



A Division of Transnet Limited

TECHNOLOGY MANAGEMENT

SPECIFICATION

SPECIFICATION FOR SURGE ARRESTERS FOR 3 KV DC ELECTRIFICATION

Author:	Engineer	S. Smit
	Technology Management	
Approved:	Senior Engineer	L O Borchard
	Technology Management	
Authorised:	Principal Engineer	S Sibande
	Technology Management	

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1.0 SCOPE

This specification covers Transnet Freight Rail's requirements for the supply of outdoor surge arresters required for the protection of 3kV direct current electrical equipment against surges caused by lightning and switching.

2.0 STANDARDS

Unless otherwise specified all materials used and equipment developed and supplied shall comply with the current edition of the relevant SANS, IEC, BS or Transnet Freight Rail publications where applicable.

The following publications/specifications (latest editions) are referred to herein:

2.1 SOUTH AFRICAN NATIONAL STANDARDS (SANS)

SANS 121: Hot dip galvanized coatings on fabricated iron and steel articles - Specifications and test methods

SANS 60099-4: Surge arresters Part 4: Metal-oxide surge arresters without gaps for AC systems.

2.2 INTERNATIONAL ORGANIZATION FOR STANDARDIZATION

ISO 9001: Quality Management systems

2.3 BRITISH STANDARDS

BS 50526-1 Railway applications - Fixed installations - D.C. surge arresters and voltage limiting devices - Part 1: Surge arresters

2.4 TRANSNET FREIGHT RAIL DRAWING

CEE-TLE-6: Adapter plate, Surge Arrestor

Any items offered in accordance with other standards will be considered at the sole discretion of Transnet Freight Rail. The tenderer shall supply full details stating where the item differs from these specifications as well as supplying a copy (in English) of the recognised standard specification(s) with which it complies.

3.0 TENDERING PROCEDURES

3.1 Tenderers shall indicate clause by clause compliance with the specification. This shall take the form of a separate document listing all the specifications clause numbers indicating the individual statement of compliance or non-compliance. This document can be used by tenderers to elaborate on their response to a clause.

3.2 A statement of non-compliance shall be motivated by the tenderer.

3.3 Tenderer shall submit for each type of surge arrester a filled in form as per Appendix 1.

3.4 Tenderers shall submit descriptive literature consisting of detailed technical specifications, general constructional details and principal dimensions, together with clear illustrations of the equipment offered.

3.5 Failure to comply with clauses 3.1, 3.2, 3.3 and 3.4 could preclude a tenderer from consideration.

4.0 SERVICE CONDITIONS

4.1 ENVIRONMENTAL CONDITIONS

Altitude:	0 - 1800 m above sea level
Relative humidity:	10% to 90%
Ambient temperature:	-10° C to +55° C
Wind pressure:	750 Pa
Lightning conditions:	19 ground flashes/km ² per annum
Pollution:	Heavily salt laden with industrial pollutants including diesel-electric locomotive emissions

The arrestors are to be installed on 3 kV DC electrification structures adjacent to the rail and shall be exposed to direct sunlight and vibrations.

4.2 MECHANICAL SERVICE CONDITIONS

- 4.2.1 The arrestor shall be exposed to severe vibration. The design must take appropriate counter measures to ensure reliability of the equipment under such conditions.

4.3 ELECTRICAL SERVICE CONDITIONS

- 4.3.1 The nominal no-load DC voltage of a traction substation output varies between 3.15 kV and 3.4 kV.
- 4.3.2 The maximum voltage under no-load conditions can increase up to 4.2 kV due to regenerative breaking.
- 4.3.3 The substation voltage under load conditions may decrease to 2.3 kV.
- 4.3.4 The arrester shall be suitable for operation on DC supply obtained from silicon diode rectification, which contain superimposed harmonics.

5.0 SURGE ARRESTER REQUIREMENTS

5.1 GENERAL

- 5.1.1 The arrester shall be of the metal oxide type.
- 5.1.2 The arrester shall be station class with a line discharge of 6.7 kJ/kV.
- 5.1.3 The arrester enclosure shall be made of porcelain or polymer that is non-flammable and non-hygroscopic and so designed as to prevent the ingress of dirt and moisture. This material shall be resistant to UV radiation, corrosion, electric erosion and tracking under normal operating conditions.
- 5.1.4 Surge arrester shall be compliant to BS 50526-1 class DC-B or better. Note the different environmental test required of the porcelain and polymer materials. The Surge Arresters is for use in outdoor conditions in highly polluted environments.
- 5.1.5 To verify the integrity of the seal, the manufacturer shall indicate the leakage rate of the arrester and the type of leakage test method has been used. The Integrated Helium Mass Spectrometer or the Membrane method is the preferred method.



A Division of Transnet SOC Limited

TECHNOLOGY MANAGEMENT

SPECIFICATION

SPECIFICATION FOR NON—FERROUS MATERIALS FOR ITEMS USED ON OVERHEAD TRACK EQUIPMENT

Author: Chief Engineering Technician
Technology Management W J Schoeman

Approved/Authorised: Principal Engineer
Technology Management S E Sibande

Date: 16 April 2021

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LIST OF AMENDMENTS TO THE SPECIFICATION

Version No.	Date Issued	Clause No.	Page No.	Remarks
	26/09/2014			Updated format. Remove DZR brass as material type. Inserted a Cu-Ni-Si material specification. Included Stainless steel as alternative material for bolts and nuts. Updated Drawing list.
	28/03/2019			Updated format. Changed Cu-Ni-Si material composition to IEC standard CW112. Added Aluminium and Bi-metal material specifications. Removed Copper Alloy bolts and screws from table 1. Removed redundant references. Changed details of testing, removed billet testing and included finished product testing. Updated Drawing list in appendix. Removed tensile testing due to restriction on testing to SANS 6892-1 – completed product dimensions too small.
	February 2021	2 6 8 9 10 13	4.0 5.4 8.0 9.0 15.0	Updated format. Added Background. Standardize Hardness on Aluminium clamps. Updated Additional Information Required. Changed Required control test pieces. Updated Method Of Tendering. Added Annexure A & B.
	April 2021	8	6.2.1	Replace N-m with kN

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1.0 SCOPE

1.1 This specification details Transnet Freight Rail's requirements for the supply of non-ferrous items for conductive clamps/splices/clips used in the Overhead Traction Equipment (OHE) such as:

- a) Contact wire splicers,
- b) Contact wire swivel clips,
- c) Parallel clamps,
- d) Feeder clamps,
- e) Bi-metal clamps,
- f) Runner clamps,
- g) Dropper clips.

This specification must be read in conjunction with each individual item's drawing specified in Appendix 1

1.2 Appendix 1 contains a table of component drawings. Note that additional drawings may exist that is not in the list. Conductive items not mentioned above may reference this specification. Any drawing referencing this specification without specifying the type of material, must by default be accepted to refer to Cu-Ni-Si as the material type. If any confusion exist written conformation must be requested from Transnet Freight Rail – Technology Management Electrical department.

1.3 This specification contains schedule of requirements (Annexure A) which must be completed by the relevant Transnet Representative.

1.4 This specification contains technical datasheet (Annexure B) which must be completed by the tenderer and must be submitted as part of the tender documents.

2.0 BACKGROUND

2.1 The overhead track equipment (OHE) is supply by a 3kV DC, 25kV AC and 50kV systems. Various non-ferrous clamps (Aluminium, copper and conductive alloys) are used to connect the different types of overhead conductors with each other.

3.0 NORMATIVE REFERENCES

Unless otherwise specified all materials used, equipment developed and supplied shall comply with the latest edition of the relevant British Standards (BS EN), International Organization for Standardization (ISO), ASTM International (American Society for Testing and Material). South African National Standards (SANS) or Transnet publications.

3.1 BS-EN STANDARDS:

- 3.1.1 BS EN 573-3 Aluminium and aluminium alloys – Chemical composition and form of wrought products.
- 3.1.2 BS EN 12165 Copper and copper alloys – Wrought and unwrought forging stock.

3.2 ASTM INTERNATIONAL

- 3.2.1 ASTM A240 Standard Specification for Chromium and Chromium –Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels and for General Applications.

3.3 ISO STANDARD:

- 3.3.1 ISO 2859 Sampling procedures for inspection by attributes.

3.3.2 ISO 9001 Quality Management systems

3.4 SANS STANDARD:

3.4.1 SANS 1700-1-1 Fasteners Part 1: Terminology and nomenclature Section 1: Bolts, screws, nuts and accessories

3.4.2 SANS 1700-5-8 Fasteners Part 5: General requirements and mechanical properties Section 8: Mechanical properties of corrosion-resistant stainless-steel fasteners - Bolts, screws and studs

3.4.3 SANS 6506 Metallic materials - Brinell hardness test

4.0 SERVICE CONDITIONS

4.1 ENVIRONMENTAL CONDITIONS

Altitude: 0 - 1800 m above sea level

Relative humidity: 10% to 90%

Ambient temperature: -10° C to +55° C

Wind pressure: 750 Pa

Lightning conditions: 20 ground flashes/km² per annum

Pollution: Heavily salt laden with industrial pollutants including diesel- electric locomotive emissions.

4.2 MECHANICAL SERVICE CONDITIONS

4.2.1 OHTE will be subjected to intermittent vibrations due to train traffic on the rail system. All fastening components should be chosen accordingly.

4.3 ELECTRICAL SERVICE CONDITIONS

4.3.1 Unless otherwise specified on component drawings, components will be installed on either 3kVDC, 25 kV AC or 50 kV AC overhead traction power systems.

5.0 TECHNICAL REQUIREMENTS- MATERIAL

5.1 MATERIAL

5.1.1 For conductive purposes materials used are Copper, Copper Alloy (Cu-Ni-Si), Aluminium, Aluminium Alloy and stainless steel. Nuts, bolts and washers completing component assemblies shall be of stainless steel.

5.2 COPPER

5.2.1 Pure copper is used only for bi-metallic liners on aluminium to date. The material specification shall be on the component drawing.

5.3 Cu-Ni-Si (COPPER ALLOY)

5.3.1 The material used in the manufacture of all fittings of a Copper-Nickel-Silicon alloy (Cu-Ni-Si) shall have the chemical composition and mechanical properties specified hereunder:

Table 1: Composition to CW112C of BS EN 12165

Composition	All Cu-Ni-Si items
Nickel	2.6 – 4.5 %
Silicon	0,8 – 1,3 %
Others Total	0,5 % (maximum)
Copper	Remainder minimum of 93.7

Table 2. Mechanical Properties

Mechanical Properties	All Cu-Ni-Si items
Hardness [HB]	170 (minimum) for splicers, 130 (minimum) for bi-metal clamps, 150 (minimum) all other items.

- 5.3.2 In order to obtain the mechanical properties specified in clauses 5.3.1 above, the alloy specified requires heat treatment which shall be determined by the manufacturer.
- 5.3.3 Each batch shall be marked for identification and recorded on related records as per ISO 9001.
- 5.3.4 The control test pieces representing the finished product in the fully heat-treated condition shall have the mechanical properties as stipulated in clause 5.3.1.

5.4 ALUMINIUM

- 5.4.1 The material used in the manufacture of all fittings of an Aluminium shall have the chemical composition and mechanical properties specified for EN AW - 6063 grade Aluminium according to BS EN 573-3. Additional electrical and mechanical properties may be specified on component drawings.

Table 3: Composition to 6063 of BS EN 573-3

Composition	All Aluminium items
Magnesium	0.45 – 0.90 %
Silicon	0.2 – 0.6 %
Iron	< 0.35 %
Others Total	0,65 % (maximum)
Aluminium	Remainder minimum of 97.5

Table 4: Mechanical Properties

Mechanical Properties	All Aluminium items
Hardness [HB]	50 (minimum)

- 5.4.2 Aluminium grade 6063 has various equivalent specifications, the following standard is known to be equivalent:
- (The Aluminium Association) AA 6063
 - Numerous equivalent standards exist as long as the properties of table 3 and 4 are met these standards may be used at the manufacturers risk.
- 5.4.3 In order to obtain the mechanical properties specified in clauses 5.4.1 above, the tempering of the aluminium which be determined by the manufacturer.
- 5.4.4 Each batch shall be marked for identification and recorded on related records as per ISO 9001
- 5.4.5 The control test pieces representing the finished product in the fully heat-treated condition shall have the mechanical properties as stipulated in clause 5.4.1.

5.5 ALUMINIUM ALLOY FOR BI METAL CLAMPS

- 5.5.1 An aluminium alloy is used for bi-metal clamps with an aluminium body and copper liner. The material used in the manufacture of bi-metal clamps shall be based on EN AW - 6063 grade aluminium with additives to facilitate fusion of the copper inserts. Additional electrical and mechanical properties may be specified on component drawings.

Table 5: Composition of Aluminium alloy based on 6063 of BS EN 573-3

Composition	All Aluminium items
Magnesium	0.45 – 1.5 %
Silicon	0.5 – 1.2 %
Copper	0.5 – 1.5 %
Iron	< 0.5 %
Zinc	<0.5 %
Manganese	<0.2%
Others Total	0,8 % (maximum)
Aluminium	Remainder minimum of 93.8%

Table 6. Mechanical Properties

Mechanical Properties	All Aluminium items
Hardness [HB]	50 (minimum)

5.5.2 Aluminium grade 6063 has various equivalent specifications, see clause 5.4.2 of this specification.

5.5.3 In order to obtain the mechanical properties specified in clauses 5.5.1 above, the tempering of the aluminium alloy which be determined by the manufacturer.

Each batch shall be marked for identification and recorded on related records as per ISO 9001.

5.5.4 The control test pieces representing the finished product in the fully heat-treated condition shall have the mechanical properties as stipulated in clause 5.5.1.

5.6 BOLTS, NUTS AND WASHERS

5.6.1 Unless otherwise specified on the component drawing all bolts, nuts and washers shall be of material type stainless steel.

5.6.2 The hexagon headed bolts and nut shall comply with the requirements of SANS 1700-1 for definition, SANS 1700-5-8 specifies applicable designation of the stainless steel bolts.

5.6.3 The material type for bolts and nuts are Stainless Steel to specification ASTM 240 Grade 304. Where stainless steel bolts and nuts are used, a different grade of stainless steel nuts must be used to prevent the bolt and nut to cease up. ASTM 240 Grade 316 is recommended for the nut, however testing will be done to check for seizure of nuts and bolts.

Torque values for parallel clamp and feeder clamps 50 N-m thus all bolts and screws must be able to withstand 75 N-m. Runner clamps torque values are 40 N-m thus all bolts and screws must be able to withstand 60 N-m.

5.6.4 The bolts supplied with the 161 mm² and 107 mm² contact wire splicer shall be able to withstand a torque of 67 N-m. and 46 N-m. respectively, plus a safety factor of 1,5.

5.6.5 The manufacturer must ensure the length of the bolts is suitable in the application with the standard 2.5 treads free after assembly.

5.6.6 Unless otherwise specified all lock washers shall be internally toothed stainless steel washers. For contact wire splices see clause 6.2.3 of this document for washers.

6.0 DESIGN

6.1 GENERAL DESIGN

6.1.1 The various items as called for in the enquiry shall be designed in accordance with the relevant drawings as listed in Appendix 1.

- 6.1.2 The items shall be designed to the dimensions given on the drawings. Additional design requirements may appear on the drawings and must be adhered to.
- 6.1.3 Hot and cold forging is acceptable as long as the appropriate tempering is done to achieve the mechanical requirements weather stated in this specification or on the relevant drawing.

6.2 DESIGN OF CONTACT WIRE SPLICES

- 6.2.1 The contact wire splicer shall be suitable for joining two contact wires (to CEE-0241 and BBD 7267) in such a manner to achieve an ultimate tensile strength of 52,4 kN in the case of 161 mm² contact wire and 38,5 kN in the case of 107 mm² contact wire when fully assembled with two short pieces of contact wire.
- 6.2.2 Contact wire splices in their assembled form will be torqued to 67 N-m. for 161 mm² Cu and 46 N-m for 107 mm² Cu.
- 6.2.3 Contact wire splices shall be fitted with wedge lock washers that:
- i. Are anti-vibration system ensuring no loosening in bolted joints
 - ii. Consists of two wedge washers with external serrations
 - iii. Material type stainless steel
- 6.2.4 Two approved manufacturers Nord Lock and Heico-Lock. Alternative manufacturers product must be first be tested and approved by Transnet Technology Management Quality Assurance

6.2 DESIGN BI-METALLIC CLAMPS

- 6.2.1 Bi-metallic clamps (Cu-Ni-Si with an Aluminium liner of Aluminium alloy with Copper liner) will be forged such that the liner is permanently forged to the half clamp body. No lose plates will be allowed.
- 6.2.2 Liner material should be at least 3mm thick for aluminium and 2mm for copper.
- 6.2.3 All bi-metal clamps require permanently forged liners that cannot be forcefully removed. Where necessary grooves in the clamp body may be used to improve the adhesion of the liner. No loose liners will be acceptable.

6.3 DESIGN ALUMINIUM CLAMPS

- 6.3.1 All aluminium and aluminium alloy clamps will have a counter sunk hex shape for the size nut specified in the drawing. It is required to enable only requiring one tool to torque the bolts during installation.

7.0 DETAILS OF REQUIREMENTS

- 7.1 Details of the type, size and quantity of the various items required will be furnished in the enquiry.
- 7.2 The relevant drawing will provide critical dimension per component.
- 7.3 All components must be delivered assembled with their relevant bolts, nuts and washers unless otherwise specified on the component drawings, the grade of bolts and nuts should suit the application.
- 7.4 Any discrepancy in requirement between the specification, component drawing or store item description, must be reported to Transnet's supply chain services (SCS) and Technology Management. A written clarification must be obtained from Technology Management Electrical department on the requirement.

8.0 ADDITIONAL INFORMATION AT TENDERING STAGE

- 8.1 Tenderers shall provide the source of supply of the alloy material. (Raw material)

8.2 Tenderers shall provide the name of the manufacturer (OEM) of the items as asked for in the enquiry.

9.0 TESTING AND INSPECTIONS

9.1 Transnet reserves the right to be present at all tests and inspections as called for in this clause.

9.2 The responsibility of arranging the tests called for in this clause rests with the successful tenderer.

9.3 All tests will be witnessed by Transnet Freight Rail's Technology Management (Electrical) department. Inspections will take place at the manufacturer's premises or suitable test facility, and must be organized well in advance (2 weeks prior).

9.4 Test and inspection must be conducted on each batch.

9.5 Two of the control test pieces of each batch of the complete component after heat treatment, shall be tested as detailed in SANS 6506 to verify the mechanical properties, referred to in clauses 5.3, 5.4 and 5.5, of the material of the finished product.

9.6 A Transnet Freight Rail, Technology Management (Electrical) department representative may request for any additional test deemed necessary to ensure compliance.

9.7 Test certificates in respect of these tests (9.5), shall be submitted to Transnet Freight Rail's Technology Management (Electrical), and shall state the following:

- i. Chemical composition, verified by a SANAS/ILAC metallurgical accredited laboratory,
- ii. Mechanical properties,
- iii. Batch identification number.

9.8 Some components require a conductivity test and will be tested to the limits specified on the component's drawing.

9.9 For high tensile components such as splicers at least 1% of each batch of the splicers will be assembled and tested for tensile strength. For other component a minimum of two samples will be tested.

9.10 Tensile testing of splices, the splices will be assembled as follow:

- i. Splices from clause 9.9 will be torqued from the centre bolt outward on both sides. (Torque values clause 6.2.2)
- ii. Ten (10) light mallet blows will be delivered to the assembled splice.
- iii. Splice will be re-torqued again to clause 9.10. This whole process repeats three (3) times.
- iv. Tensile testing of clause 6.2.1 will be conducted on the assembled splices.

9.11 All conductive components with bolt assemblies will have at least 2 samples per batch assembled and torqued to the stamped torque value, three times. Each component will be inspected for fractures and deformation.

9.12 Complete assemblies will be checked for seizure of nuts and bolts.

9.13 Transnet Freight Rail reserves the right to call for a further two control test pieces to be submitted to the Transnet Freight Rail Technology Management (Electrical).

9.14 These samples and test pieces, when called for in clause 9.13, shall be specifically marked for positive identification with their associated heat-treatment batches and test certificates and shall be subjected to all tests called for in this specification.

9.15 All samples submitted for test purposes shall be excluded from those supplied in terms of the contract quantities.

10.0 MARKINGS

The items shall be permanently marked, where one item consist of more than one article each article must be permanently marked, with the following.

- 10.1 TRANSNET or the Transnet logo.
- 10.2 Wire size as indicated on the relevant drawings (except swivel clip stems).
- 10.3 A dated batch number.
- 10.4 Manufacturers name or logo.
- 10.5 Torque values for assemblies marked as:” Torque = <value> Nm” on larger pieces and where space is restricted “T = <value> Nm” where value is the required torque value. Splices must be marked with “Torque 3 x <value> Nm”.

11.0 DOCUMENTATION REQUIREMENTS

- 11.1 Drawings and technical documentation shall be submitted with tender.
- 11.2 The manufacturer must provide one soft copy and two hard copies of the technical specification.
- 11.3 The manufacturer must provide one soft and two hard copy of the method of installation.

