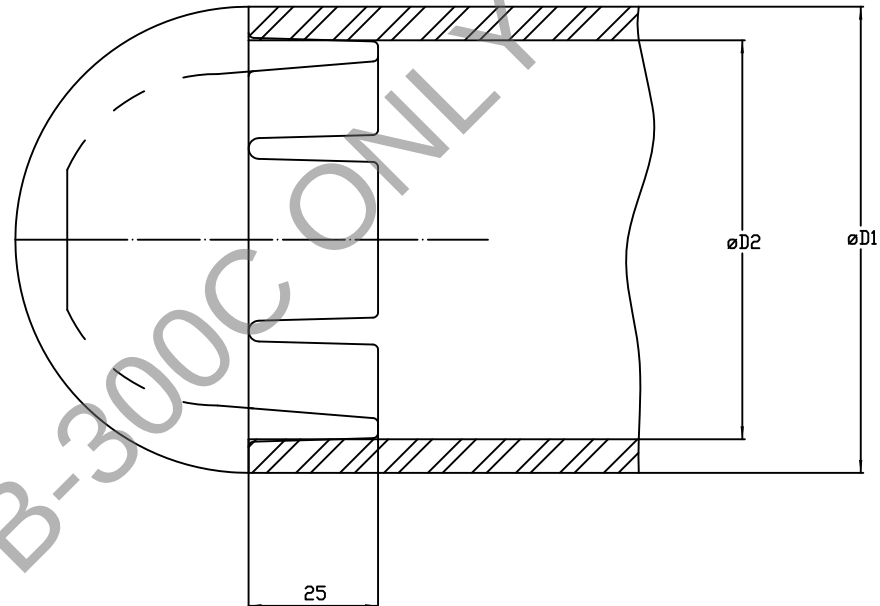
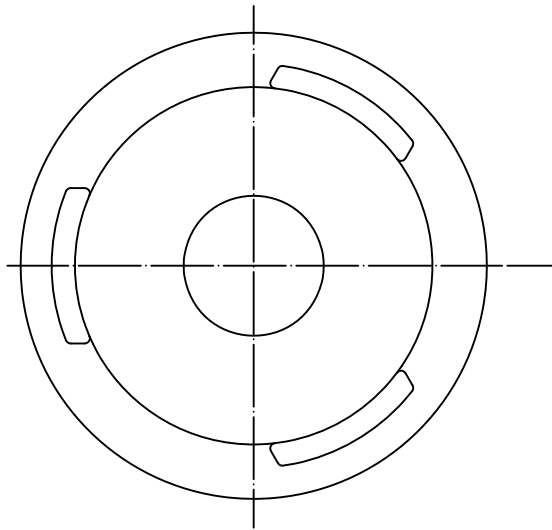
NOTES:

1. All dimensions are in millimeters
2. Body & keeper manufactured in Al-Alloy
3. Type of material:
 - (i) Al Alloy heat treated - EN AC 42100 body & EN AC 42200 keeper
 - (ii) Bolts, Nuts and washers - Stainless steel A2-70 & A4-70
4. This drawing is for guidance only

T-SBSP3.0	88.9	100
T-SBSP3.5	101.6	105
TYPE & DESIGNATION	øD1	A

National Transmission & Despatch Company			Design NTDC
Drawn	-	MONOMETALLIC T-SLIDE BUS SUPPORT FOR ALUMINIUM PIPE	
Checked	-		
Approved	-		
Chief Engineer Design NTDC	-	Scale: -	Date: -
DWG No: PDW/DF 432R			

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



CAPP3.0	88.9	77.92
CAPP3.5	101.6	90.12
CAPP5.0	141.3	128.3
TYPE & DESIGNATION	ØD1	ØD2

NOTES:

1. All dimensions are in millimeters
2. Body manufactured in Al-Alloy
3. Type of material:
 - (i) Al Alloy heat treated - EN AC 42100 for body
 - (ii) Bolts, Nuts and washers - Stainless steel A2-70 & A4-70
4. This drawing is for guidance only