12.0 QUALITY ASSURANCE

- 12.1 The successful tenderer shall maintain a Quality Management System (QMS) based on or certified to ISO 9001.

13.0 PACKAGING

- 13.1 The items shall be packed in suitable containers such as bags or cartons. The mass of each container with contents shall not exceed 25 kg.
- 13.2 Each container shall have firmly attached thereto a water resistant label, on which the following shall be designated:
 - i. Stores item number.
 - ii. Name, size (if applicable) and quantity of items contained therein.
 - iii. Contract/Purchase order number.
 - iv. Other information as detailed in the Supply Chain Services (SCS) order.

14.0 GUARANTEE AND DEFECTS

- 14.1 The appointed tenderer shall accept liability for makers’ defects, which may appear in design, material and workmanship.

15.0 METHOD OF TENDERING

- 15.1 Tenderer shall indicate clause-by-clause compliance document with the specification. This shall take the form of a separate document listing each of the specification’s clause and sub-clause numbers, indicating the individual statements of compliance or non-compliance.
- 15.2 Statement of non-compliance shall be motivated by the tenderer in a letter format, as per 15.1. The letter and evidence of deviation shall be submitted as part of the tender document.
- 15.3 Tenderers shall submit comprehensive literature consisting of detailed technical specifications in accordance to clause 5.0 (Technical Requirements) and clause 6.0 (Design), the general constructional details and principal dimensions if not indicated on the provided Transnet

drawings, maintenance schedules if required in any of the Appendix/Annexure and datasheets if required in any of the Appendix/Annexure or in the specifications.

- 15.4 Any items offered in accordance with other standards will be considered at the sole discretion of Transnet. The tenderer shall supply full details stating where the item differs from these specifications as well as supplying a copy (in English) of the recognized standard specification(s) with which it complies. Any deviations must be approved by Transnet Freight Rail, Technology Management (Electrical) department in writing.
- 15.5 Failure to comply with clauses 15.1, 15.2, 15.3 and 15.4 could preclude a tenderer from consideration.
- 15.6 In the event of any conflict between the various submitted relevant documents, the order of precedence shall be, and in consultation with Transnet Freight Rail, Technology Management (Electrical Technology) department:
- a) Legal and safety requirements.
 - b) This Specification.

END

APPENDIX 1:

This attachment contains the drawings of each components assembly drawing.

Item description	Drawing Description	Drawing number
Contact wire Splicers.	Splice, Conductor, 161mm ² SQ Cu Contact wire – Electrification TYPES A, B, F, G, H and Coal line deviations	CEE-TNB-0021
	CONDUCTOR SPLICE ASSEMBLY 107mm SQ Cu CONTACT WIRE	CEE- TN-0405
Contact wire swivel clips/clamps	SWIVEL CLIP STEM FOR HOCKEY STICK/STEADY ARM	CEE-TND-0029
	CLAMP, ELECTRICAL, ASSEMBLY 161mm ² CONTACT WIRE	CEE-TN-0264
	SWIVEL CLIP: CONTACT WIRE: STEADY ARM:	CEE-TN-0049
	ELECTRICAL CLAMP ASSEMBLY	CEE-TND-0033
Parallel Clamps	PARALLEL HALF CLAMP FOR VARIOUS CONDUCTOR SIZES	CEE-TNB-0054
	PARALLEL HALF CLAMP FOR VARIOUS CONDUCTOR SIZES	CEE-TNB-0055
	ALUMINIUM PARALLEL CLAMP 160 MM SQ - 160 MM SQ TIGER CATENARY	BBB 0376
	ALUMINIUM PARALLEL CLAMP 500MM ALUMINIUM TO 160MM ALUMINIUM	BBG 7987
	ALUMINIUM CLAMP 800MM ALUMINIUM TO 160MM ALUMINIUM	BBG 7988
	BI-METALLIC CONDUCTOR SPLICE PARALLEL CLAMP 160 MM ² Cu to 250MM ² AL FEEDER	BBD 5138
	BI-METALLIC CONDUCTOR SPLICE PARRALEL CLAMP "SKUNK" CATENARY 25 KV AC ELECTRIFICATION	BBB 4185
Feeder Clamps	FEEDER CLAMP FOR 161mm SQ Cu CONTACT WIRE	CEE-TNB-0057
	CLAMP, ELECTRICAL: FEEDER CLAMP 107mm SQ CONTACT WIRE	CEE-TNB-0081
	BI-METAL FEEDER CLAMP FOR 161 mmSQ AL/107 mmSQ Cu CONTACT WIRE	BBH 0306
	BI-METAL FEEDER CLAMP FOR 161mmSQ AL/161 mmSQ Cu CONTACT WIRE	BBG 6147
Runner Clamps	CLAMP, RUNNER, ASSEMBLY: 161mm SQ & 107mm SQ Cu CONTACT WIRE	CEE-TNB-0086
Dropper Clips	DROPPER CLIP (PLATE TYPE) 80/100mm SQ CATENARY	CEE- TND-0036
	CONDUCTIVE DROPPER CLAMP'S	BBH 1331
Support Wire Clamp	CLAMP 107MMSQ CU. CONTACT WIRE SUPPORT WIRE ASSEMBLY	BBC 2604

ANNEXURE A: SCHEDULE OF REQUIREMENTS

(To be completed by Transnet Representative)

Item	Clamp/Fittings required	Drawing number and material type

Completed by:

.....

Capacity

.....

Signature

.....

Date

.....

ANNEXURE B: TECHNICAL DATA SHEET

(To be completed by the tenderers and submitted as part of their tender)

Item	Clamp/Fitting/component tender for: (Full description)	Is all technical data sheets attached, as required in this specification? (Yes/No)



A Division of Transnet SOC Limited

TECHNOLOGY MANAGEMENT

SPECIFICATION

SPECIFICATION FOR NON—FERROUS MATERIALS FOR ITEMS USED ON OVERHEAD TRACK EQUIPMENT

Author: Chief Engineering Technician
Technology Management W J Schoeman

Approved/Authorised: Principal Engineer
Technology Management S E Sibande

Date: 16 April 2021

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LIST OF AMENDMENTS TO THE SPECIFICATION

Version No.	Date Issued	Clause No.	Page No.	Remarks
	26/09/2014			Updated format. Remove DZR brass as material type. Inserted a Cu-Ni-Si material specification. Included Stainless steel as alternative material for bolts and nuts. Updated Drawing list.
	28/03/2019			Updated format. Changed Cu-Ni-Si material composition to IEC standard CW112. Added Aluminium and Bi-metal material specifications. Removed Copper Alloy bolts and screws from table 1. Removed redundant references. Changed details of testing, removed billet testing and included finished product testing. Updated Drawing list in appendix. Removed tensile testing due to restriction on testing to SANS 6892-1 – completed product dimensions too small.
	February 2021	2 6 8 9 10 13	4.0 5.4 8.0 9.0 15.0	Updated format. Added Background. Standardize Hardness on Aluminium clamps. Updated Additional Information Required. Changed Required control test pieces. Updated Method Of Tendering. Added Annexure A & B.
	April 2021	8	6.2.1	Replace N-m with kN

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1.0 SCOPE

1.1 This specification details Transnet Freight Rail's requirements for the supply of non-ferrous items for conductive clamps/splices/clips used in the Overhead Traction Equipment (OHE) such as:

- a) Contact wire splicers,
- b) Contact wire swivel clips,
- c) Parallel clamps,
- d) Feeder clamps,
- e) Bi-metal clamps,
- f) Runner clamps,
- g) Dropper clips.

This specification must be read in conjunction with each individual item's drawing specified in Appendix 1

1.2 Appendix 1 contains a table of component drawings. Note that additional drawings may exist that is not in the list. Conductive items not mentioned above may reference this specification. Any drawing referencing this specification without specifying the type of material, must by default be accepted to refer to Cu-Ni-Si as the material type. If any confusion exist written conformation must be requested from Transnet Freight Rail – Technology Management Electrical department.

1.3 This specification contains schedule of requirements (Annexure A) which must be completed by the relevant Transnet Representative.

1.4 This specification contains technical datasheet (Annexure B) which must be completed by the tenderer and must be submitted as part of the tender documents.

2.0 BACKGROUND

2.1 The overhead track equipment (OHE) is supply by a 3kV DC, 25kV AC and 50kV systems. Various non-ferrous clamps (Aluminium, copper and conductive alloys) are used to connect the different types of overhead conductors with each other.

3.0 NORMATIVE REFERENCES

Unless otherwise specified all materials used, equipment developed and supplied shall comply with the latest edition of the relevant British Standards (BS EN), International Organization for Standardization (ISO), ASTM International (American Society for Testing and Material). South African National Standards (SANS) or Transnet publications.

3.1 BS-EN STANDARDS:

- 3.1.1 BS EN 573-3 Aluminium and aluminium alloys – Chemical composition and form of wrought products.
- 3.1.2 BS EN 12165 Copper and copper alloys – Wrought and unwrought forging stock.

3.2 ASTM INTERNATIONAL

- 3.2.1 ASTM A240 Standard Specification for Chromium and Chromium –Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels and for General Applications.

3.3 ISO STANDARD:

- 3.3.1 ISO 2859 Sampling procedures for inspection by attributes.

3.3.2 ISO 9001 Quality Management systems

3.4 SANS STANDARD:

3.4.1 SANS 1700-1-1 Fasteners Part 1: Terminology and nomenclature Section 1: Bolts, screws, nuts and accessories

3.4.2 SANS 1700-5-8 Fasteners Part 5: General requirements and mechanical properties Section 8: Mechanical properties of corrosion-resistant stainless-steel fasteners - Bolts, screws and studs

3.4.3 SANS 6506 Metallic materials - Brinell hardness test

4.0 SERVICE CONDITIONS

4.1 ENVIRONMENTAL CONDITIONS

Altitude: 0 - 1800 m above sea level

Relative humidity: 10% to 90%

Ambient temperature: -10° C to +55° C

Wind pressure: 750 Pa

Lightning conditions: 20 ground flashes/km² per annum

Pollution: Heavily salt laden with industrial pollutants including diesel- electric locomotive emissions.

4.2 MECHANICAL SERVICE CONDITIONS

4.2.1 OHTE will be subjected to intermittent vibrations due to train traffic on the rail system. All fastening components should be chosen accordingly.

4.3 ELECTRICAL SERVICE CONDITIONS

4.3.1 Unless otherwise specified on component drawings, components will be installed on either 3kVDC, 25 kV AC or 50 kV AC overhead traction power systems.

5.0 TECHNICAL REQUIREMENTS- MATERIAL

5.1 MATERIAL

5.1.1 For conductive purposes materials used are Copper, Copper Alloy (Cu-Ni-Si), Aluminium, Aluminium Alloy and stainless steel. Nuts, bolts and washers completing component assemblies shall be of stainless steel.

5.2 COPPER

5.2.1 Pure copper is used only for bi-metallic liners on aluminium to date. The material specification shall be on the component drawing.

5.3 Cu-Ni-Si (COPPER ALLOY)

5.3.1 The material used in the manufacture of all fittings of a Copper-Nickel-Silicon alloy (Cu-Ni-Si) shall have the chemical composition and mechanical properties specified hereunder:

Table 1: Composition to CW112C of BS EN 12165

Composition	All Cu-Ni-Si items
Nickel	2.6 – 4.5 %
Silicon	0,8 – 1,3 %
Others Total	0,5 % (maximum)
Copper	Remainder minimum of 93.7

Table 2. Mechanical Properties

Mechanical Properties	All Cu-Ni-Si items
Hardness [HB]	170 (minimum) for splicers, 130 (minimum) for bi-metal clamps, 150 (minimum) all other items.

- 5.3.2 In order to obtain the mechanical properties specified in clauses 5.3.1 above, the alloy specified requires heat treatment which shall be determined by the manufacturer.
- 5.3.3 Each batch shall be marked for identification and recorded on related records as per ISO 9001.
- 5.3.4 The control test pieces representing the finished product in the fully heat-treated condition shall have the mechanical properties as stipulated in clause 5.3.1.

5.4 ALUMINIUM

- 5.4.1 The material used in the manufacture of all fittings of an Aluminium shall have the chemical composition and mechanical properties specified for EN AW - 6063 grade Aluminium according to BS EN 573-3. Additional electrical and mechanical properties may be specified on component drawings.

Table 3: Composition to 6063 of BS EN 573-3

Composition	All Aluminium items
Magnesium	0.45 – 0.90 %
Silicon	0.2 – 0.6 %
Iron	< 0.35 %
Others Total	0,65 % (maximum)
Aluminium	Remainder minimum of 97.5

Table 4: Mechanical Properties

Mechanical Properties	All Aluminium items
Hardness [HB]	50 (minimum)

- 5.4.2 Aluminium grade 6063 has various equivalent specifications, the following standard is known to be equivalent:
- (The Aluminium Association) AA 6063
 - Numerous equivalent standards exist as long as the properties of table 3 and 4 are met these standards may be used at the manufacturers risk.
- 5.4.3 In order to obtain the mechanical properties specified in clauses 5.4.1 above, the tempering of the aluminium which be determined by the manufacturer.
- 5.4.4 Each batch shall be marked for identification and recorded on related records as per ISO 9001
- 5.4.5 The control test pieces representing the finished product in the fully heat-treated condition shall have the mechanical properties as stipulated in clause 5.4.1.

5.5 ALUMINIUM ALLOY FOR BI METAL CLAMPS

- 5.5.1 An aluminium alloy is used for bi-metal clamps with an aluminium body and copper liner. The material used in the manufacture of bi-metal clamps shall be based on EN AW - 6063 grade aluminium with additives to facilitate fusion of the copper inserts. Additional electrical and mechanical properties may be specified on component drawings.

Table 5: Composition of Aluminium alloy based on 6063 of BS EN 573-3

Composition	All Aluminium items
Magnesium	0.45 – 1.5 %
Silicon	0.5 – 1.2 %
Copper	0.5 – 1.5 %
Iron	< 0.5 %
Zinc	<0.5 %
Manganese	<0.2%
Others Total	0,8 % (maximum)
Aluminium	Remainder minimum of 93.8%

Table 6. Mechanical Properties

Mechanical Properties	All Aluminium items
Hardness [HB]	50 (minimum)

5.5.2 Aluminium grade 6063 has various equivalent specifications, see clause 5.4.2 of this specification.

5.5.3 In order to obtain the mechanical properties specified in clauses 5.5.1 above, the tempering of the aluminium alloy which be determined by the manufacturer.

Each batch shall be marked for identification and recorded on related records as per ISO 9001.

5.5.4 The control test pieces representing the finished product in the fully heat-treated condition shall have the mechanical properties as stipulated in clause 5.5.1.

5.6 BOLTS, NUTS AND WASHERS

5.6.1 Unless otherwise specified on the component drawing all bolts, nuts and washers shall be of material type stainless steel.

5.6.2 The hexagon headed bolts and nut shall comply with the requirements of SANS 1700-1 for definition, SANS 1700-5-8 specifies applicable designation of the stainless steel bolts.

5.6.3 The material type for bolts and nuts are Stainless Steel to specification ASTM 240 Grade 304. Where stainless steel bolts and nuts are used, a different grade of stainless steel nuts must be used to prevent the bolt and nut to cease up. ASTM 240 Grade 316 is recommended for the nut, however testing will be done to check for seizure of nuts and bolts.

Torque values for parallel clamp and feeder clamps 50 N-m thus all bolts and screws must be able to withstand 75 N-m. Runner clamps torque values are 40 N-m thus all bolts and screws must be able to withstand 60 N-m.

5.6.4 The bolts supplied with the 161 mm² and 107 mm² contact wire splicer shall be able to withstand a torque of 67 N-m. and 46 N-m. respectively, plus a safety factor of 1,5.

5.6.5 The manufacturer must ensure the length of the bolts is suitable in the application with the standard 2.5 treads free after assembly.

5.6.6 Unless otherwise specified all lock washers shall be internally toothed stainless steel washers. For contact wire splices see clause 6.2.3 of this document for washers.

6.0 DESIGN

6.1 GENERAL DESIGN

6.1.1 The various items as called for in the enquiry shall be designed in accordance with the relevant drawings as listed in Appendix 1.

- 6.1.2 The items shall be designed to the dimensions given on the drawings. Additional design requirements may appear on the drawings and must be adhered to.
- 6.1.3 Hot and cold forging is acceptable as long as the appropriate tempering is done to achieve the mechanical requirements weather stated in this specification or on the relevant drawing.

6.2 DESIGN OF CONTACT WIRE SPLICES

- 6.2.1 The contact wire splicer shall be suitable for joining two contact wires (to CEE-0241 and BBD 7267) in such a manner to achieve an ultimate tensile strength of 52,4 kN in the case of 161 mm² contact wire and 38,5 kN in the case of 107 mm² contact wire when fully assembled with two short pieces of contact wire.
- 6.2.2 Contact wire splices in their assembled form will be torqued to 67 N-m. for 161 mm² Cu and 46 N-m for 107 mm² Cu.
- 6.2.3 Contact wire splices shall be fitted with wedge lock washers that:
- i. Are anti-vibration system ensuring no loosening in bolted joints
 - ii. Consists of two wedge washers with external serrations
 - iii. Material type stainless steel
- 6.2.4 Two approved manufacturers Nord Lock and Heico-Lock. Alternative manufacturers product must be first be tested and approved by Transnet Technology Management Quality Assurance

6.2 DESIGN BI-METALLIC CLAMPS

- 6.2.1 Bi-metallic clamps (Cu-Ni-Si with an Aluminium liner of Aluminium alloy with Copper liner) will be forged such that the liner is permanently forged to the half clamp body. No lose plates will be allowed.
- 6.2.2 Liner material should be at least 3mm thick for aluminium and 2mm for copper.
- 6.2.3 All bi-metal clamps require permanently forged liners that cannot be forcefully removed. Where necessary grooves in the clamp body may be used to improve the adhesion of the liner. No loose liners will be acceptable.

6.3 DESIGN ALUMINIUM CLAMPS

- 6.3.1 All aluminium and aluminium alloy clamps will have a counter sunk hex shape for the size nut specified in the drawing. It is required to enable only requiring one tool to torque the bolts during installation.

7.0 DETAILS OF REQUIREMENTS

- 7.1 Details of the type, size and quantity of the various items required will be furnished in the enquiry.
- 7.2 The relevant drawing will provide critical dimension per component.
- 7.3 All components must be delivered assembled with their relevant bolts, nuts and washers unless otherwise specified on the component drawings, the grade of bolts and nuts should suit the application.
- 7.4 Any discrepancy in requirement between the specification, component drawing or store item description, must be reported to Transnet's supply chain services (SCS) and Technology Management. A written clarification must be obtained from Technology Management Electrical department on the requirement.

8.0 ADDITIONAL INFORMATION AT TENDERING STAGE

- 8.1 Tenderers shall provide the source of supply of the alloy material. (Raw material)

8.2 Tenderers shall provide the name of the manufacturer (OEM) of the items as asked for in the enquiry.

9.0 TESTING AND INSPECTIONS

9.1 Transnet reserves the right to be present at all tests and inspections as called for in this clause.

9.2 The responsibility of arranging the tests called for in this clause rests with the successful tenderer.

9.3 All tests will be witnessed by Transnet Freight Rail's Technology Management (Electrical) department. Inspections will take place at the manufacturer's premises or suitable test facility, and must be organized well in advance (2 weeks prior).

9.4 Test and inspection must be conducted on each batch.

9.5 Two of the control test pieces of each batch of the complete component after heat treatment, shall be tested as detailed in SANS 6506 to verify the mechanical properties, referred to in clauses 5.3, 5.4 and 5.5, of the material of the finished product.

9.6 A Transnet Freight Rail, Technology Management (Electrical) department representative may request for any additional test deemed necessary to ensure compliance.

9.7 Test certificates in respect of these tests (9.5), shall be submitted to Transnet Freight Rail's Technology Management (Electrical), and shall state the following:

- i. Chemical composition, verified by a SANAS/ILAC metallurgical accredited laboratory,
- ii. Mechanical properties,
- iii. Batch identification number.

9.8 Some components require a conductivity test and will be tested to the limits specified on the component's drawing.

9.9 For high tensile components such as splicers at least 1% of each batch of the splicers will be assembled and tested for tensile strength. For other component a minimum of two samples will be tested.

9.10 Tensile testing of splices, the splices will be assembled as follow:

- i. Splices from clause 9.9 will be torqued from the centre bolt outward on both sides. (Torque values clause 6.2.2)
- ii. Ten (10) light mallet blows will be delivered to the assembled splice.
- iii. Splice will be re-torqued again to clause 9.10. This whole process repeats three (3) times.
- iv. Tensile testing of clause 6.2.1 will be conducted on the assembled splices.

9.11 All conductive components with bolt assemblies will have at least 2 samples per batch assembled and torqued to the stamped torque value, three times. Each component will be inspected for fractures and deformation.

9.12 Complete assemblies will be checked for seizure of nuts and bolts.

9.13 Transnet Freight Rail reserves the right to call for a further two control test pieces to be submitted to the Transnet Freight Rail Technology Management (Electrical).

9.14 These samples and test pieces, when called for in clause 9.13, shall be specifically marked for positive identification with their associated heat-treatment batches and test certificates and shall be subjected to all tests called for in this specification.

9.15 All samples submitted for test purposes shall be excluded from those supplied in terms of the contract quantities.

10.0 MARKINGS

The items shall be permanently marked, where one item consist of more than one article each article must be permanently marked, with the following.

- 10.1 TRANSNET or the Transnet logo.
- 10.2 Wire size as indicated on the relevant drawings (except swivel clip stems).
- 10.3 A dated batch number.
- 10.4 Manufacturers name or logo.
- 10.5 Torque values for assemblies marked as:” Torque = <value> Nm” on larger pieces and where space is restricted “T = <value> Nm” where value is the required torque value. Splices must be marked with “Torque 3 x <value> Nm”.

11.0 DOCUMENTATION REQUIREMENTS

- 11.1 Drawings and technical documentation shall be submitted with tender.
- 11.2 The manufacturer must provide one soft copy and two hard copies of the technical specification.
- 11.3 The manufacturer must provide one soft and two hard copy of the method of installation.

12.0 QUALITY ASSURANCE

- 12.1 The successful tenderer shall maintain a Quality Management System (QMS) based on or certified to ISO 9001.

13.0 PACKAGING

- 13.1 The items shall be packed in suitable containers such as bags or cartons. The mass of each container with contents shall not exceed 25 kg.
- 13.2 Each container shall have firmly attached thereto a water resistant label, on which the following shall be designated:
 - i. Stores item number.
 - ii. Name, size (if applicable) and quantity of items contained therein.
 - iii. Contract/Purchase order number.
 - iv. Other information as detailed in the Supply Chain Services (SCS) order.

14.0 GUARANTEE AND DEFECTS

- 14.1 The appointed tenderer shall accept liability for makers’ defects, which may appear in design, material and workmanship.

15.0 METHOD OF TENDERING

- 15.1 Tenderer shall indicate clause-by-clause compliance document with the specification. This shall take the form of a separate document listing each of the specification’s clause and sub-clause numbers, indicating the individual statements of compliance or non-compliance.
- 15.2 Statement of non-compliance shall be motivated by the tenderer in a letter format, as per 15.1. The letter and evidence of deviation shall be submitted as part of the tender document.
- 15.3 Tenderers shall submit comprehensive literature consisting of detailed technical specifications in accordance to clause 5.0 (Technical Requirements) and clause 6.0 (Design), the general constructional details and principal dimensions if not indicated on the provided Transnet

drawings, maintenance schedules if required in any of the Appendix/Annexure and datasheets if required in any of the Appendix/Annexure or in the specifications.

- 15.4 Any items offered in accordance with other standards will be considered at the sole discretion of Transnet. The tenderer shall supply full details stating where the item differs from these specifications as well as supplying a copy (in English) of the recognized standard specification(s) with which it complies. Any deviations must be approved by Transnet Freight Rail, Technology Management (Electrical) department in writing.
- 15.5 Failure to comply with clauses 15.1, 15.2, 15.3 and 15.4 could preclude a tenderer from consideration.
- 15.6 In the event of any conflict between the various submitted relevant documents, the order of precedence shall be, and in consultation with Transnet Freight Rail, Technology Management (Electrical Technology) department:
- a) Legal and safety requirements.
 - b) This Specification.

END

APPENDIX 1:

This attachment contains the drawings of each components assembly drawing.

Item description	Drawing Description	Drawing number
Contact wire Splicers.	Splice, Conductor, 161mm ² SQ Cu Contact wire – Electrification TYPES A, B, F, G, H and Coal line deviations	CEE-TNB-0021
	CONDUCTOR SPLICE ASSEMBLY 107mm SQ Cu CONTACT WIRE	CEE- TN-0405
Contact wire swivel clips/clamps	SWIVEL CLIP STEM FOR HOCKEY STICK/STEADY ARM	CEE-TND-0029
	CLAMP, ELECTRICAL, ASSEMBLY 161mm ² CONTACT WIRE	CEE-TN-0264
	SWIVEL CLIP: CONTACT WIRE: STEADY ARM:	CEE-TN-0049
	ELECTRICAL CLAMP ASSEMBLY	CEE-TND-0033
Parallel Clamps	PARALLEL HALF CLAMP FOR VARIOUS CONDUCTOR SIZES	CEE-TNB-0054
	PARALLEL HALF CLAMP FOR VARIOUS CONDUCTOR SIZES	CEE-TNB-0055
	ALUMINIUM PARALLEL CLAMP 160 MM SQ - 160 MM SQ TIGER CATENARY	BBB 0376
	ALUMINIUM PARALLEL CLAMP 500MM ALUMINIUM TO 160MM ALUMINIUM	BBG 7987
	ALUMINIUM CLAMP 800MM ALUMINIUM TO 160MM ALUMINIUM	BBG 7988
	BI-METALLIC CONDUCTOR SPLICE PARALLEL CLAMP 160 MM ² Cu to 250MM ² AL FEEDER	BBD 5138
	BI-METALLIC CONDUCTOR SPLICE PARRALEL CLAMP "SKUNK" CATENARY 25 KV AC ELECTRIFICATION	BBB 4185
Feeder Clamps	FEEDER CLAMP FOR 161mm SQ Cu CONTACT WIRE	CEE-TNB-0057
	CLAMP, ELECTRICAL: FEEDER CLAMP 107mm SQ CONTACT WIRE	CEE-TNB-0081
	BI-METAL FEEDER CLAMP FOR 161 mmSQ AL/107 mmSQ Cu CONTACT WIRE	BBH 0306
	BI-METAL FEEDER CLAMP FOR 161mmSQ AL/161 mmSQ Cu CONTACT WIRE	BBG 6147
Runner Clamps	CLAMP, RUNNER, ASSEMBLY: 161mm SQ & 107mm SQ Cu CONTACT WIRE	CEE-TNB-0086
Dropper Clips	DROPPER CLIP (PLATE TYPE) 80/100mm SQ CATENARY	CEE- TND-0036
	CONDUCTIVE DROPPER CLAMP'S	BBH 1331
Support Wire Clamp	CLAMP 107MMSQ CU. CONTACT WIRE SUPPORT WIRE ASSEMBLY	BBC 2604

ANNEXURE A: SCHEDULE OF REQUIREMENTS

(To be completed by Transnet Representative)

Item	Clamp/Fittings required	Drawing number and material type

Completed by:

.....

Capacity

.....

Signature

.....

Date

.....

ANNEXURE B: TECHNICAL DATA SHEET

(To be completed by the tenderers and submitted as part of their tender)

Item	Clamp/Fitting/component tender for: (Full description)	Is all technical data sheets attached, as required in this specification? (Yes/No)

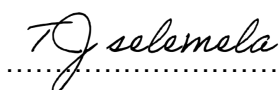


Transnet SOC Limited

TECHNOLOGY MANAGEMENT

SPECIFICATION

4 MICROFARAD CAPACITOR SURGE ARBSOBER 3 KV DC ELECTRIFICATION

Author:	Engineer Technology Management	T J Selemela	
Approved	Principal Engineer Technology Management	S E Sibande	
		Date:	22 May 2020

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LIST OF AMENDMENTS THE SPECIFICATION

Version No.	Date Issued	Clause No.	Page No.	Remarks
-	1986			Original edition
-	05/2020	Entire doc.		Changed formatting and layout of specification
		2.0	4	Added normative references
		3.0	5	Updated service conditions
		4.1	6	Added insulation and creepage ratings in the schedule of ratings
		4.3	6	Mounting brackets of capacitor is illustrated diagrammatically
		4.4	6	Added capacitor container requirements
		4.4.3	7	Added minimum IP rating of container
		5.0	8	Amended testing and inspection requirements
		6.0	8	Added rating plate and instruction labels
		7.0	8	Added documentation requirements
		8.0	8	Added quality assurance requirement
		9.0	9	Amended packaging storage and handling requirements
		10.0	9	Added guarantee and defect requirements
		11.0	9	Amended tendering method
		Appendix A	10	Added technical datasheet
		Appendix B	11	Added mounting bracket drawing

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1.0 SCOPE

- 1.1 This specification details Transnet's requirements for the supply of 4uF capacitor intended to be used in 3 kV DC traction system.
- 1.2 The capacitor protects 3 kV DC electrical equipment against surges caused by lightning, switching and regenerative braking.
- 1.3 This specification contains technical datasheet (Annexure A) which must be completed by the tenderer and must be submitted as part of the tender documents.

2.0 NORMATIVE REFERENCES

- 2.1 Unless otherwise specified all materials used, equipment developed and supplied shall comply with the latest edition of the relevant International Electro-technical Commission (IEC), International Organization for Standardization (ISO), British Standard (BS), South African National Standards (SANS) or Transnet publications.

2.2 IEC standards:

IEC 60137 :Bushings for alternating voltage above 1000V.

IEC 60871-1 :Shunt capacitors for AC power systems having a rated voltage above 1 000 V – Part 1: Performance, testing and rating – Safety requirements – Guide for installation and operation.

2.3 ISO standard:

ISO 9001 :Quality Management Systems.

2.4 BS standard

BS EN 10028-7 :Flat products made of steels for pressure purposes - Part 7: Stainless steels.

2.5 SANS standard:

SANS 60529 :Degrees of protection provided by enclosures.

2.6 Transnet publications

BBB 5452 :Transnet Freight Rail's requirements for the installation of electrical equipment for 3 kV DC traction substations.

CEE-TMG-97 :Terminating structure at substations, assembly.

3.0 SERVICE CONDITIONS

3.1 ENVIRONMENTAL CONDITIONS

3.1.1 The capacitor shall be designed for outdoor installation and shall be exposed to the following atmospheric conditions:

Altitude	:	0 - 1800 m above sea level
Relative humidity	:	up to a level of 95%
Ambient temperature	:	-10° C to +55° C
Wind pressure	:	750 Pa
Lightning conditions	:	Up to 20 ground flashes/km ² per annum
Pollution	:	Heavily salt laden with industrial pollutants including diesel- electric locomotive emissions

3.2 MECHANICAL SERVICE CONDITIONS

3.2.1 The capacitor shall be installed on electrification structures and shall be exposed to intermittent vibration due to passing trains. The design must be adequately robust so as to ensure reliability of the equipment under service conditions.

3.3 ELECTRICAL SERVICE CONDITIONS

3.3.1 The capacitor shall be used in traction systems with the following electrical parameters in accordance with BBB 5452:

Table 1 OHTE system electrical design parameters

Nominal system voltage	3 kV
Highest system voltage	3.9 kV
Lowest system voltage	2.4 kV
Outdoor earth clearance	150 mm

4.0 TECHNICAL REQUIREMENTS

Capacitor shall comply with the following technical requirements:

4.1 CAPACITOR SCHEDULE OF RATINGS

Capacitor ratings shall be in accordance with table 2 below.

Table 2 Capacitor schedule of ratings

4.1.1	Rated capacitance	4 μ F
4.1.2	Capacitance tolerance	-5% to +10%
4.1.3	Rated DC voltage	3 kV DC
4.1.4	Maximum permissible DC voltage	4.5 kV DC
4.1.5	Insulating bushing minimum short duration power frequency withstand voltage, RMS (Wet)	20 kV
4.1.6	Insulating bushings minimum lightning impulse withstand voltage, peak	60 kV
4.1.7	Bushing minimum creepage distance	380 mm
4.1.8	Bushing minimum arcing distance	200 mm
4.1.9	Temperature category	-5/D
4.1.10	Minimum capacitor life expectancy (Hours)	175200

4.2 DIELECTRIC MATERIAL

- 4.2.1 The construction of the dielectric must be all-film type.
- 4.2.2 The dielectric fluid shall be polypropylene foil impregnated with non-toxic, non-PCB, environmentally friendly and bio-degradable synthetic insulating oil sealed under vacuum.

4.3 MOUNTING OF CAPACITOR

- 4.3.1 The capacitor shall be mounted on the terminating structure at 3 kV DC substations as shown in drawing CEE-TMG-97.
- 4.3.2 The capacitor shall be suitable for vertical mounting between two horizontal angled brackets of which the inside surface are 280 mm apart.
- 4.3.3 The typical dimensions of the capacitor brackets are illustrated in Appendix B.

4.4 CAPACITOR CONTAINER

- 4.4.1 The capacitor container shall be manufactured using stainless steel of suitable grade in accordance with BS EN 10028-7 or other anti-corrosion materials as approved by Transnet Freight Rail, Technology management (Electrical Technology) department.
- 4.4.2 The brackets shall be made of a steel grade with the name X5CrNi18-10 and the number 1.4301 as specified in EN 10028-7.

- 4.4.3 The container shall be sealed construction type to prevent breathing and the absorption of moisture. The IP rating of the container shall be IP63 in accordance with SANS 60529.
- 4.4.4 The container shall have adequate mechanical strength to avoid bulging and bursting throughout the service life of the capacitor.
- 4.4.5 Provision for lifting of the capacitor shall be made.

4.5 CAPACITOR TERMINALS

- 4.5.1 Each capacitor shall be provided with a single positive terminal bushing with the earth side of the capacitor coupled to the container and clearly marked with an earthing symbol.
- 4.5.2 The capacitor lead shall be brought out and terminated in the bushing. The bushing insulation shall be designed to suite application and to have minimum creepage distance as specified in clause 4.1.8.
- 4.5.3 Bushing insulation shall be stabilized against the effects of ultraviolet, solar radiation and against the effects of airborne contaminants.
- 4.5.4 The design and selection bushings shall be in accordance with IEC 60137, clause 4.0.

4.6 OPERATIONAL REQUIREMENTS

- 4.6.1 The capacitor shall be suitable for operations on DC supply, obtained from silicon diode rectifiers which contain a superimposed alternating current ripple due to harmonics. The capacitors must therefore be capable of withstanding continuously the following harmonic voltages without overheating or deterioration:

Table 2 System harmonic voltages

Harmonics	Frequency	RMS Voltage
6 th Harmonic	300 Hz	120 V
12 th harmonics	600 Hz	30 V
18 th Harmonic	900 Hz	14 V
24 th Harmonic	1200 Hz	8 V

4.7 SAFETY REQUIREMENTS

- 4.7.1 A built-in discharge device must be provided which shall reduce the residual voltage to 50 V within 5 minutes after capacitor is disconnected from source of supply.
- 4.7.2 There must be no switch, fuse, or any other isolating device between the capacitor unit and the discharging device.

5.0 TESTING AND INSPECTIONS

- 5.1 Transnet reserves the right to be present at all tests and inspections as called for in this clause.
- 5.2 The responsibility of arranging the tests called for in this clause rests with the successful tenderer.
- 5.3 A Transnet Freight Rail, Technology Management (Electrical Technology) representative may request any additional test deemed necessary to ensure compliance.
- 5.4 The capacitor shall undergo applicable type tests and routine tests in accordance with IEC 60871-1, section 2.
- 5.5 All capacitor shall be insulated to withstand a test voltage of not less than 20 kV DC for 1 minute between the container and terminal.

6.0 RATING PLATE AND INSTRUCTION LABELS

- 6.1 The capacitor container shall be permanently marked with the following information:
 - a. Manufacturer's name or trademark
 - b. Dated batch number
 - c. Rated capacitance in microfarad
 - d. Rated DC voltage
 - e. Temperature category
 - f. Insulating medium
 - g. Bushing insulation level
 - h. Rating of discharge device/resistor
 - i. Gross weight
- 6.2 The manufacturer must provide warning instruction that "DISCHARGE CAPACITOR BEFORE HANDLING". The instruction must be written clearly and permanently in red.

7.0 DOCUMENTATION REQUIREMENTS

- 7.1 Drawings and technical documentation shall be submitted with tender.
- 7.2 The manufacturer must provide one soft copy and two hard copies of the technical specification.
- 7.3 The manufacturer must provide one soft and two hard copy of the method of installation and mounting details.
- 7.4 The manufacturer must provide one soft copy and two hard copies of maintenance manual.
- 7.5 The manufacturer must provide design and type test certificates to verify conformance to the requirements and these must be submitted with tender documents.
- 7.6 Supplier shall advise how to proceed with the equipment at the end of its operating life, taking into consideration environmental requirements and regulations.

8.0 QUALITY ASSURANCE

- 8.1 The successful tenderer shall maintain a Quality Management System (QMS) based on or certified to ISO 9001.

9.0 PACKAGING, STORAGE AND HANDLING

- 9.1 Capacitor shall be packed individually in sea worthy crates.
- 9.2 Each package shall have visible and clear handling instructions.
- 9.3 Packaging shall be designed to protect against mechanical damage and ingress of moisture and dust.

10.0 GUARANTEE AND DEFECTS

- 10.1 The appointed tenderer shall guarantee that the supplied capacitor conforms to Transnet's requirements.
- 10.2 The appointed tenderer shall accept liability for makers' defects, which may appear in design, material and workmanship.
- 10.3 The appointed tenderer shall provide all information regarding guarantees and warranties in writing.

11.0 METHOD OF TENDERING

- 11.1 Tenderers shall indicate clause-by-clause compliance document with the specification. This shall take the form of a separate document listing each of the specification's clause and sub-clause numbers, indicating the individual statements of compliance or non-compliance.
- 11.2 Statement of non-compliance shall be motivated by the tenderer, as per 11.1.
- 11.3 Tenderers shall submit comprehensive literature consisting of detailed technical specifications, general constructional details and principal dimensions, maintenance schedules, datasheets, together with clear illustrations of the equipment offered.
- 11.4 Any items offered in accordance with other standards will be considered at the sole discretion of Transnet. The tenderer shall supply full details stating where the item differs from these specifications as well as supplying a copy (in English) of the recognized standard specification(s) with which it complies. Any deviations must be approved by the relevant Transnet, Technology Management department in writing.
- 11.5 Failure to comply with clauses 11.1, 11.2, 11.3 and 11.4 could preclude a tenderer from consideration.
- 11.6 In the event of any conflict between the various submitted relevant documents, the order of precedence shall be, and in consultation with Transnet Freight Rail, Technology Management (Electrical Technology) department:
 - a) Legal and safety requirements.
 - b) This Specification.

END

ANNEXURE A: TECHNICAL DATA SHEET

(To be completed by the tenderers and submitted as part of their tender)

Item No.	Description	Values	Units
1.	Rated capacitance		μF
2.	Rated nominal DC voltage		kV
3.	Maximum permissible DC voltage		DC
4.	Capacitor gross mass (kg)		kg
5.	Dielectric insulating material		
6.	Bushing lightning impulse withstand voltage, peak		kV
7.	Bushing short duration power frequency withstand voltage, RMS (Wet)		kV
8.	Bushing insulating material type		
9.	Container material		
10.	Container material grade		
11.	Bracket material		
12.	Bracket material grade		
13.	Peak surge current		kA
14.	Peak surge voltage		kV
15.	Temperature category		
16.	Bracket material grade		
17.	Life expectancy (Hours)		Hours
18.	Time to discharge voltage to 50 V		min

APPENDIX B: MOUNTING BRACKET DIMENSIONS

Figure B-1 below illustrates typical dimensions for the mounting bracket of the capacitor.