National Transmission & Despatch Company			Design NTDC
Drawn	-	CAP FOR ALUMINIUM PIPE	
Checked	-		
Approved	-		
Chief Engineer Design NTDC		Scale: -	Date: -
DWG No: PDW/DF 433R			

D

D

C

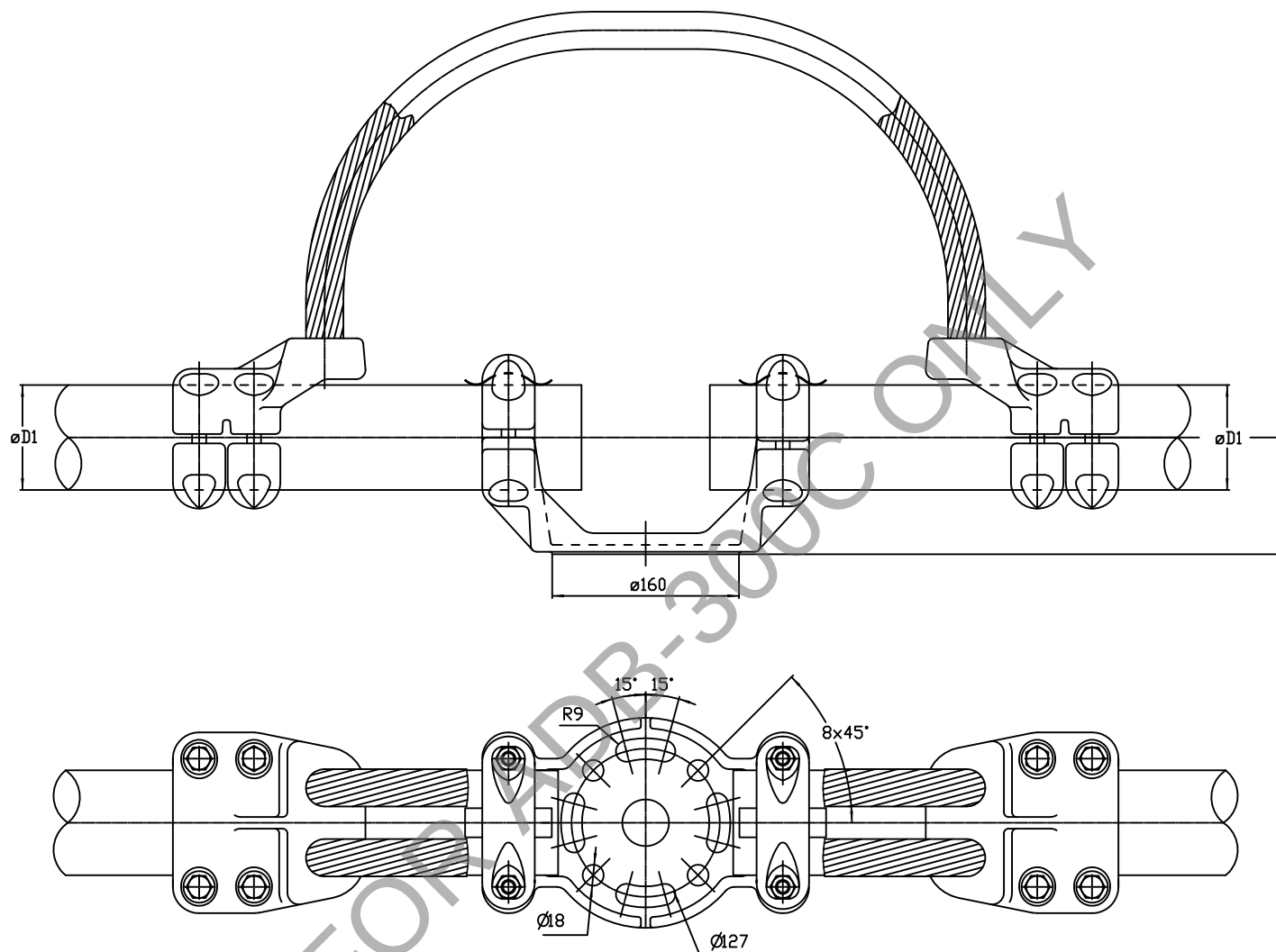
C

B

B

A

A

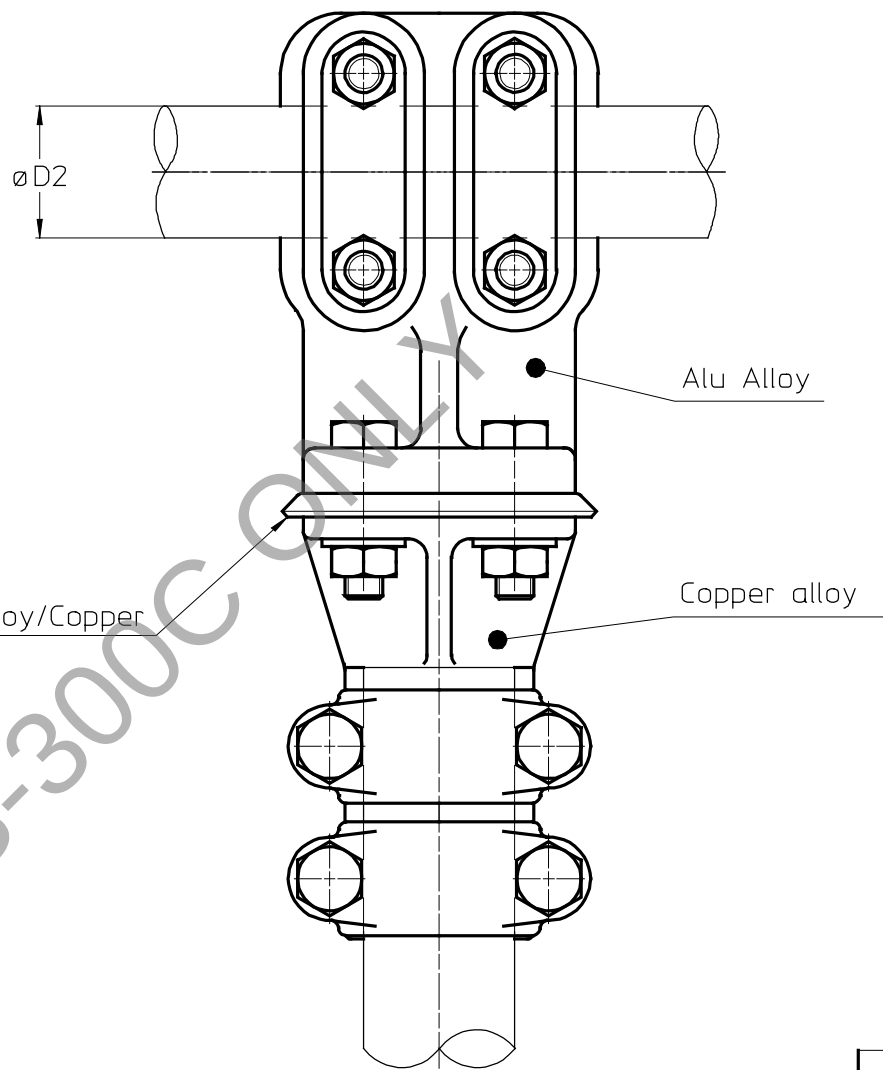
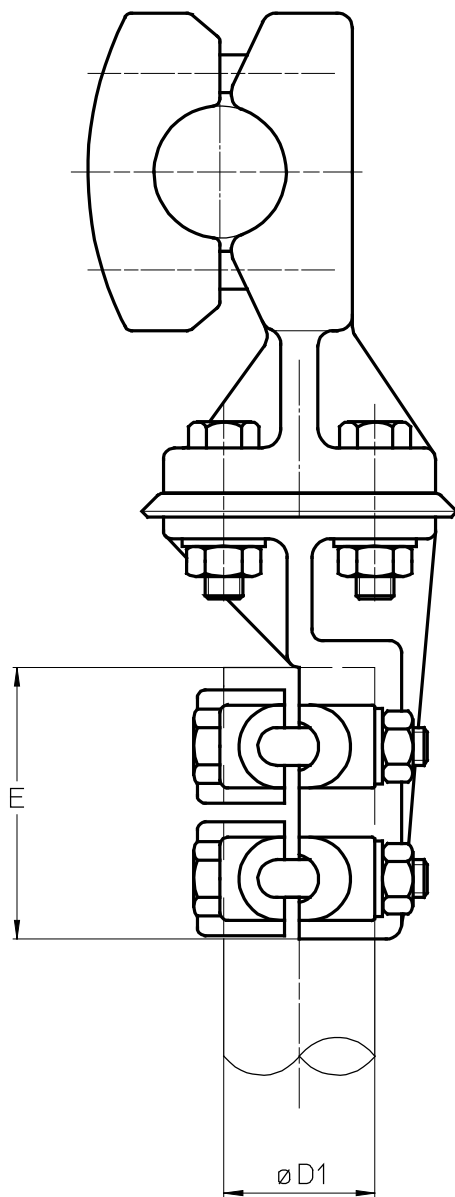