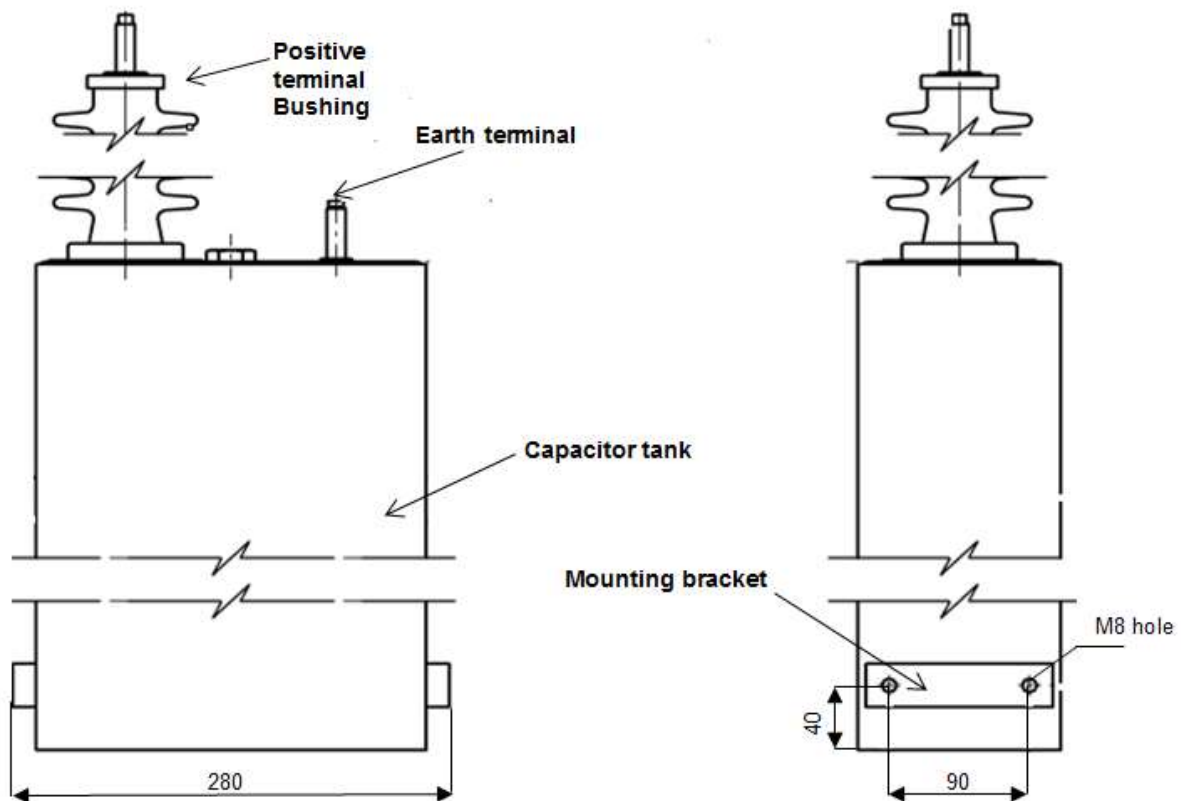
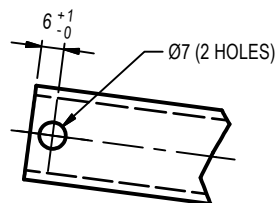
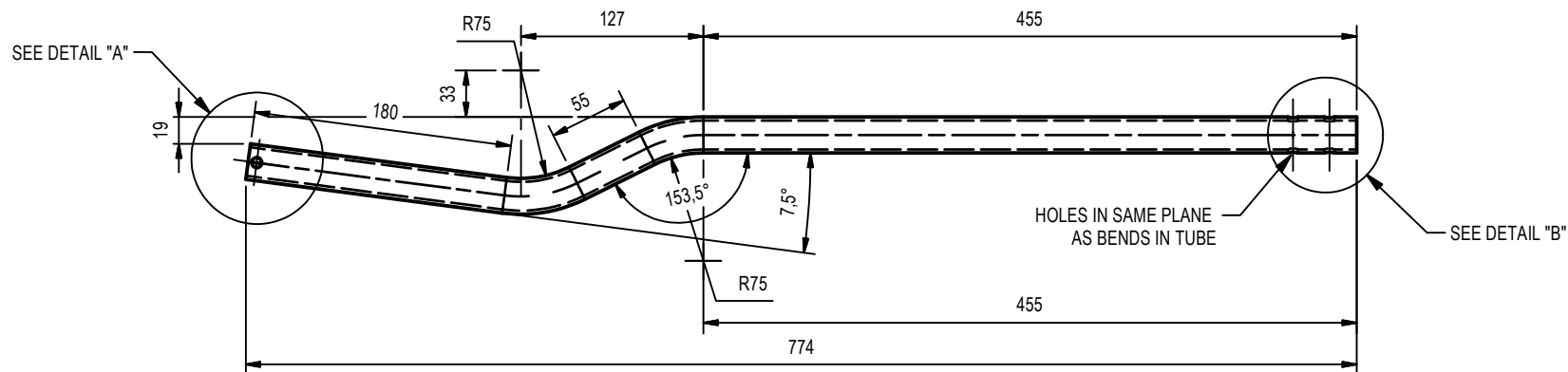
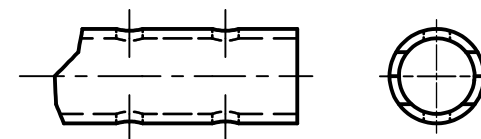


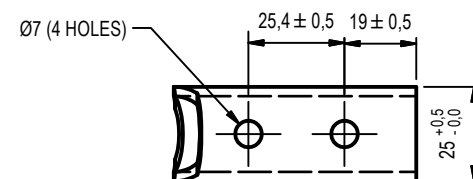
Figure B-1 Typical mounting dimensions



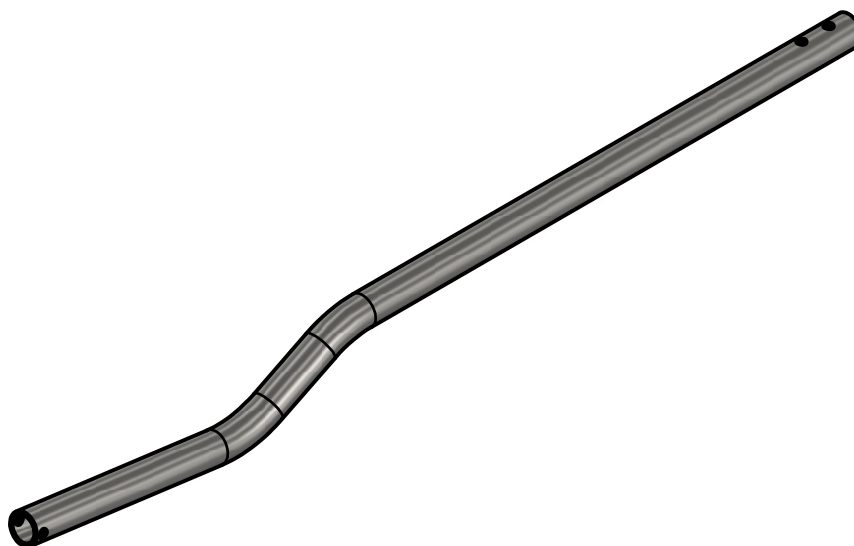
DETAIL "A"
SCALE 1 : 2



DETAIL "B"
SCALE 1 : 2



DETAIL "B" ROTATED 90°
SCALE 1 : 2



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DIMENSIONS : mm SCALE : 1 : 5
TOLERANCE : LIN ± 1 ANG $\pm 0,5^\circ$ ITEM NO : 54009302
MATERIAL : STAINLESS STEEL TUBE O.D. 25mm, WALL THK 2mm MIN. TO SPEC AISI GR 304.
VERSION INFO : REVISED AND REDRAWN

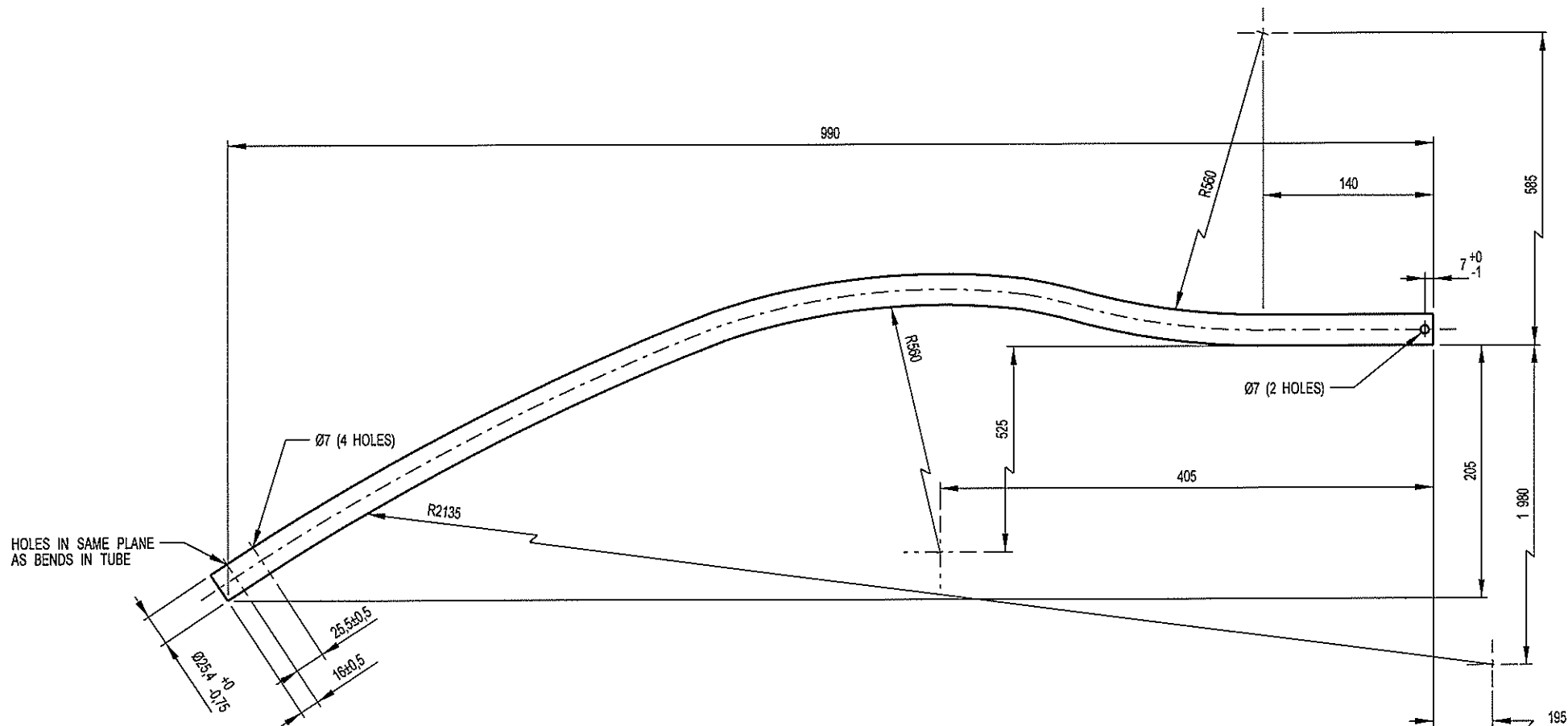
28/02/2024

APPROVED : W SCHOEMAN

AUTHORISED : T GOVENDER

STEADY ARM - BRIDGE TYPE

CEE-TN-0152
VERSION 3



NOTE
THIS DRAWING SUPERSEDES DRG. NO. CEE-54/110915

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DIMENSIONS : mm SCALE : 1 : 5
TOLERANCE : LIN ± 3 ANG $\pm$ ITEM NO: 54/9338
MATERIAL : STAINLESS STEEL TUBE 2,03 THICK
TO SPEC A.I.S.I. GRADE 304
VERSION INFO : HOLE DISTANCE FROM END OF STEADY
ARM WAS 19mm.

DO REF : CDO/5970
CP REF : BBC8791
DRAWN : C L BUCKLE
DESIGNED : -
CHECKED : J D VAN DYK

DATE: 24/11/2008
APPROVED
AUTHORISED

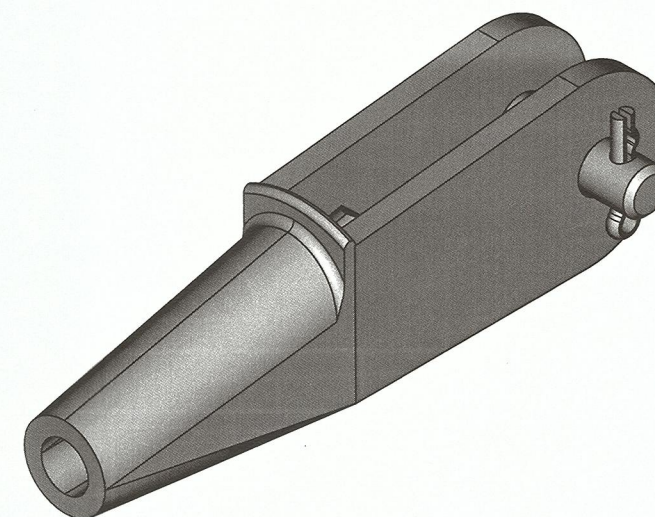
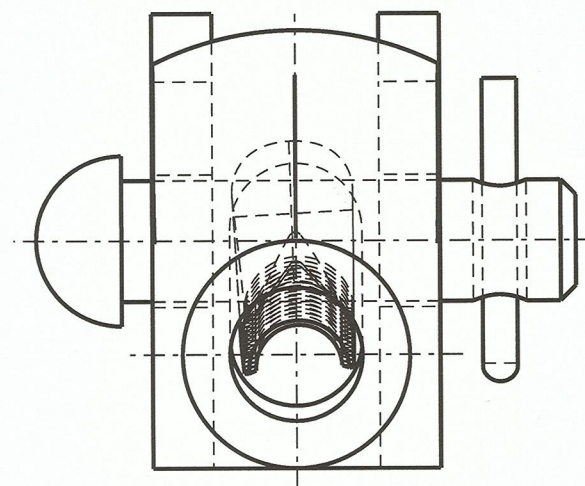
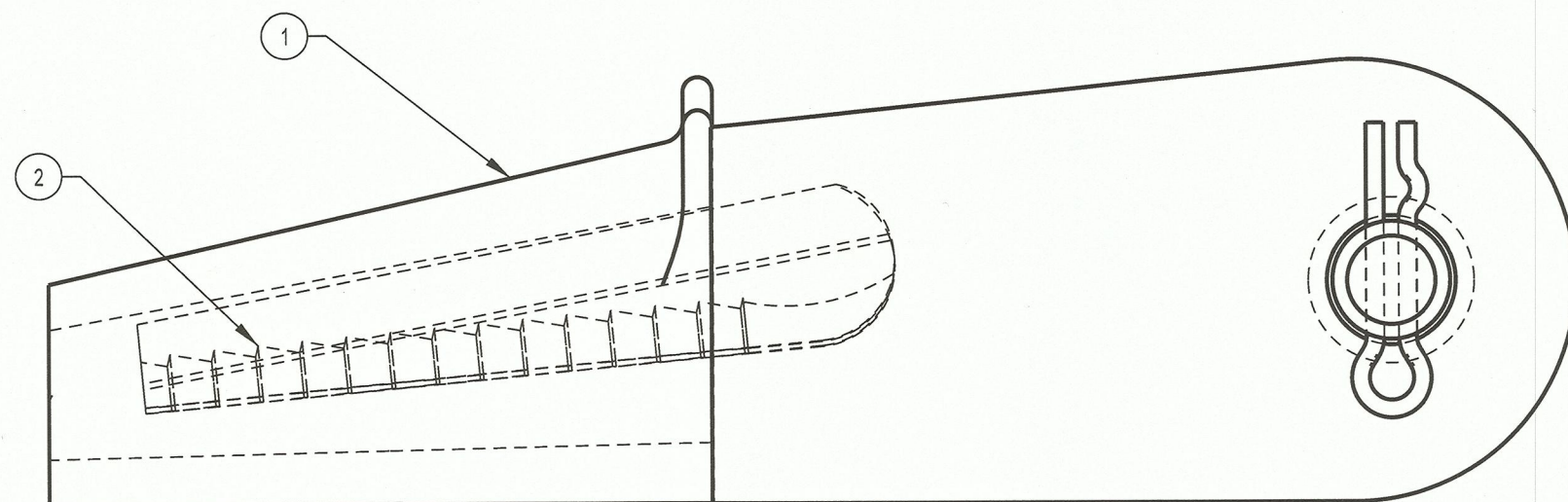
STEADY ARM: TUNNEL TYPE

TRANSNET
freight rail

CEE-TN-0153

AMENDMENT 2

A4



- NOTES
1. MINIMUM ULTIMATE TENSILE = 90kN
 2. TEST SAMPLES OF EACH BATCH SHALL BE ROUTINE TESTED IN TENSION WITH A STEEL BAR TO 63kN

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DIMENSIONS : mm SCALE : 1 : 1
 TOLERANCE : LIN± - ANG± - ITEM NO : 54004978
 MATERIAL : -
 VERSION INFO : REDRAW AND UPDATE

+ 2019-08-16

[Signature]

APPROVED S. SMIT

+ 2019-8-16

[Signature]

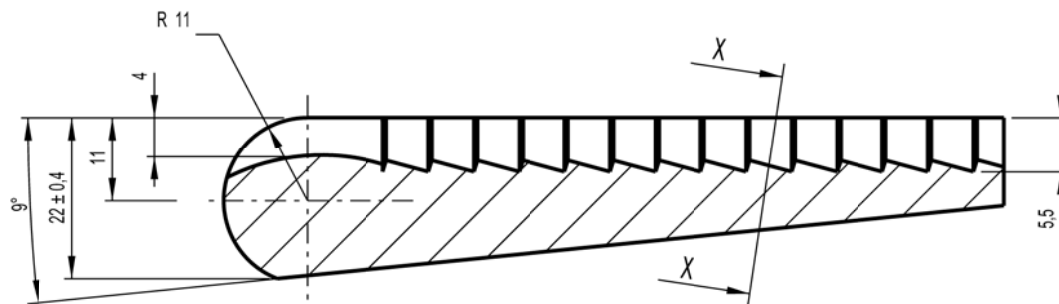
AUTHORISED L. BORCHARD

ITEM NO	DESCRIPTION	QTY	STORES ITEM NO	DRAWING NO
3	CLEVIS PIN, Ø16 x 60 LONG COMPLETE WITH LOCKING SPLIT PIN	1	54004020	CEE-TX-0066
2	CONE BODY	1	-	CEE-TNB-0036 Sht 2
1	WEDGE	1	-	CEE-TNB-0036 Sht 1

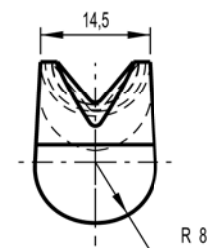
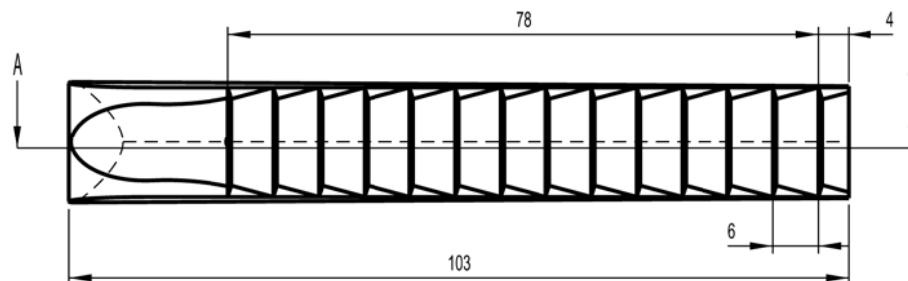
WIRE ENDING CONE ASSEMBLY
 107mm² / 161mm² Cu CONTACT WIRE

TRANSNET
 freight rail
 CEE-TNB-0036
 VERSION 2

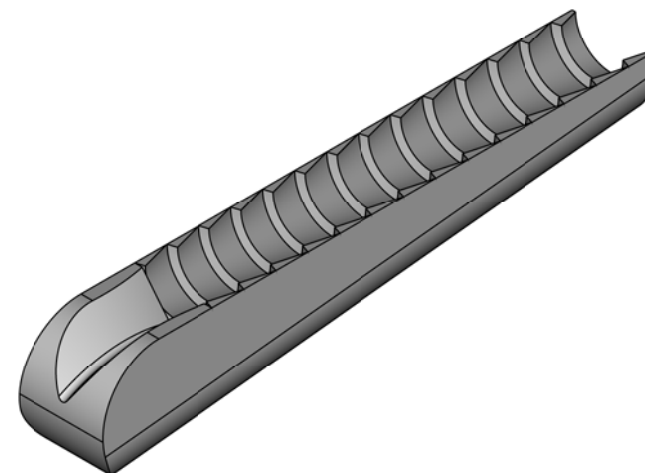
A3



SECTION A - A

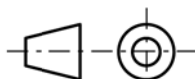


SECTION X - X



NOTES.

1. THE FOLLOWING PERMANENT MARKINGS MUST APPEAR ON THIS ARTICLE:
2. FINISH: HOT DIP GALVANISED TO SANS 121



DIMENSIONS : mm SCALE : 1 : 1
TOLERANCE : LIN ± 1 ANG ± 0,5°
MATERIAL : SPHEROIDAL GRAPHITE IRON TO SANS 936
GRADE SG 50

DRAWN : MP SAKO

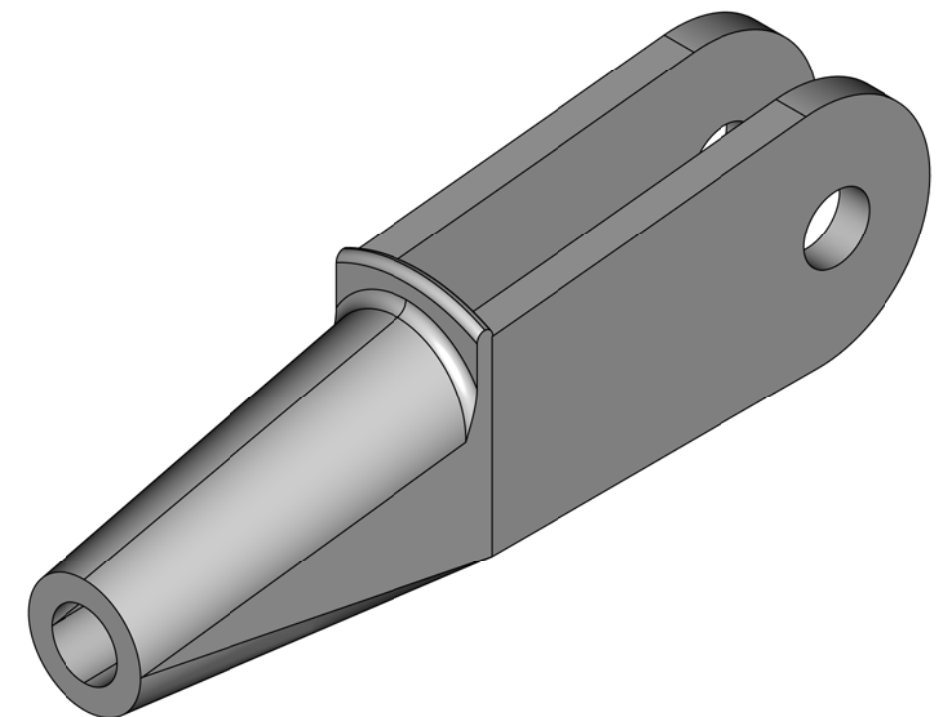
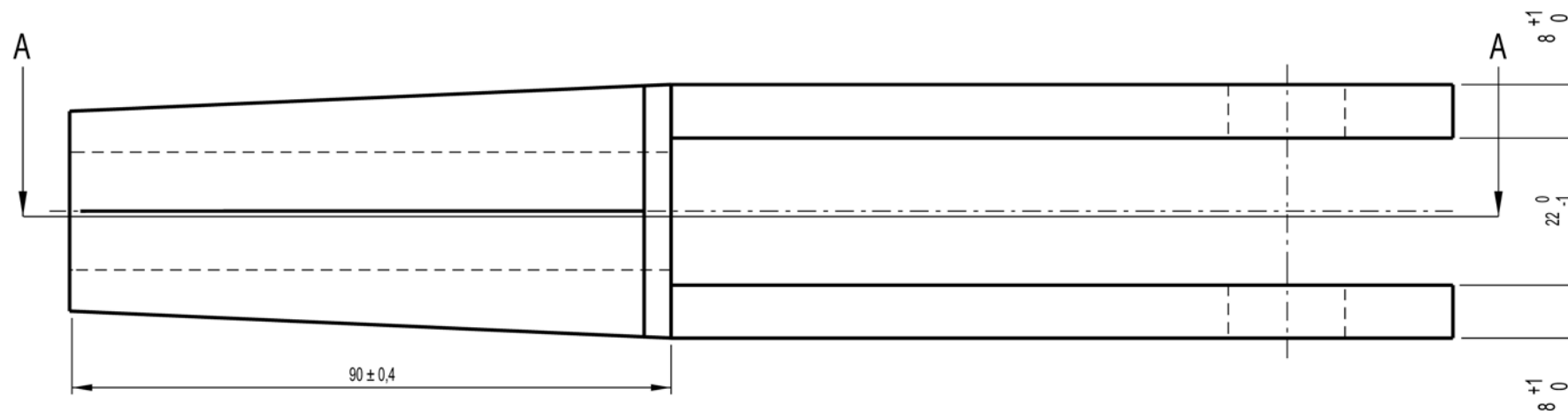
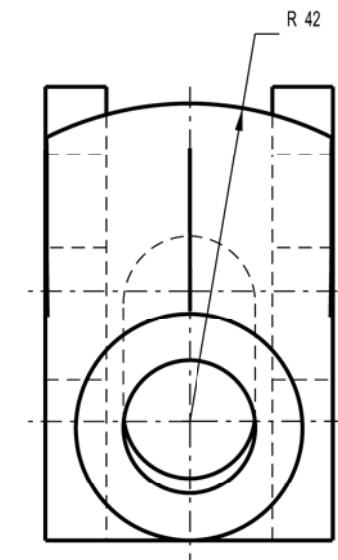
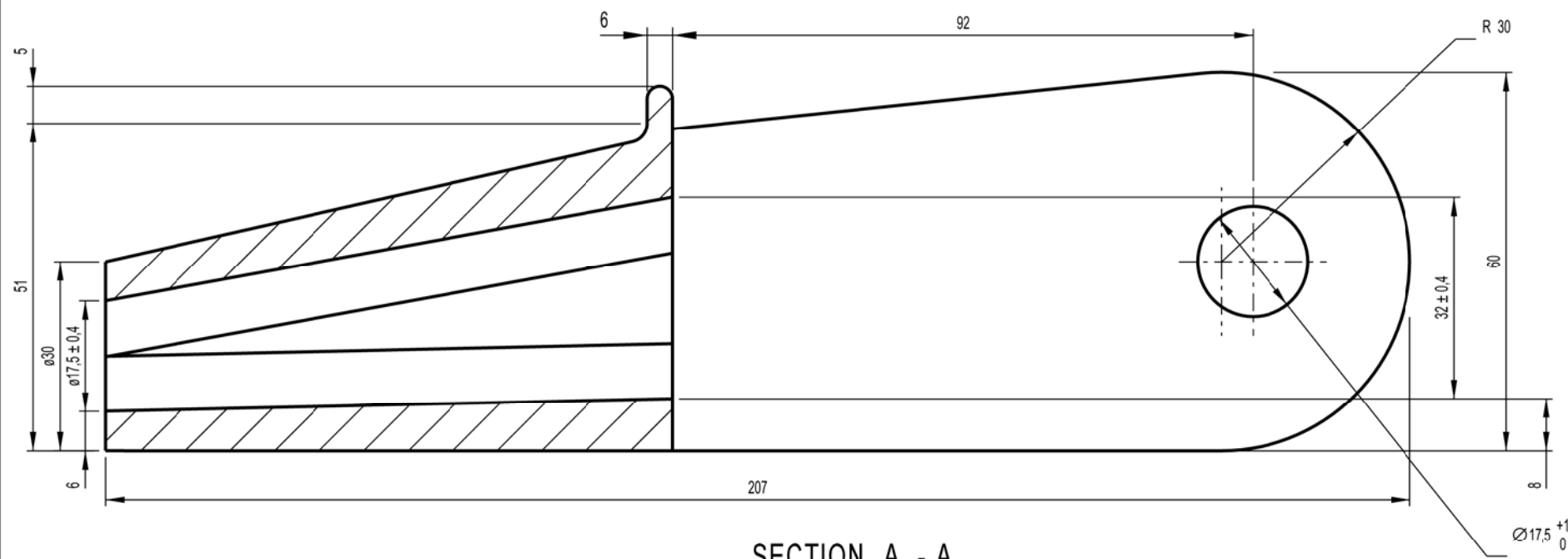
CHECKED : D HATTINGH

WEDGE
107mm² / 161mm² Cu CONTACT
WIRE ENDING CONE



CEE-TNB-0036 Sht 1

VERSION 2



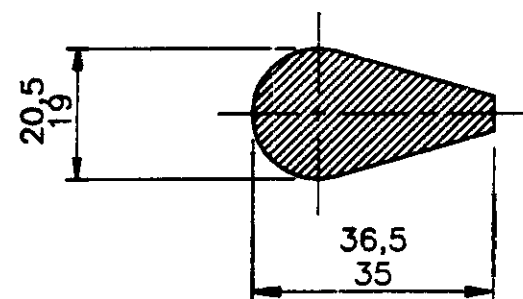
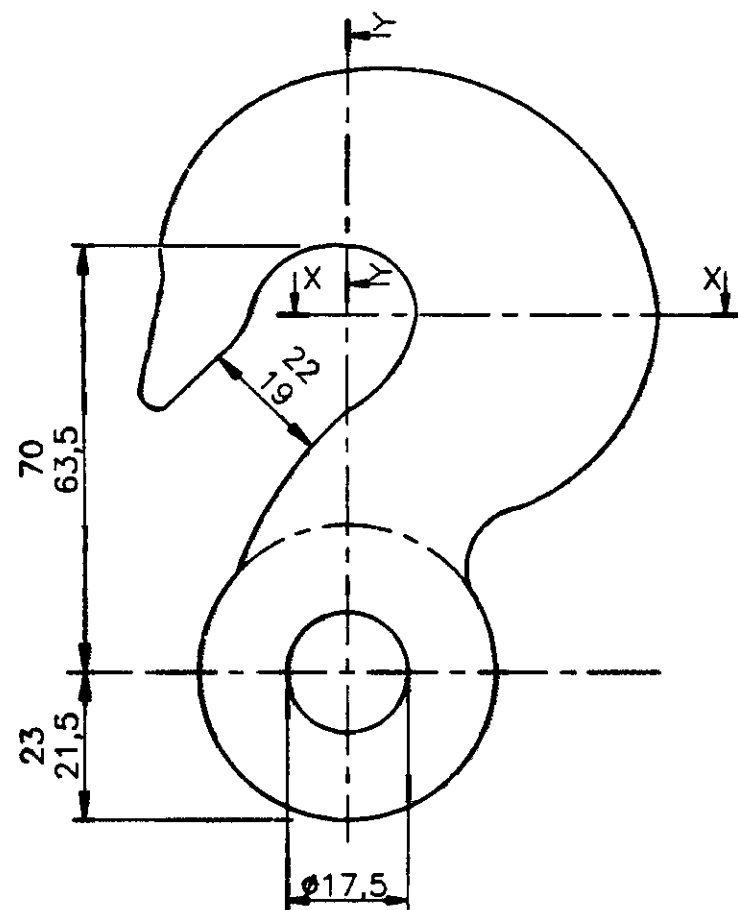
FINISH
HOT DIP GALVANISED TO SANS 121.
REMOVE ALL SHARP EDGES BEFORE GALVANISING

NOTES
THE FOLLOWING PERMANENT MARKINGS MUST APPEAR ON THIS ARTICLE:
a) TRANSNET LOGO
b) MAKER'S IDENTIFICATION
c) DATED BATCH NUMBER

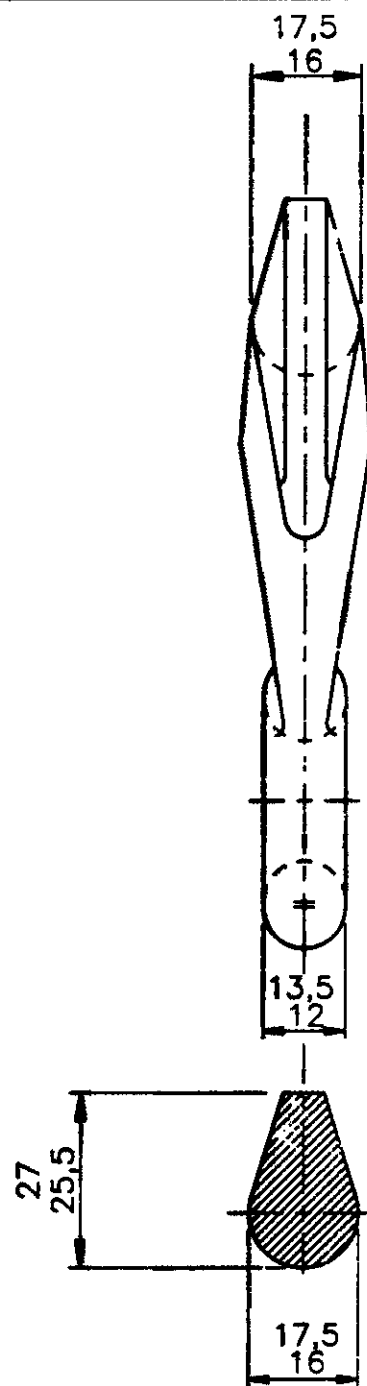
© COPYRIGHT PROTECTED. PREPARED BY CENTRAL DRAWING OFFICE

DIMENSIONS : mm	SCALE : 1 : 1
TOLERANCE : LIN ± 1 ANG ± -	
MATERIAL : SPHEROIDAL GRAPHITE IRON TO SANS 936	
GRADE SG 50	
DRAWN : MP SAKO	CHECKED : D HATTINGH

CONE BODY
107mm²/ 161mm² Cu CONTACT WIRE ENDING CONE



SECTION X-X



SECTION Y-Y

NOTES

1. MECHANICAL STRENGTH 44.5kN.
2. THE FOLLOWING PERMANENT MARKINGS MUST APPEAR ON THIS ARTICLE:
 - a) SPOORNET
 - b) MAKER'S IDENTIFICATION
 - c) BATCH NUMBER.
3. ZINC COAT TO SPEC SABS 763 FOR CONDITIONS IN SITU.

AMENDMENTS

NO	NAME	DATE
1	JVT	95-09-11

REVISED, DRG NO WAS
CEE-TN-361.
DO REF: T95/051

STORES ITEM NO

DIMENSION: mm
SCALE: 1:1



A3

DRAWING NO CEE-
TNB-41

SHEET - OF -

MATERIAL: ITEM NO _____ SPHEROIDAL GRAPHITE IRON TO SPEC SABS 936 GRADE SG 50

DO REF: J71/228 GEN TOL: LIN $\pm$ 0.5 ANG $\pm$ 1°

DRN: C. S. CKD: _____ DATE: 62-06-13

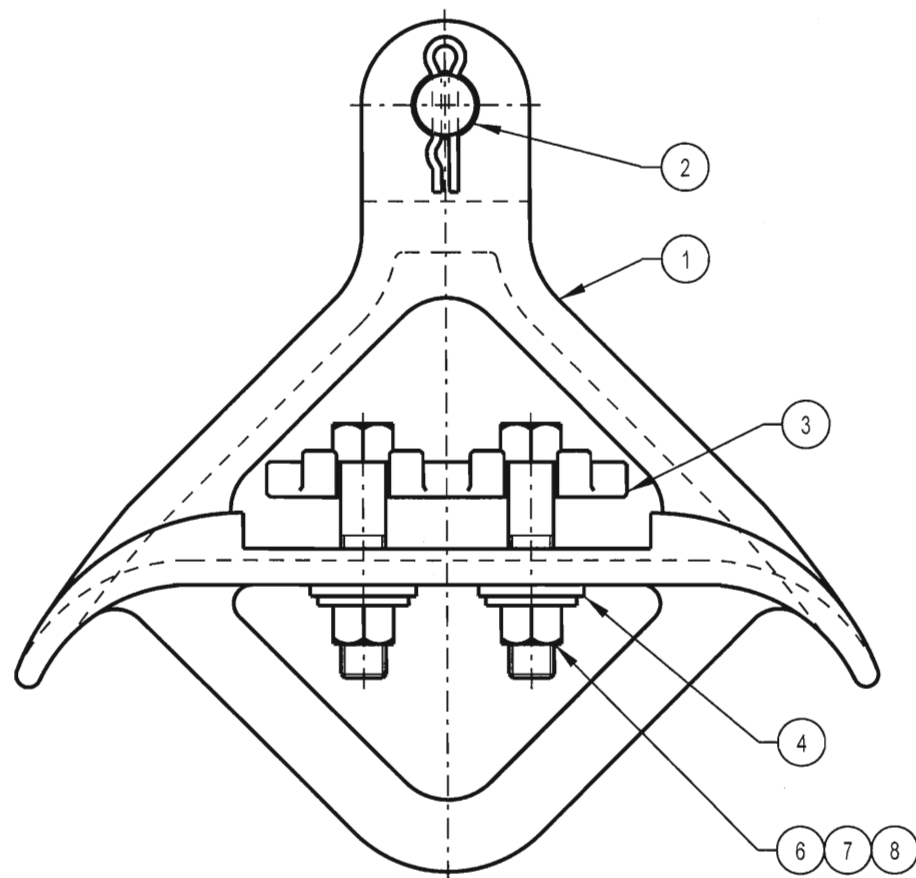
ENG: _____ W PHILLIPS for CHIEF ENG

INFRASTRUCTURE
(ELECTRICAL)

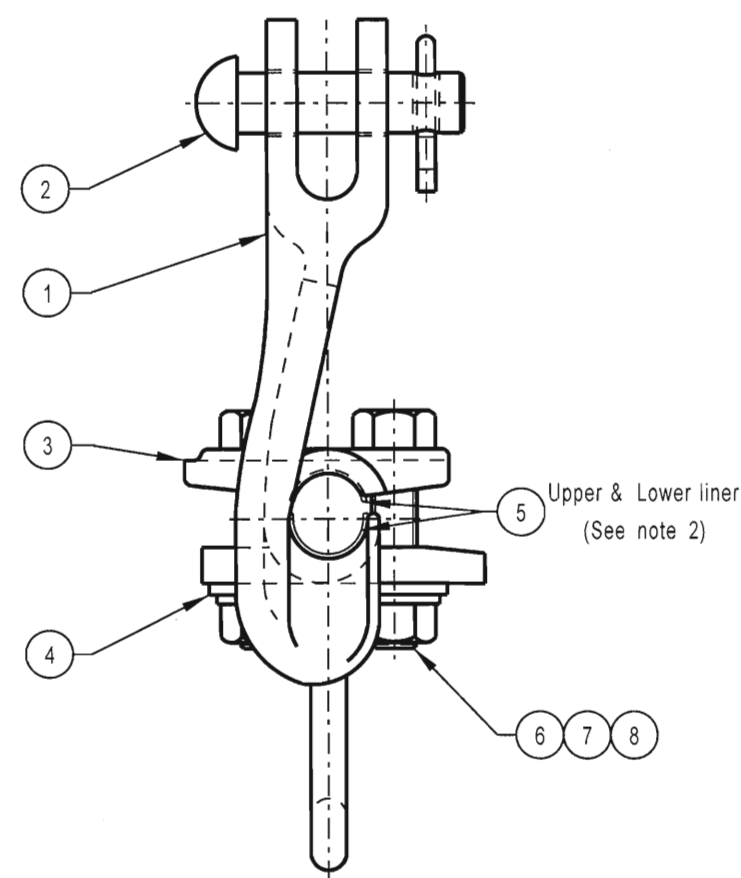
 SPOORNET

TOWER HOOK

T0000971



ITEM 5 NOT SHOWN IN THIS VIEW
(SEE NOTE 2)



Upper & Lower liner
(See note 2)

NOTES.

1. Mechanical strength with vertical load 44,5kN, Slipping load 13,3kN
2. Use Item 5 when this clamp is used for the 162mm² ACSR (Tiger) Catenary.

8	Hexagon nut, Mild steel, Galvanised, M12	4	-	-
7	Spring lock washer, Single coil, Sq. section, Galvanised, M12	4	-	-
6	Hexagon Bolt, Grade 8,8, Galvanised, M12 x 65 long	4	-	-
5	Upper and Lower liner, 162mm ² ACSR Catenary wire (See Note 2)	1	-	CEE TNB-0089
4	Strap	2	54301081	CEE TNB-0072 Sht. 4
3	Saddle	1	54301080	CEE TNB-0072 Sht. 3
2	Clevis pin, Ø16 x 60 long complete with locking pin	1	54004020	CEE TX-0066
1	Clamp body clevis type with tie down facility	1	-	CEE TNB-0073 Sht. 2
ITEM NO	DESCRIPTION	QTY	STORES ITEM NO	DRAWING NO

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DIMENSIONS : mm SCALE : 1 : 2
TOLERANCE : LIN± - ANG± - ITEM NO : -
MATERIAL : -
VERSION INFO : Updated and placed on Transnet frame