EBSP3.0	88.9	100
EBSP3.5	101.6	105
EBSP5.0	141.3	125
TYPE & DESIGNATION	øD1	A

NOTES:

1. All dimensions are in millimeters
2. Body & keeper manufactured in Al-Alloy
3. Type of material:
 - (i) Al Alloy heat treated - EN AC 42100 for body & EN AC 42200 for keeper
 - (ii) Bolts, Nuts and washers - Stainless steel A2-70 & A4-70
4. This drawing is for guidance only

National Transmission & Despatch Company		Design NTDC
Drawn	-	MONOMETALLIC EXPANSION BUS SUPPORT FOR ALUMINIUM PIPE
Checked	-	
Approved	-	
Chief Engineer Design NTDC		Scale: - Date: -
		DWG No: PDW/DF 434R



FOR ADB-300C ONLY

90BH60	60	32	90
90BH40	40	32	72
90BH30	30	32	72
TYPE & DESIGNATION	øD1	øD2	E

- NOTES:
- 1. All dimensions are in millimeters
 - 2. Body manufactured in Al-Alloy and Copper Alloy
 - 3. Type of material:
 - (i) Al Alloy - EN AC-serial 42000
 - (ii) Copper alloy-Copper / Nikel base family CuNi2Si,96.4% copper +3.6% other alloy (Heat Treated)
 - (iii) Bolts, Nuts and washers - Stainless steel A2-70 & A4-70
 - 4. This drawing is for guidance only

National Transmission & Despatch Company			Design NTDC
Drawn	-	BIMETALLIC CONNECTOR FOR SINGLE AL.CONDUCTOR TO COPPER TERMINAL	
Checked	-		
Approved	-		
Chief Engineer Design NTDC		Scale: -	Date: -
DWG No: PDW/DF 435R			