+ 30/07/2018

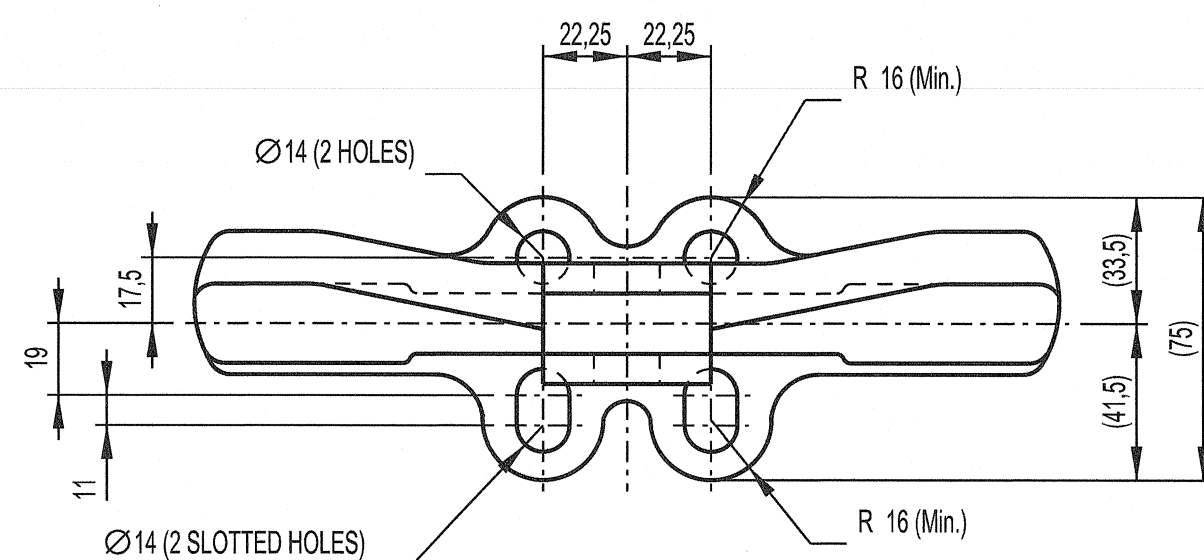
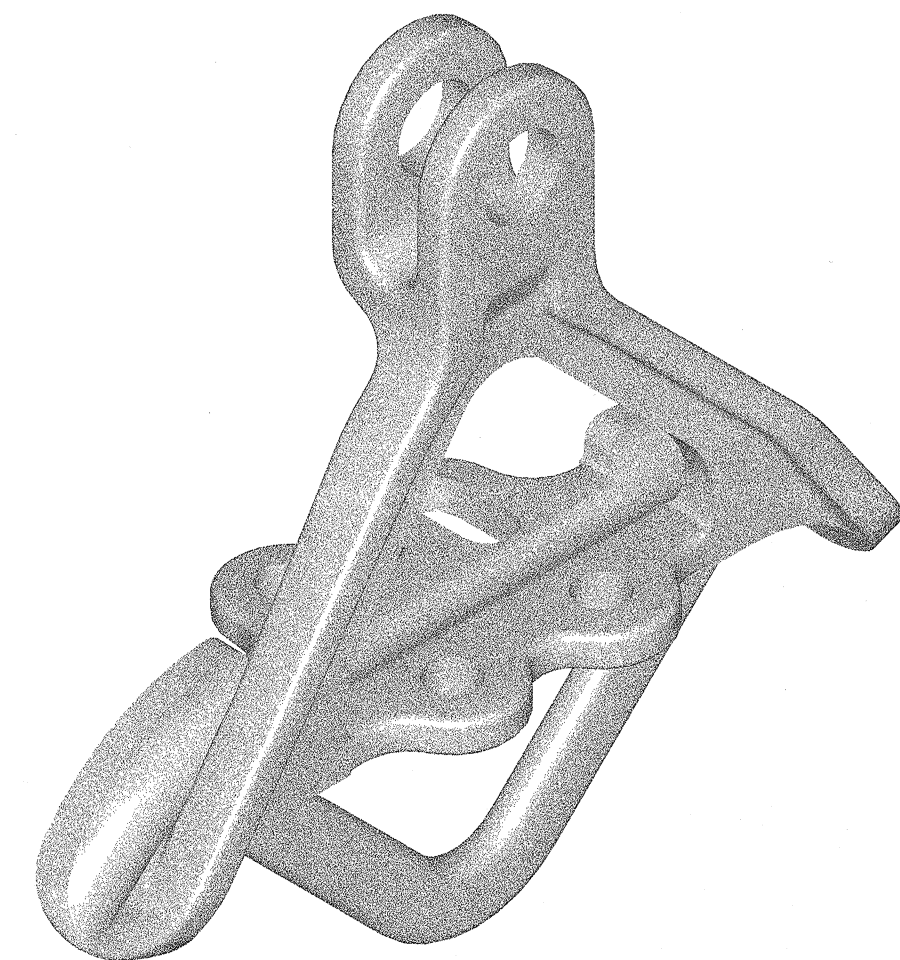
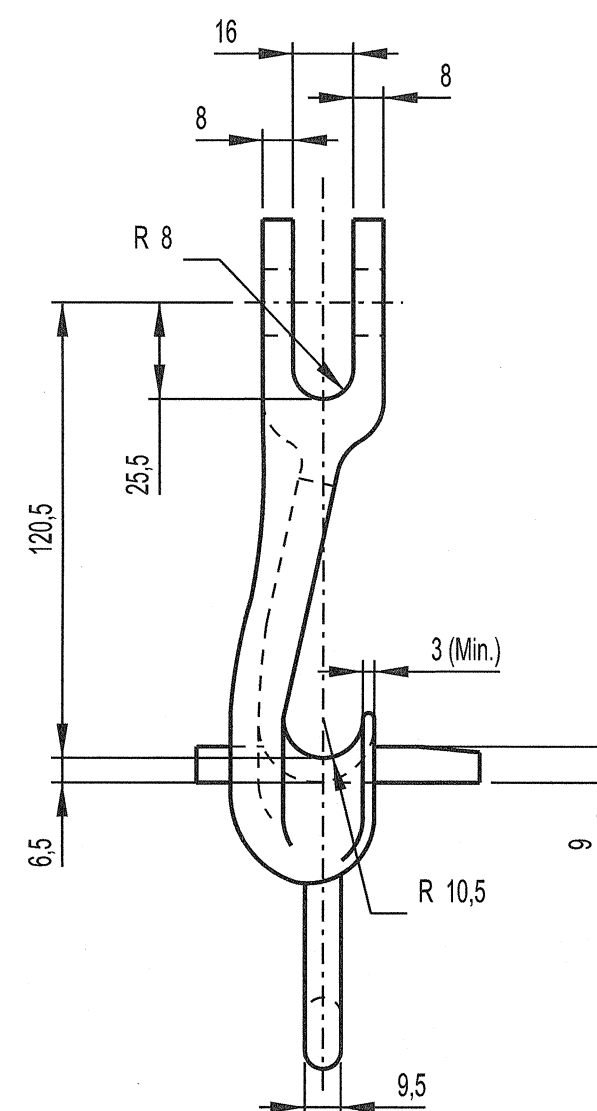
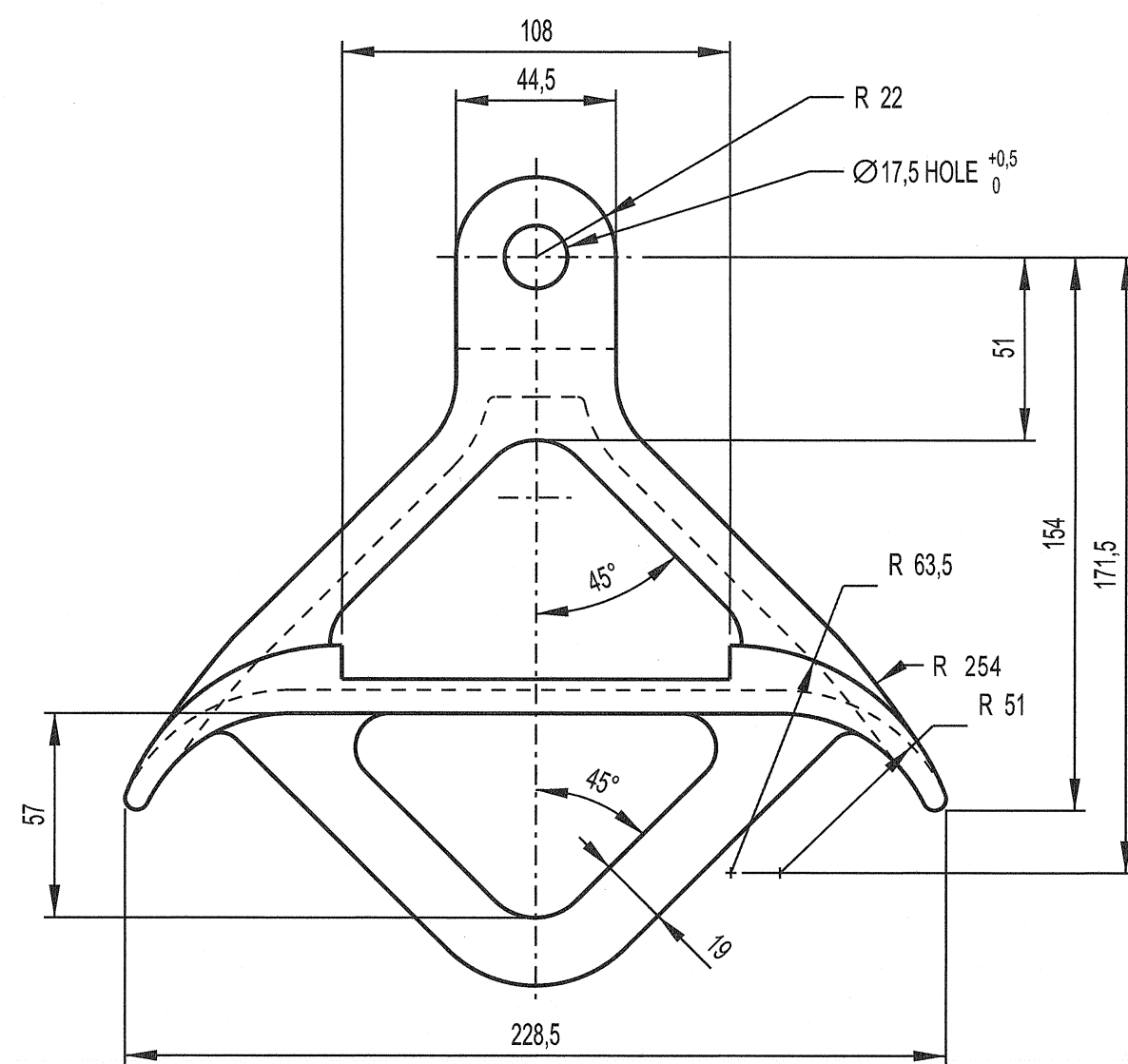
+ 2018-7-30

APPROVED

AUTHORISED

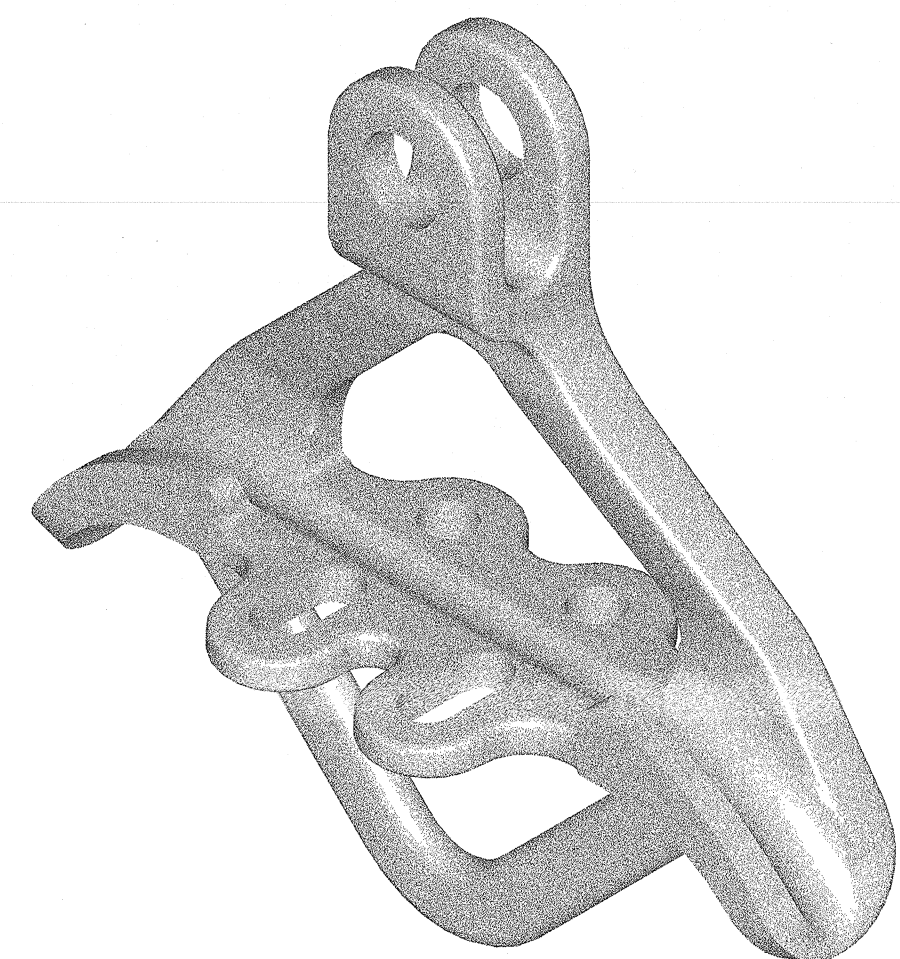
SINGLE SUSPENSION CLAMP
CLEVIS TYPE WITH TIE DOWN FACILITY

TRANSNET
freight rail
CEE TNB-0073 Sht. 1
VERSION 3 A3



NOTES

1. ALL UNSPECIFIED RADII TO BE R2.
2. THE FOLLOWING PERMANENT MARKINGS MUST APPEAR ON THIS ARTICLE:
 - a). TRANSNET LOGO.
 - b). MANUFACTURERS IDENTIFICATION.
 - c). DATED BATCH NUMBER.
 - d). CONDUCTOR SIZE.
3. ITEM TO BE SUPPLIED WITH AN ALUMINIUM LINER.
4. FINISH: HOT DIP GALVANISED TO SANS 121.
5. MAX. VERTICAL LOADING = 44.5kN



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DIMENSIONS : mm SCALE : 1 : 2
 TOLERANCE : LIN ± 0,5 ANG ± 1° ITEM NO : -
 MATERIAL : SPHEROIDAL GRAPHITE IRON
 TO SPEC SANS 936 GRADE SG 50
 VERSION INFO : NOTE ADDED.

DO REF : CDO/ 9424
 ECP REF : -
 DRAWN : D HATTINGH
 DESIGNED : -
 CHECKED : -

2019-09-18

APPROVED: S SMIT

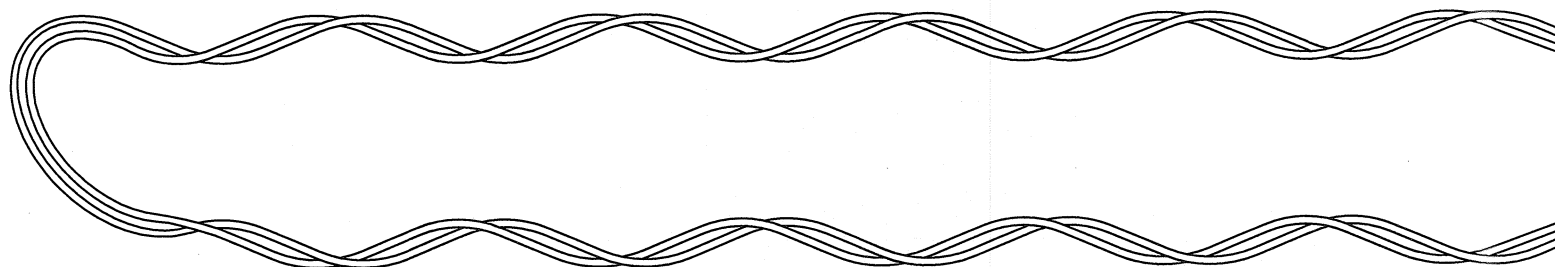
2019-09-18

AUTHORISED: L O BORCHARD

SINGLE SUSPENSION CLAMP BODY
 CLEVIS TYPE WITH TIE DOWN FACILITY

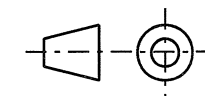
TRANSNET
 freight rail
 CEE TNB-0073 Sht. 2
 VERSION 3

ITEM	STORES ITEM NO	USE FOR CONDUCTOR:
1	-	50mm ² AL
2	54008560	250mm ² AL
3	54009706	80mm ² Cu
4	54005506	160mm ² AL



NOTES

1. TYPICAL DRAWING ONLY, CLAMP TO SUIT CONDUCTOR.
2. CLAMP IS A CONDUCTOR FITTING TO BE TESTED TO SANS 61284.



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DIMENSIONS : mm SCALE : NTS
TOLERANCE : LIN±1 ANG±- ITEM NO :-
MATERIAL :-

VERSION INFO : NEW FRAME ADDED.

2018-11-28

APPROVED: S SMIT

2018-11-28

AUTHORISED: L O BORCHARD

CLAMP, ELECTRICAL
CONDUCTOR, STRAIN

TRANSNET
freight rail

CEE-TNB-0077

VERSION 3

A4

DO REF: CDO/9201

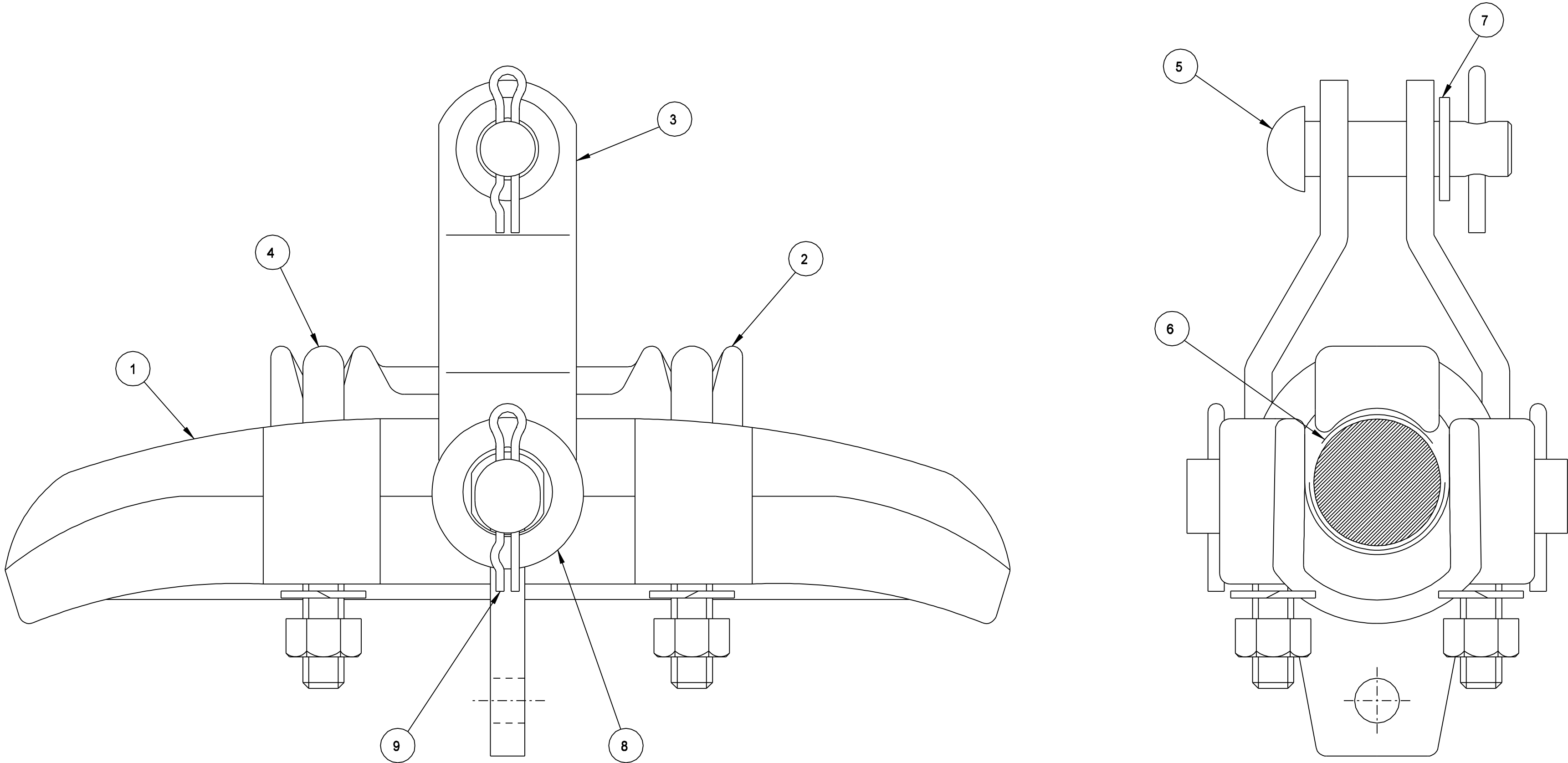
ECP REF: -

DRAWN: D HATTINGH

DESIGNED: -

CHECKED: D HATTINGH

ITEM	DESCRIPTION	QTY	STORES NO	DRG NO CEE-	AMENDMENTS		
1	CRADLE	1	_____	TNB-91 SHT 2	NO	NAME	DATE
2	SADDLE	1	_____	TNB-91 SHT 3			
3	LINK STRAP	2	_____	TNB-91 SHT 4			
4	U-BOLT, M12	2	_____	TNB-91 SHT 5			
5	PIN, STRAIGHT, HEADED, Ø16	1	_____	TX-66			
6	LINERS	2	_____	TNB-91 SHT 6			
7	WASHER, STEEL, ROUND, GALV. M16	1	01/33660	_____			
8	WASHER, STEEL, ROUND, GALV. M24	2	01/33684	_____			
9	LOCKING SPLIT PIN	3	54/3734	TX-54			

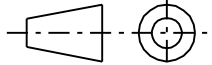


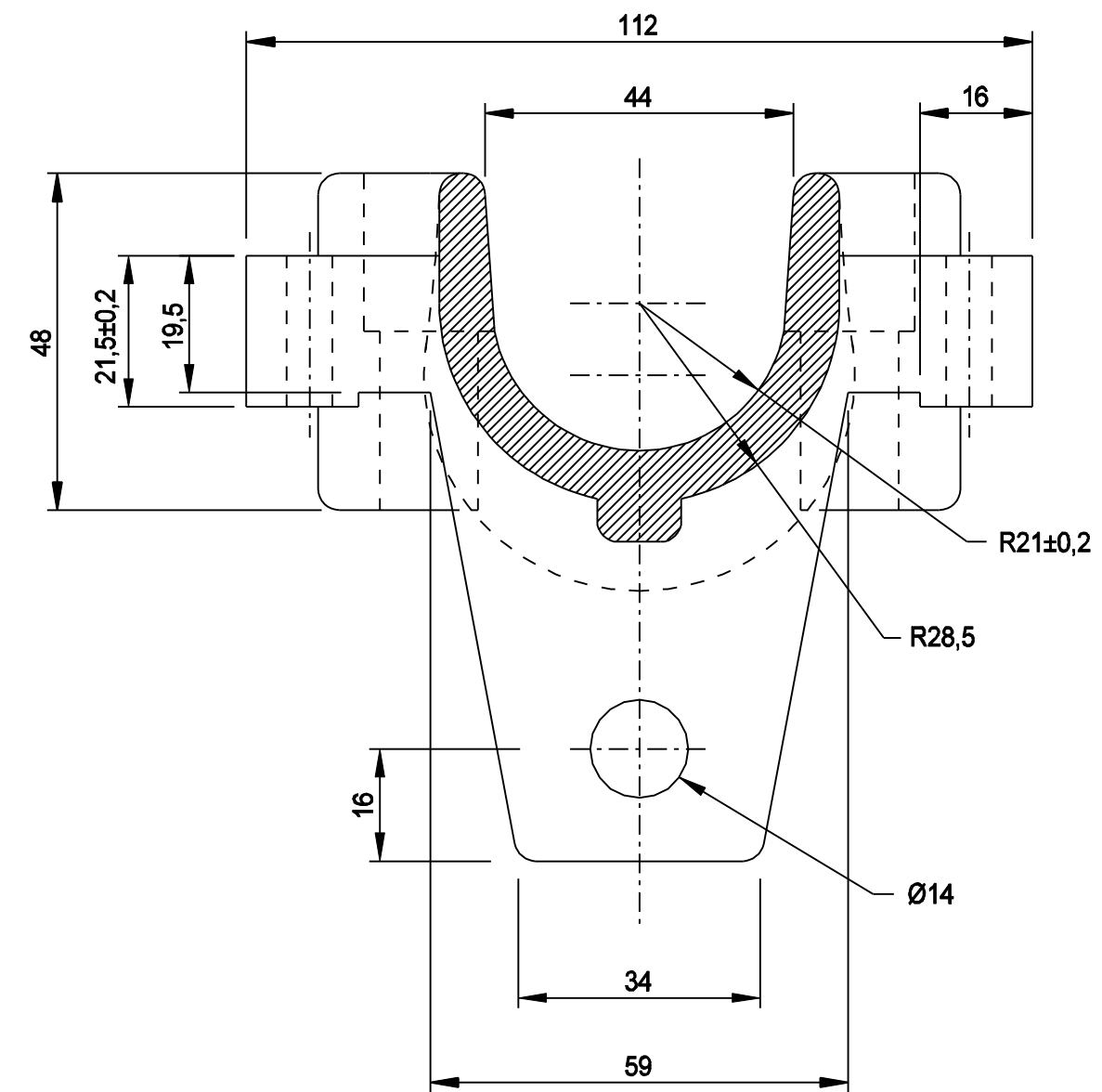
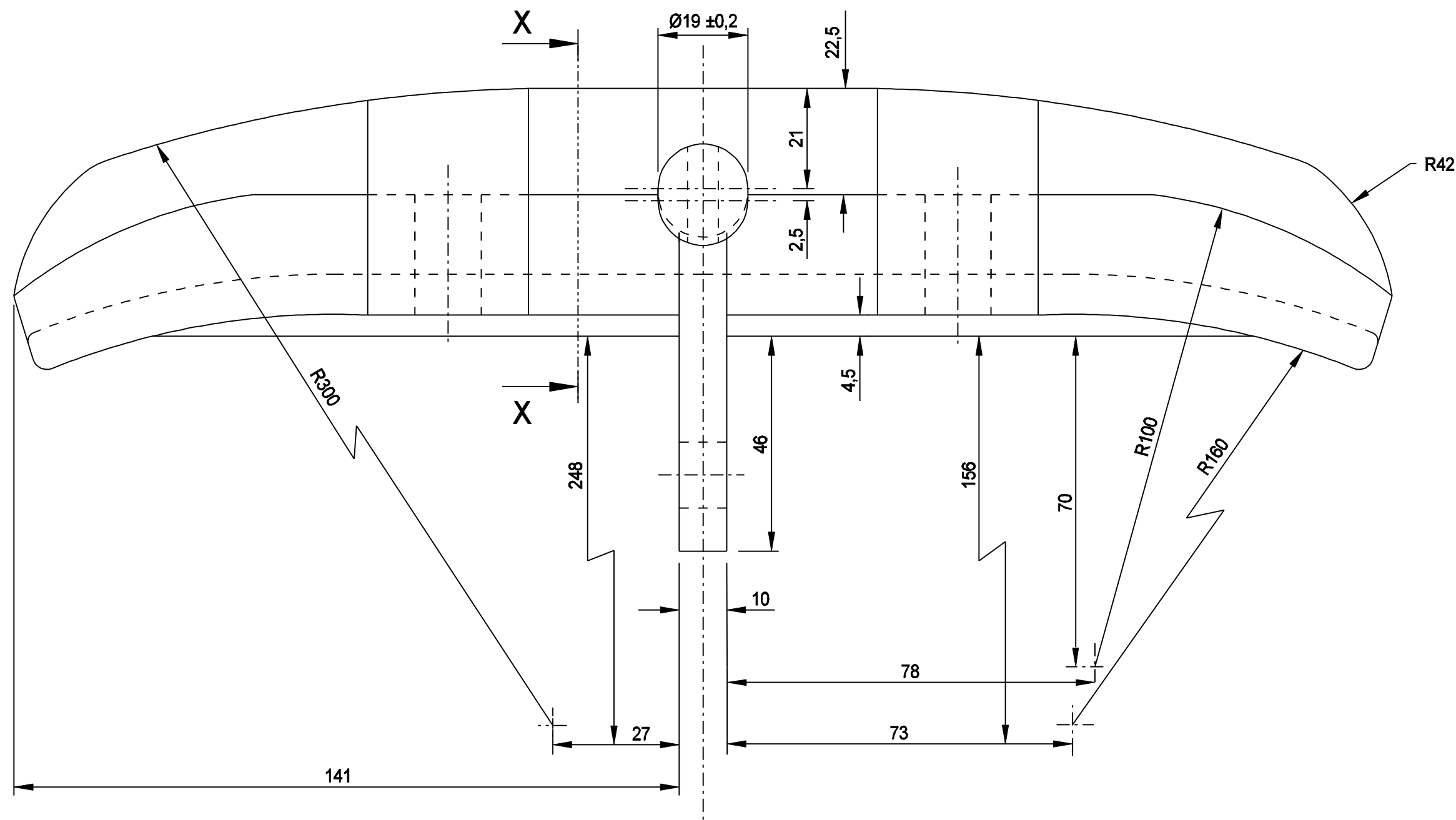
- NOTES
- 1. IDENTIFICATION: CLAMP MUST BE PERMANENTLY MARKED WITH MAKERS IDENTIFICATION AND MONTH AND YEAR OF MANUFACTURE.
 - 2. MINIMUM ULTIMATE STRENGTH: 70kN.
 - 3. THIS ARTICLE MUST BE MANUFACTURED UNDER THE MARK OF THE SABS.
 - 4. ZINC COAT TO SPEC SABS 763 FOR CONDITIONS IN SITU.

DO REF: T98/027	GEN TOL: LIN± -	ANG± -
DRN: JR ANTHONY	CKD: JVT	DATE: 98-07-15
ENG: HA SLIER	HA SLIER	for CHIEF ENG
CENTRAL DRAWING OFFICE  SPOORNET		

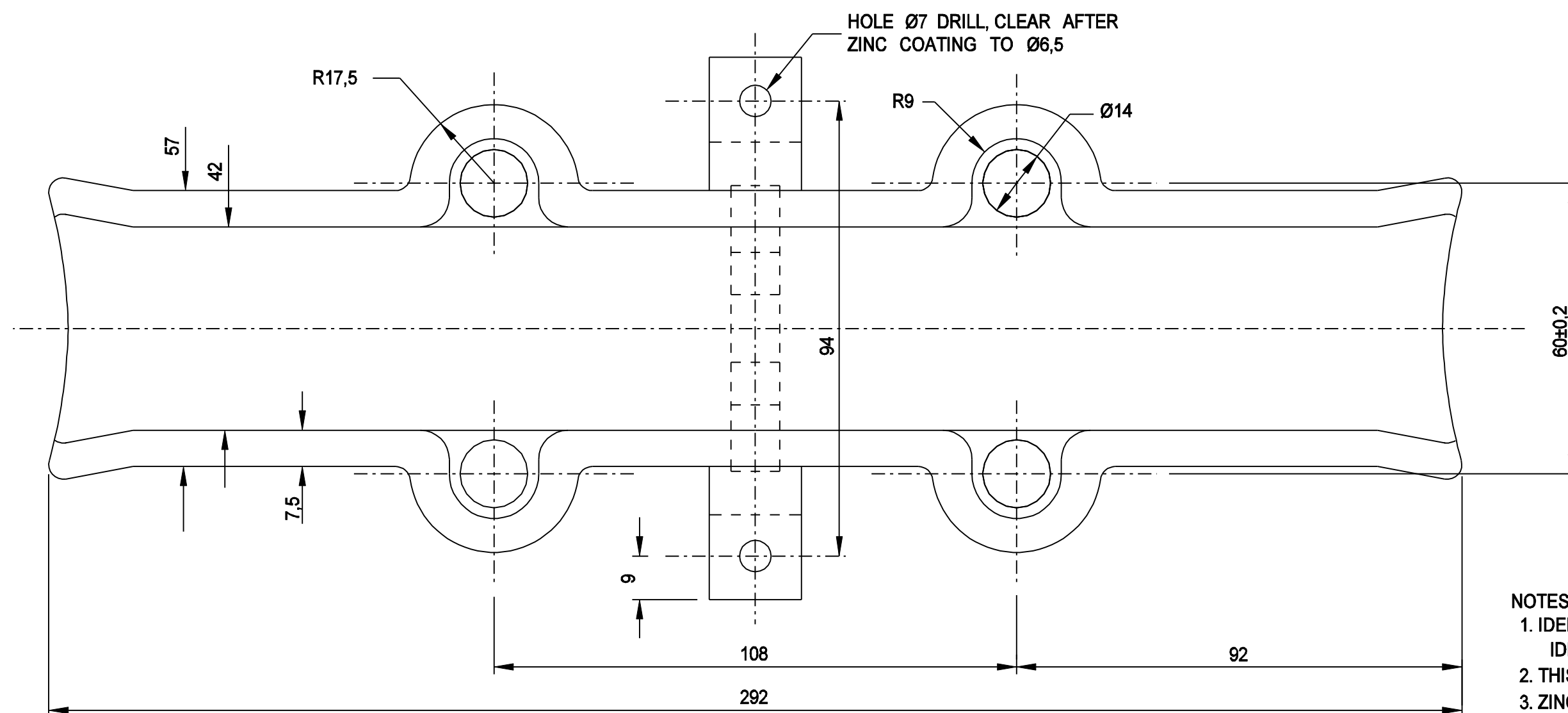
SINGLE SUSPENSION CLAMP ASSY

500 / 800mm² CONDUCTORS

STORES ITEM NO	
54/21980	
DIMENSIONS: mm	
SCALE: 1:1	
	A2
DRAWING NO CEE-	
TNB-91	
SHEET 1	OF 6



SECTION X-X



- NOTES
1. IDENTIFICATION: CRADLE MUST BE PERMANENTLY MARKED WITH MAKERS IDENTIFICATION AND MONTH AND YEAR OF MANUFACTURE.
 2. THIS ARTICLE MUST BE MANUFACTURED UNDER THE MARK OF THE SABS.
 3. ZINC COAT TO SPEC SABS 763 FOR CONDITIONS IN SITU.
 4. ALL UNSPECIFIED RADII R3.

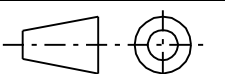
MATERIAL: SPHEROIDAL GRAPHITE IRON TO SABS 936 GRADE SG 50		
DO REF: T98/027	GEN TOL: LIN± 1	ANG± -
DRN: GA ERASMUS	CKD: JVT	DATE: 98-07-15
ENG: HA SLIER	HA SLIER	for CHIEF ENG
CENTRAL DRAWING OFFICE  SPOORNET		

CRADLE
SINGLE SUSPENSION CLAMP
 500 / 800mm² CONDUCTORS

AMENDMENTS		
NO	NAME	DATE
1	HA SLIER	99-01-15

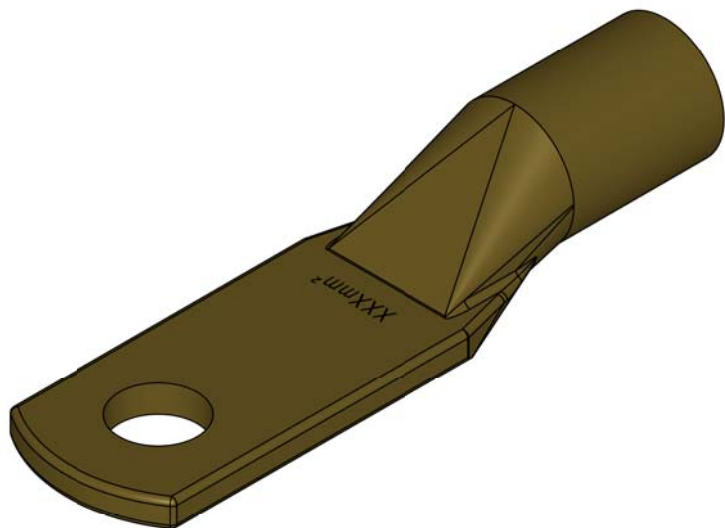
DIMENSION 44 ADDED.
 RADII CENTRES ADDED.
 DO REF: T98/045

DIMENSIONS: mm
 SCALE: 1:1

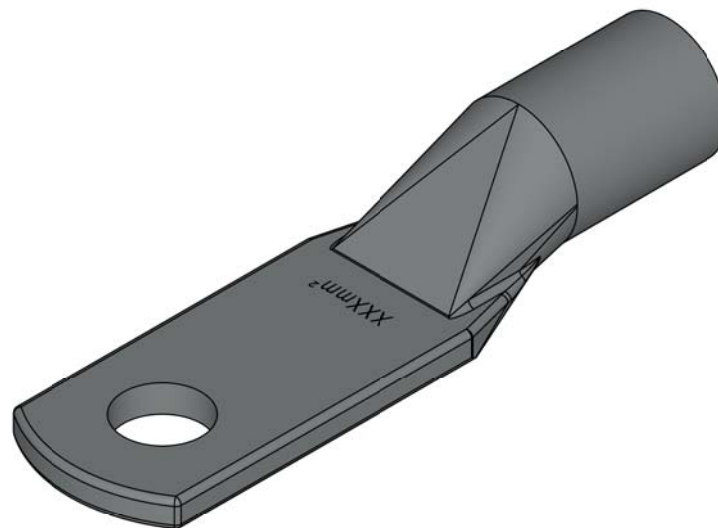


A2

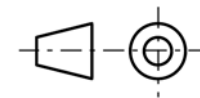
DRAWING NO **CEE-
TNB-91**
 SHEET **2** OF **6**



FOR TINNED COPPER LUGS
SEE CEE-TU-0136 SHT. 1



FOR ALUMINIUM LUGS
SEE CEE-TU-0136 SHT. 2



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DIMENSIONS : mm SCALE : NTS
TOLERANCE : LIN $\pm 0,5$ ANG $\pm 1^\circ$ ITEM NO : -
MATERIAL : -

VERSION INFO : NOTE 5 ADDED ON SHEET 1.
NOTE 4 ADDED ON SHEET 2.

28/02/2024

APPROVED: W SCHOEMAN

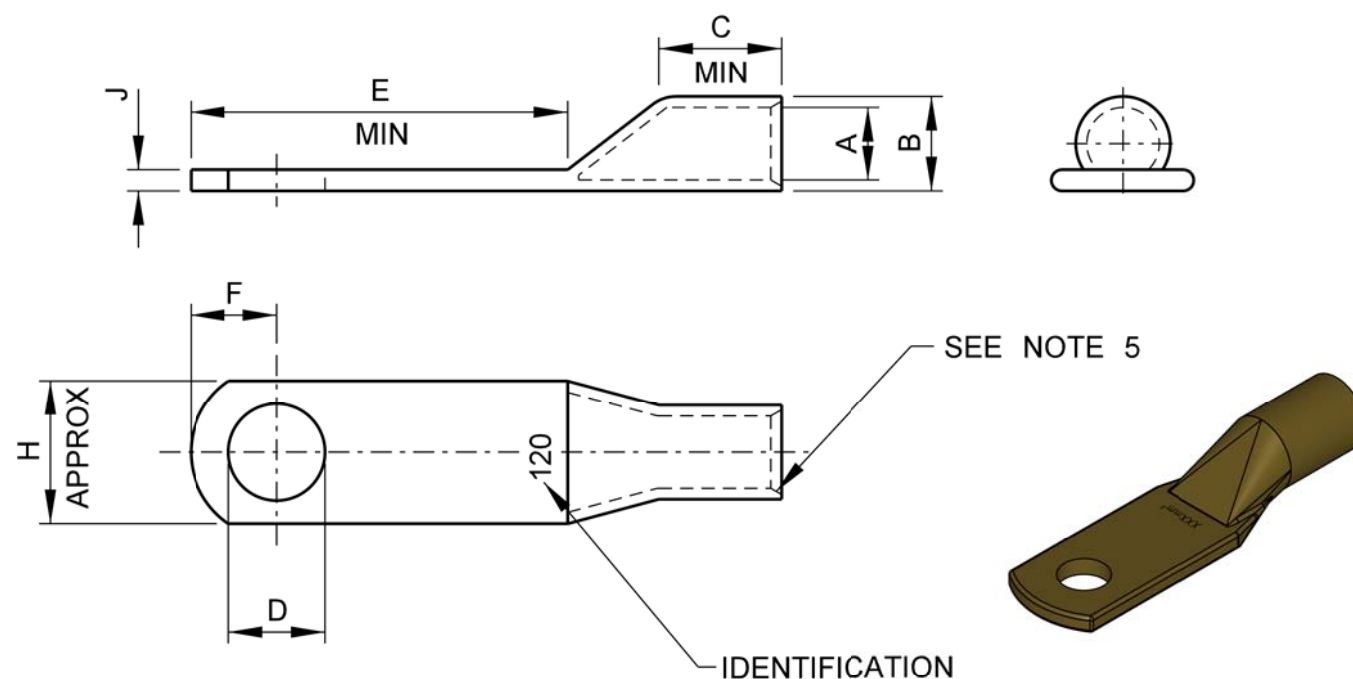
AUTHORISED: T GOVENDER

TERMINAL LUG
FOR BONDING CABLE

TRANSNET
freight rail

CEE-TU-0136
VERSION 10

A4



TOLERANCES		
DIM	SIZES UP TO 7mm	0 -0,15
	A SIZES OVER 7mm	0 -0,2
DIM	SIZES UP TO 10mm	+0,15 0
	B SIZES OVER 10mm	+0,2 0
DIM	SIZES UP TO 9mm	±0,3
	D SIZES OVER 9mm	0 -0,5
DIM	SIZES UP TO 8mm	±0,5
	F SIZES OVER 8mm	±1,0
DIM	SIZES UP TO 5mm	±0,25
	J SIZES OVER 5mm	±0,5

STORES ITEM NO	NORMAL LUG SIZE mm ²	STUD Ø	DIMENSIONS								IDENTIFICATION
			A	B	C	D	E	F	H	J	
54017082	50	14,5	9,56	12,45	16,2	14,5	50,0	11,0	18,9	2,8	50
54017094	70	14,5	11,28	14,71	18,1	14,5	50,0	11,0	24,0	3,1	70
54017109	95	14,5	13,5	17,15	20,3	14,5	52,5	13,5	24,2	4,0	95
54022835	100	14,5	13,8	17,7	20,3	14,5	52,5	13,5	24,2	4,0	100
54017110	120	14,5	14,72	19,22	22,6	14,5	52,5	13,5	27,0	4,45	120
54017122	150	14,5	16,42	21,46	25,3	14,5	56,5	17,5	31,0	5,10	150
54004081	160	14,5	17,0	22,0	28,0	14,5	60,0	17,5	31,0	5,10	160

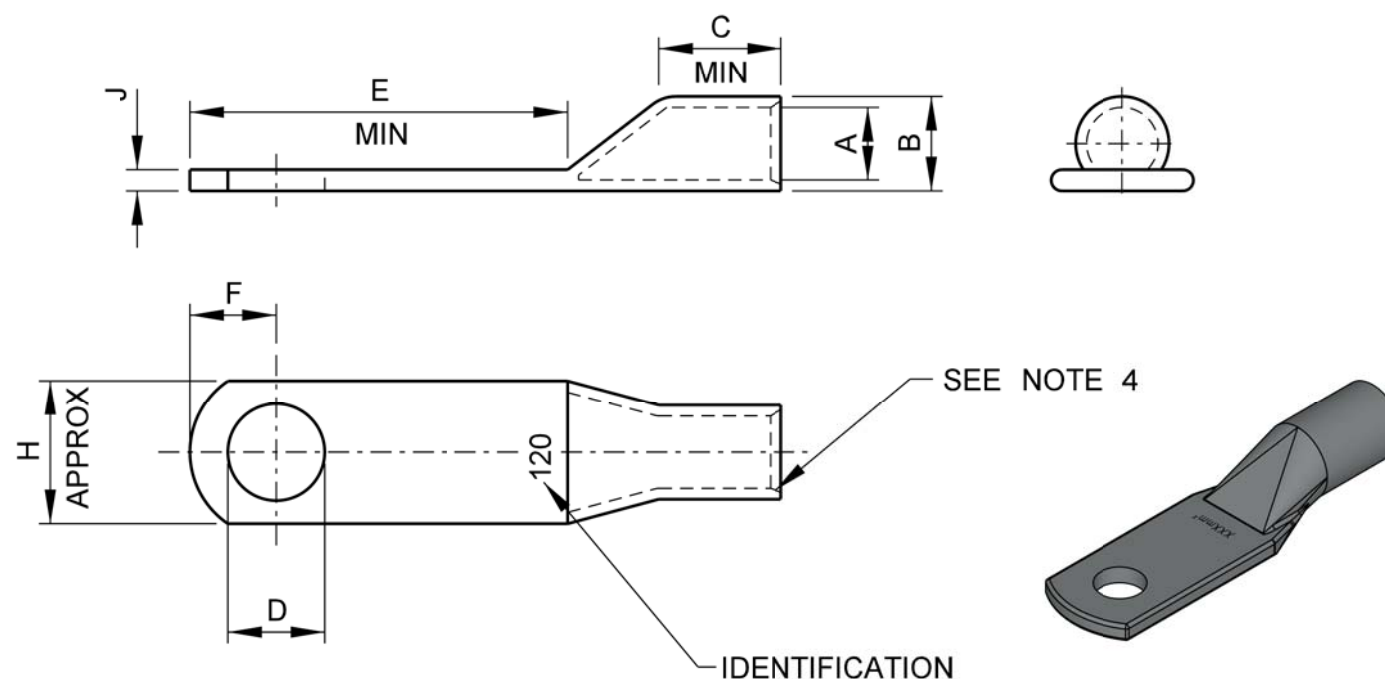
NOTES

- THE FOLLOWING PERMANENT MARKINGS MUST APPEAR ON THIS ARTICLE:
 - MANUFACTURERS IDENTIFICATION.
 - CABLE SIZE.
- LUG TO BE CRIMPED WITH DIES SHOWN ON DRG NO. CEE-PP-0015.
- WHEN LUG IS FORMED, MATERIAL MUST NOT BE FRACTURED.
- LUG TO BE THOROUGHLY ELECTRO-TINNED: INTERNALLY AND EXTERNALLY.
- INSIDE OF LUG BARREL TO BE CHAMFERED.