4

3

2

1

D

D

C

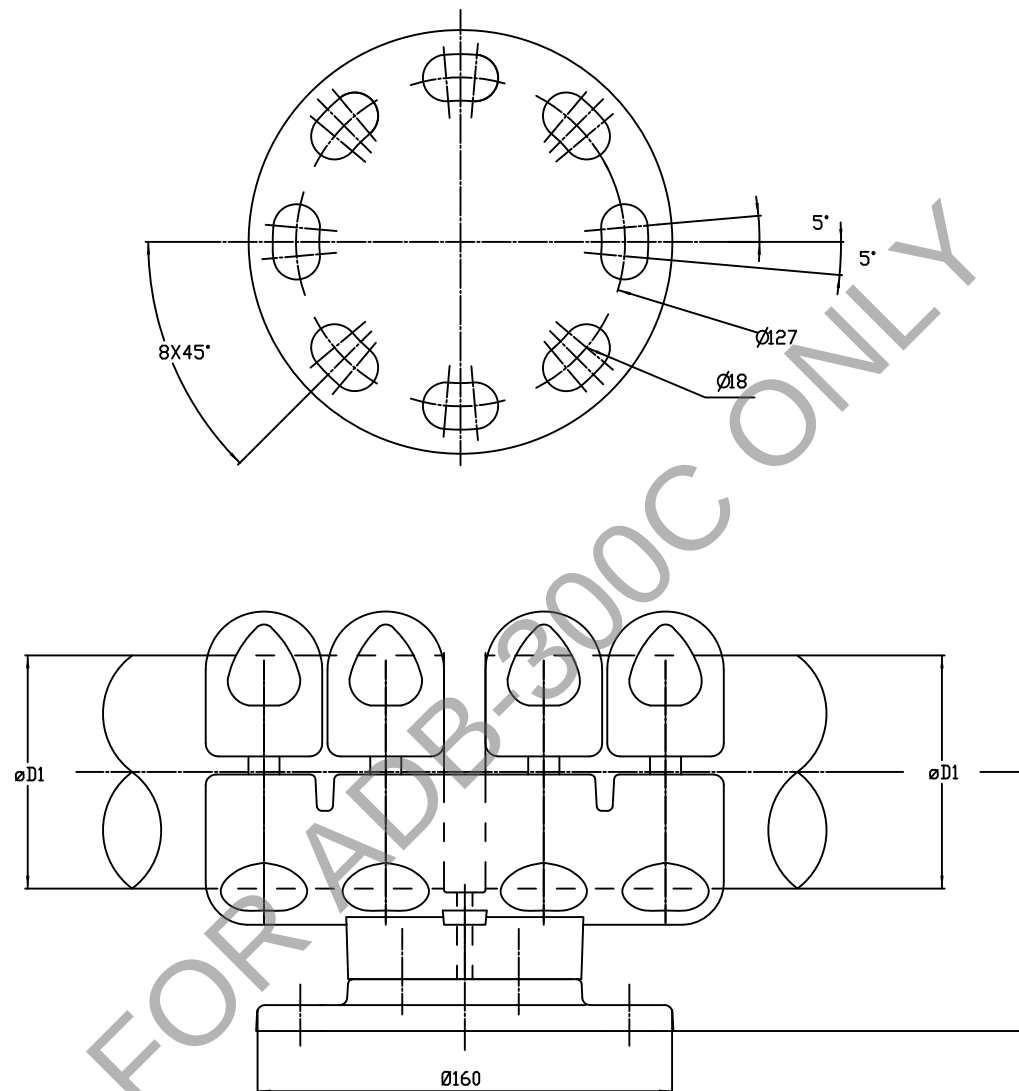
C

B

B

A

A



BSP3.0	88.9	100
BSP3.5	101.6	105
BSP5.0	141.3	125
TYPE & DESIGNATION	ØD1	A

NOTES:

1. All dimensions are in millimeters
2. Body & keeper manufactured in Al-Alloy
3. Type of material:
 - (i) Al Alloy heat treated - EN AC 42100 for body & EN AC 42200 for keeper
 - (ii) Bolts, Nuts and washers - Stainless steel A2-70 & A4-70
4. This drawing is for guidance only

National Transmission & Despatch Company

Design
NTDC

Drawn	-	MONOMETALLIC FIXED BUS SUPPORT FOR ALUMINIUM PIPE	
Checked	-		
Approved	-		
Chief Engineer Design NTDC		Scale: -	Date: -

DWG No: PDW/DF 436R

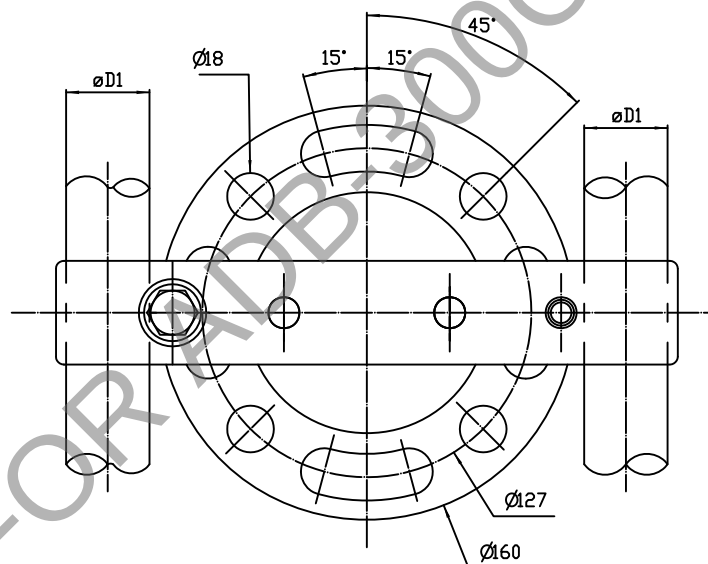
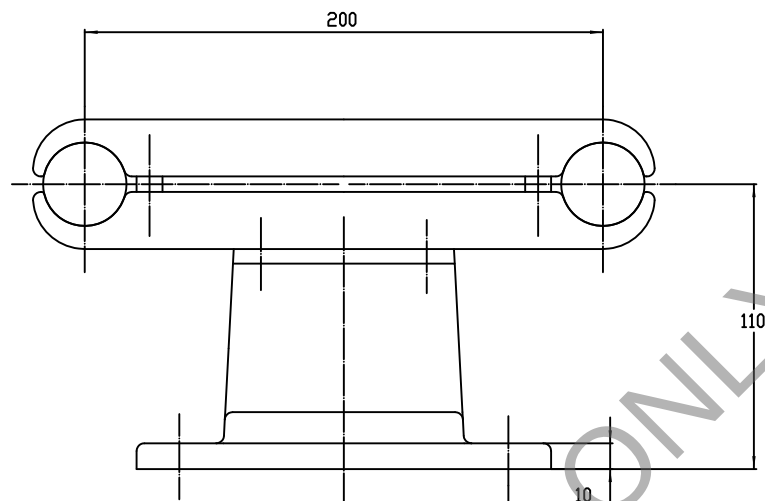
This document is property of Design NTDC. No Part of this can be modified or used for any purpose other than its designated purpose.

D

C

B

A



BSHH	32
TYPE & DESIGNATION	øD1

NOTES:

1. All dimensions are in millimeters
2. Body manufactured in Al-Alloy
3. Type of material:
 - (i) Al Alloy heat treated - EN AC 42100 for body
 - (ii) Bolts, Nuts and washers - Stainless steel A2-70 & A4-70
4. This drawing is for guidance only

National Transmission & Despatch Company		Design NTDC
Drawn	-	MONOMETALLIC BUS SUPPORT FOR DOUBLE AL. HAWTHORN CONDUCTOR
Checked	-	
Approved	-	
Chief Engineer Design NTDC		
		Scale: - Date: -
purpose other than its designated purpose		DWG No: PDW/DF 437R

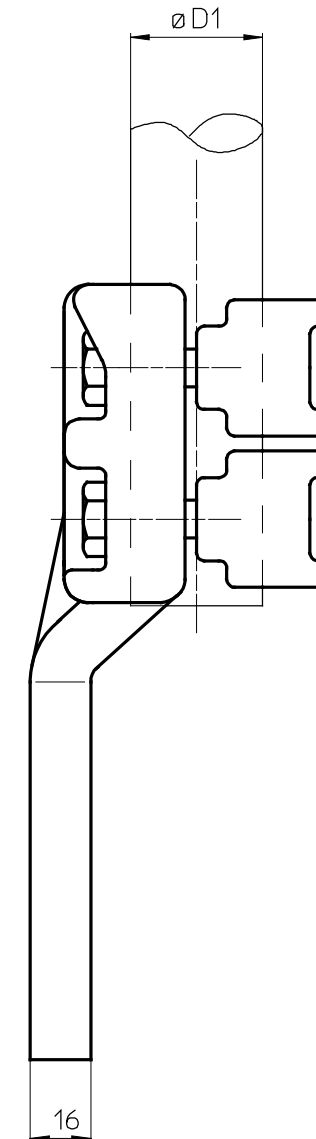
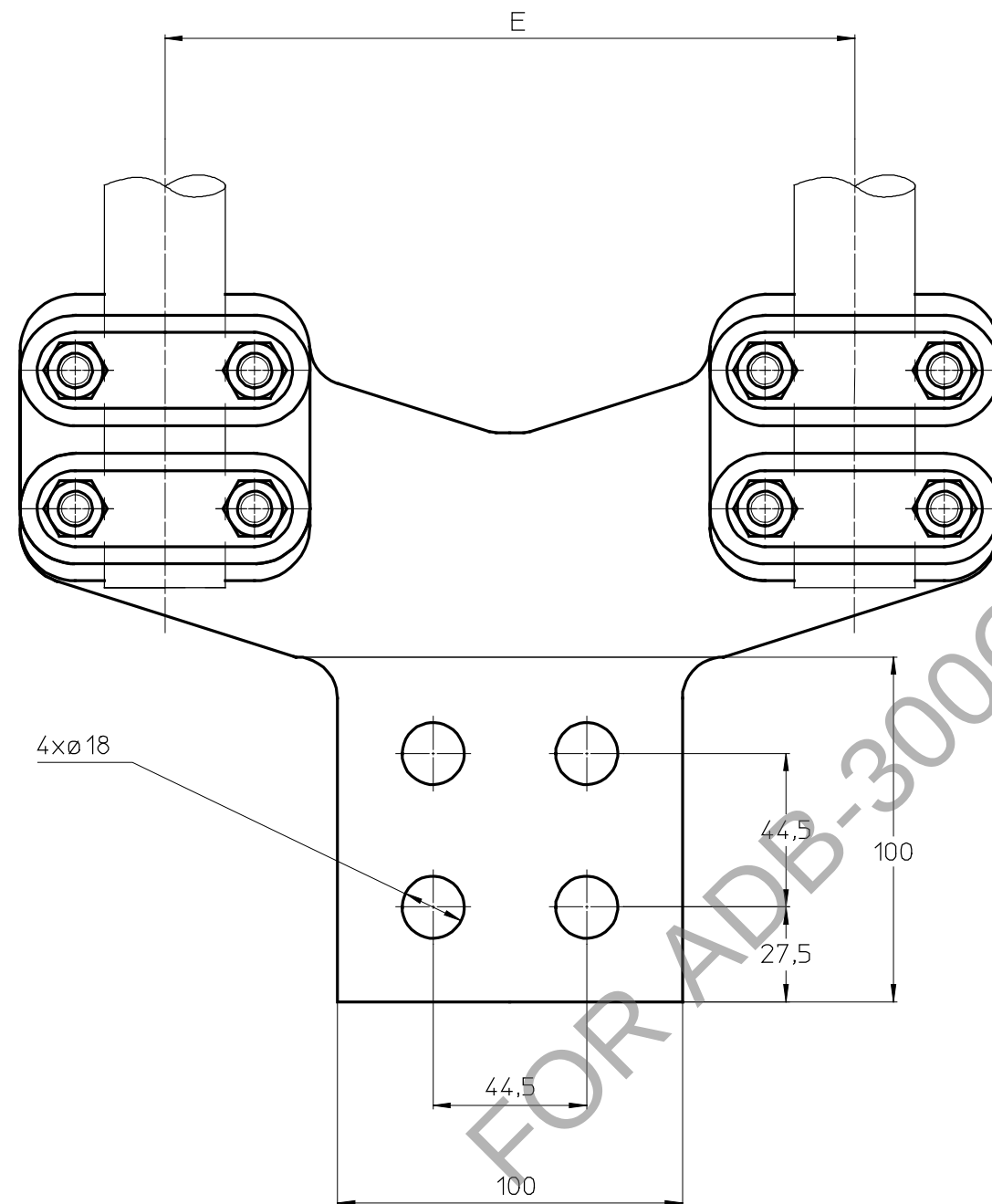
~~This document is property of Design NTDC. No Part of this can be modified or used for any purpose other than its designated purpose.~~

4

3

2

1

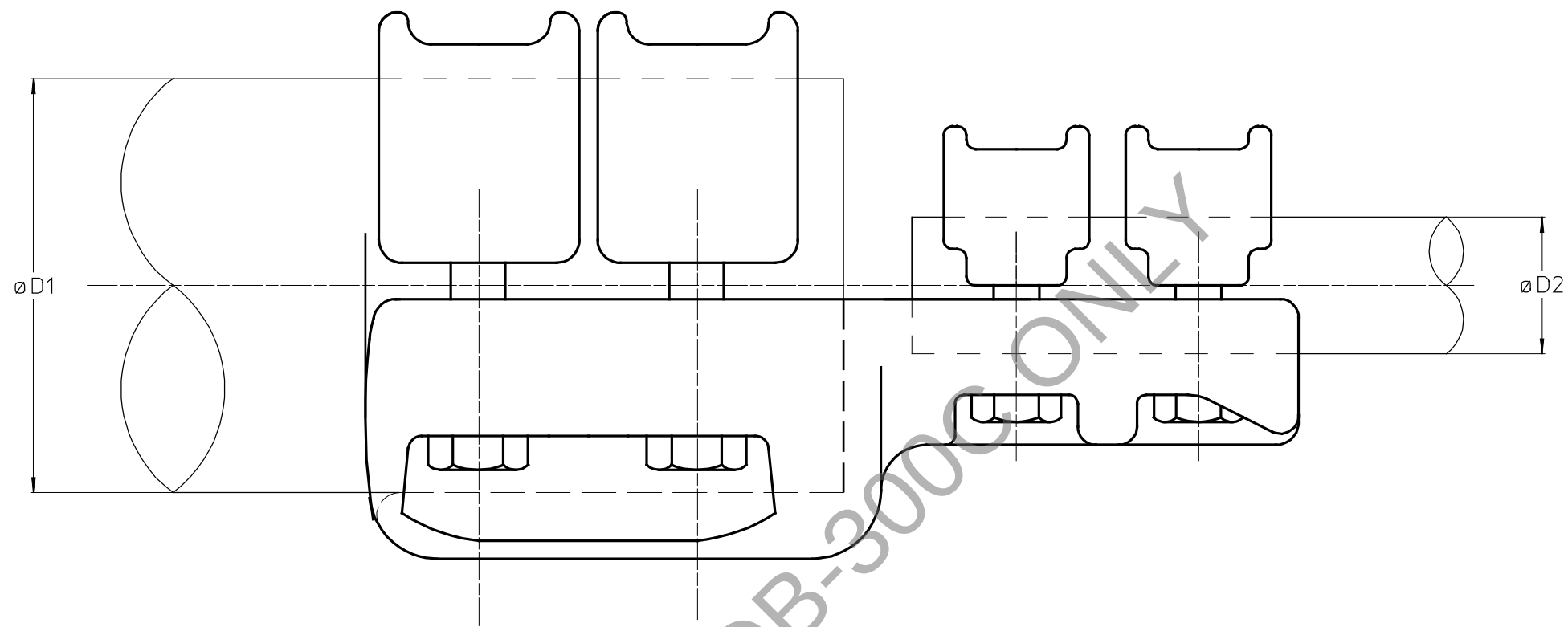


NOTES:

1. All dimensions are in millimeters
2. Body manufactured in Al-Alloy
3. Type of material:
 - (i) Al Alloy - EN AC-series 42000
 - (ii) Bolts, Nuts and washers - Stainless steel A2-70 & A4-70
4. This drawing is for guidance only

ODMHF	32	200
TYPE & DESIGNATION	ØD1	E

National Transmission & Despatch Company		Design NTDC
Drawn	-	STRAIGHT MONOMETALLIC CONNECTOR FOR DOUBLE ALUMINIUM CONDUCTOR TO FLAT ALUMINIUM TERMINAL
Checked	-	
Approved	-	
Chief Engineer Design NTDC		Scale: - Date: -
DWG No: PDW/DF 438R		



NOTES:

1. All dimensions are in millimeters
2. Body manufactured in Al-Alloy
3. Type of material:
 - (i) Al Alloy - EN AC-serial 42000
 - (ii) Bolts, Nuts and washers - Stainless steel A2-70 & A4-70
4. This drawing is for guidance only

OMHP5.0	141.3	32
OMHP3.0	88.9	32
TYPE & DESIGNATION	ØD1	ØD2

National Transmission & Despatch Company		Design NTDC
Drawn	-	STRAIGHT MONOMETALLIC CONNECTOR FOR ALUMINIUM PIPE TO ALUMINIUM CONDUCTOR
Checked	-	
Approved	-	
Chief Engineer Design NTDC		Scale: - Date: -
DWG No: PDW/DF 439R		