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DIMENSIONS : mm	SCALE : NTS
TOLERANCE : LIN± - ANG± -	
MATERIAL : COPPER TO SPECIFICATION SANS 460, FULLY ANNEALED.	
DRAWN : D HATTINGH	CHECKED : D HATTINGH

TINNED COPPER TERMINAL LUG FOR BONDING CABLES



TOLERANCES		
DIM	SIZES UP TO 7mm	0 -0,15
	SIZES OVER 7mm	0 -0,2
A	SIZES UP TO 10mm	+0,15 0
	SIZES OVER 10mm	+0,2 0
B	SIZES UP TO 9mm	±0,3
	SIZES OVER 9mm	0 -0,5
D	SIZES UP TO 8mm	±0,5
	SIZES OVER 8mm	±1,0
F	SIZES UP TO 5mm	±0,25
	SIZES OVER 5mm	±0,5
J	SIZES UP TO 5mm	±0,25
	SIZES OVER 5mm	±0,5

STORES ITEM NO	NORMAL LUG SIZE mm ²	STUD Ø	DIMENSIONS								IDENTIFICATION
			A	B	C	D	E	F	H	J	
54112445	50	14,5	9,9	14,7	16,2	14,5	50,0	11,0	18,9	4,8	50
54112446	70	14,5	11,7	17,0	18,1	14,5	50,0	11,0	24,0	5,1	70
54112447	95	14,5	13,7	19,7	20,3	14,5	52,5	13,5	24,2	6,0	95
54112448	100	14,5	14,0	20,2	20,3	14,5	52,5	13,5	24,2	6,2	100
54112449	120	14,5	15,3	22,2	22,6	14,5	52,5	13,5	27,0	6,9	120
54112450	150	14,5	17,2	24,7	25,3	14,5	56,5	17,5	31,0	7,4	150
54112451	160	14,5	19,0	27,3	28,0	14,5	60,0	17,5	31,0	8,3	160

NOTES

- THE FOLLOWING PERMANENT MARKINGS MUST APPEAR ON THIS ARTICLE:
 - MANUFACTURERS IDENTIFICATION.
 - CABLE SIZE.
- LUG TO BE CRIMPED WITH DIES SHOWN ON DRG NO. CEE-PP-0015.
- WHEN LUG IS FORMED, MATERIAL MUST NOT BE FRACTURED.
- INSIDE OF LUG BARREL TO BE CHAMFERED.

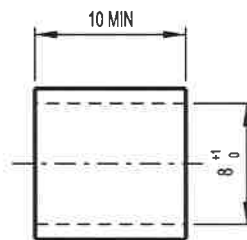
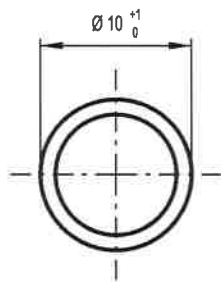
© COPYRIGHT PROTECTED. PREPARED BY CENTRAL DRAWING OFFICE

DIMENSIONS : mm	SCALE : NTS
TOLERANCE : LIN± - ANG± -	
MATERIAL : ALUMINIUM	
DRAWN : D HATTINGH	CHECKED : D HATTINGH

ALUMINIUM TERMINAL LUG FOR BONDING CABLES

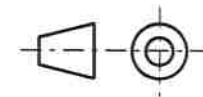


CEE-TU-0136 SHT 2
VERSION 10 A3



NOTE

1. SEE SHEET 1 FOR AN ALTERNATIVE SPRING SECURING SLEEVE



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DIMENSIONS : mm SCALE : 2 : 1
 TOLERANCE : LIN $\pm 0,5$ ANG $\pm -$ ITEM NO : 54002790
 MATERIAL : Stainless Steel, AISI Grade 304,
 Ø10 OD x 10L x 1mm Thick Wall
 Alternately:
 Copper Tube, To SANS 460 Table 2 Class 3.

VERSION INFO: Sheet 1 with a spring alternative added

2020/07/16

 APPROVED: W. SCHOEMAN

2020/07/16

 AUTHORISED: S. SMIT

SLEEVE, DROPPER SECURING

TRANSNET
 freight rail

CEE-TX-0079

VERSION 9

A4

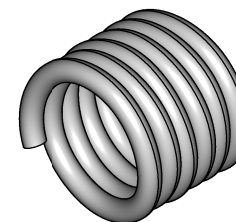
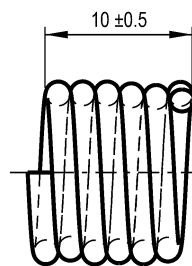
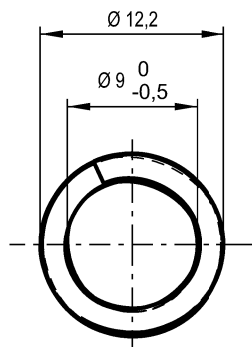
DO REF: CDO/ 9541

ECP REF: -

DRAWN: S. MAZIBUKO

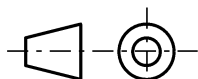
DESIGNED: -

CHECKED: S. MAZIBUKO



NOTE

1. THE SPRING MUST HAVE A MINIMUM OF 6.5 TURNS.



DIMENSIONS: mm SCALE: 2 : 1
TOLERANCE : LIN±- ANG±-
MATERIAL : STAINLESS STEEL WIRE,
AISI GRADE 304, Ø1.6

DRAWN : S.M. MAZIBUKO CHECKED: -

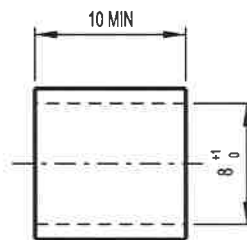
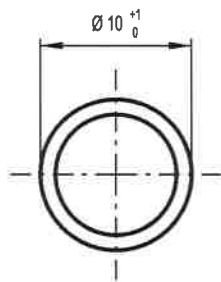
SPRING, DROPPER SECURING



CEE-TX-0079 Sht 1

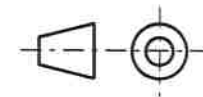
VERSION 9

A4



NOTE

1. SEE SHEET 1 FOR AN ALTERNATIVE SPRING SECURING SLEEVE



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DIMENSIONS : mm SCALE : 2 : 1
 TOLERANCE : LIN $\pm 0,5$ ANG $\pm -$ ITEM NO : 54002790
 MATERIAL : Stainless Steel, AISI Grade 304,
 Ø10 OD x 10L x 1mm Thick Wall
 Alternately:
 Copper Tube, To SANS 460 Table 2 Class 3.

VERSION INFO: Sheet 1 with a spring alternative added

2020/07/16

 APPROVED: W. SCHOEMAN

2020/07/16

 AUTHORISED: S. SMIT

SLEEVE, DROPPER SECURING

TRANSNET
 freight rail

CEE-TX-0079

VERSION 9

A4

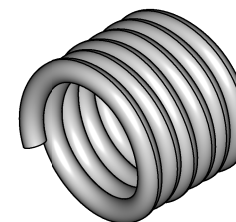
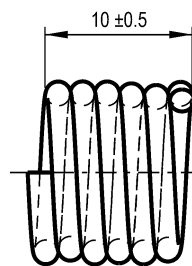
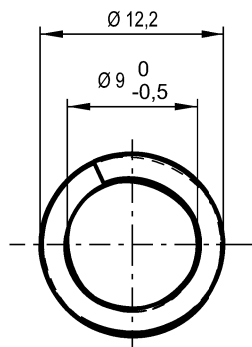
DO REF: CDO/ 9541

ECP REF: -

DRAWN: S. MAZIBUKO

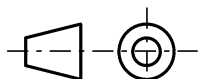
DESIGNED: -

CHECKED: S. MAZIBUKO



NOTE

1. THE SPRING MUST HAVE A MINIMUM OF 6.5 TURNS.



DIMENSIONS: mm SCALE: 2 : 1
TOLERANCE : LIN $\pm$ - ANG $\pm$ -
MATERIAL : STAINLESS STEEL WIRE,
AISI GRADE 304, $\varnothing 1,6$

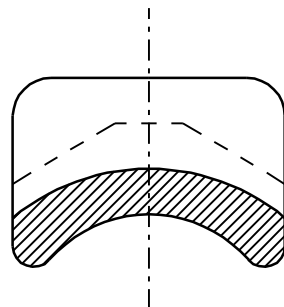
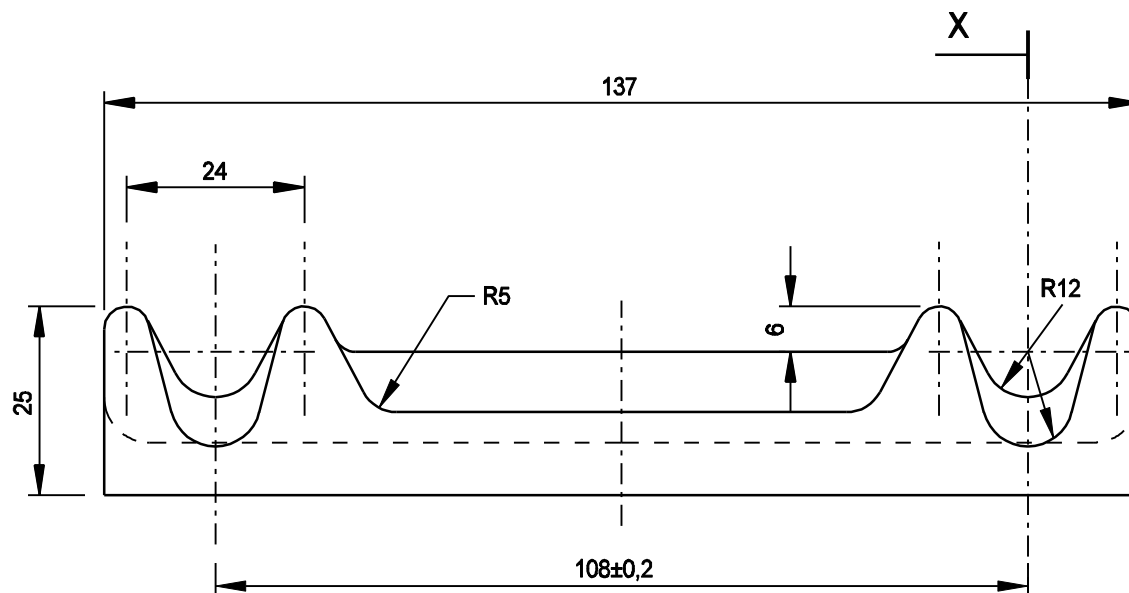
DRAWN : S.M. MAZIBUKO CHECKED: -

SPRING, DROPPER SECURING



CEE-TX-0079 Sht 1

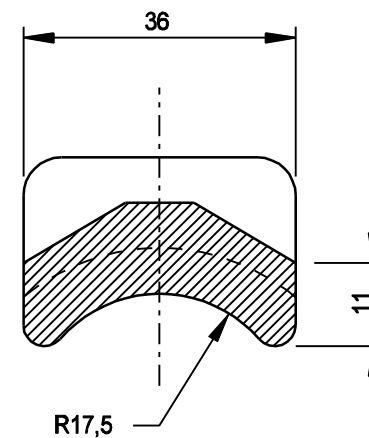
VERSION 9



SECTION X-X

NOTES

1. ZINC COAT TO SPEC SABS 763 FOR CONDITIONS IN SITU.
2. ALL UNSPECIFIED RADII R3.



AMENDMENTS

NO	NAME	DATE
1	HA SLIER	99-01-15

STRESS RELIEF
RADII ADDED.
DO REF: T98/045

DIMENSIONS: mm
SCALE: 1:1

MATERIAL: SPHEROIDAL GRAPHITE IRON TO SABS 936 GRADE SG 50

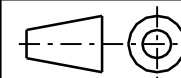
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DRN: JVT	CKD: JVT	DATE: 98-7-15
ENG: HA SLIER	HA SLIER	for CHIEF ENG

CENTRAL DRAWING OFFICE



SADDLE SINGLE SUSPENSION CLAMP

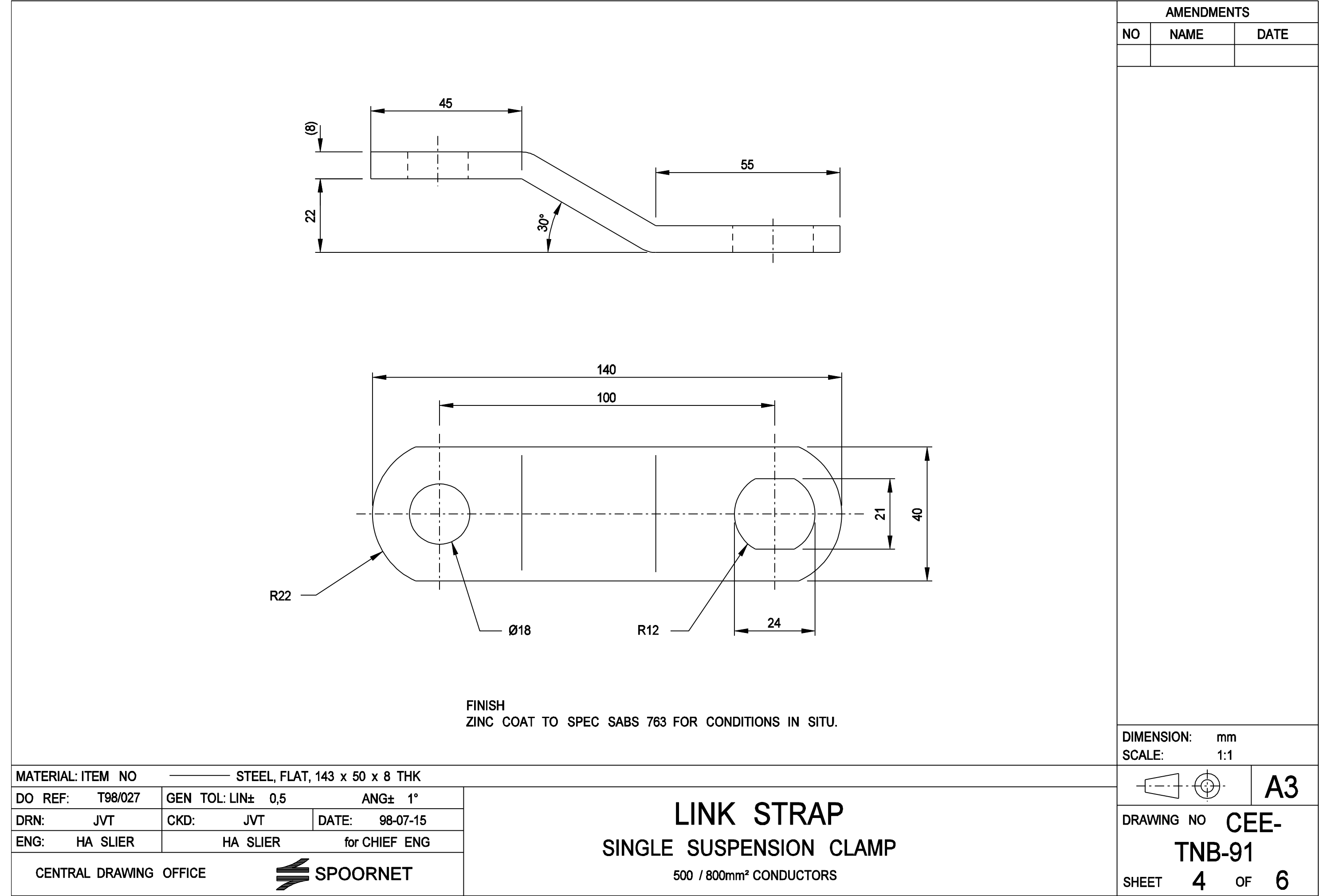
500 / 800mm² CONDUCTORS



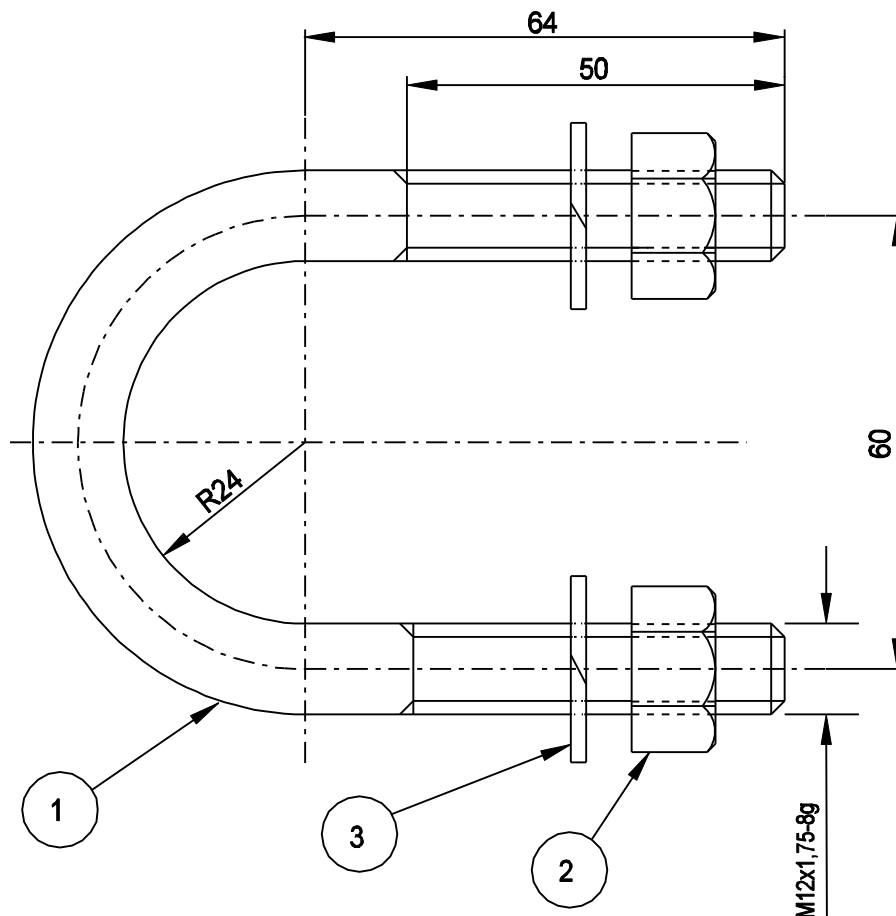
A4

DRG NO CEE-
TNB-91

SHT 3 OF 6

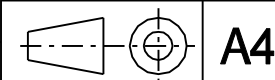


ITEM	DESCRIPTION	QTY	STORES NO	AMENDMENTS		
1	STEEL, ROUND Ø12 x 225LG	1	11/2740	NO	NAME	DATE
2	NUT, PLAIN, HEX, STEEL GALV. M12	2	1/32856			
3	WASHER, SPRING, STEEL, GALV. M12	2	1/-			



FINISH
ZINC COAT TO SPEC SABS 763
FOR CONDITIONS IN SITU.

DIMENSIONS: mm
SCALE: 1:1



DO REF: T98/027	GEN TOL: LIN± 0,5	ANG± —
DRN: JVT	CKD: JVT	DATE: 98-7-15
ENG: HA SLIER	HA SLIER	for CHIEF ENG

CENTRAL DRAWING OFFICE

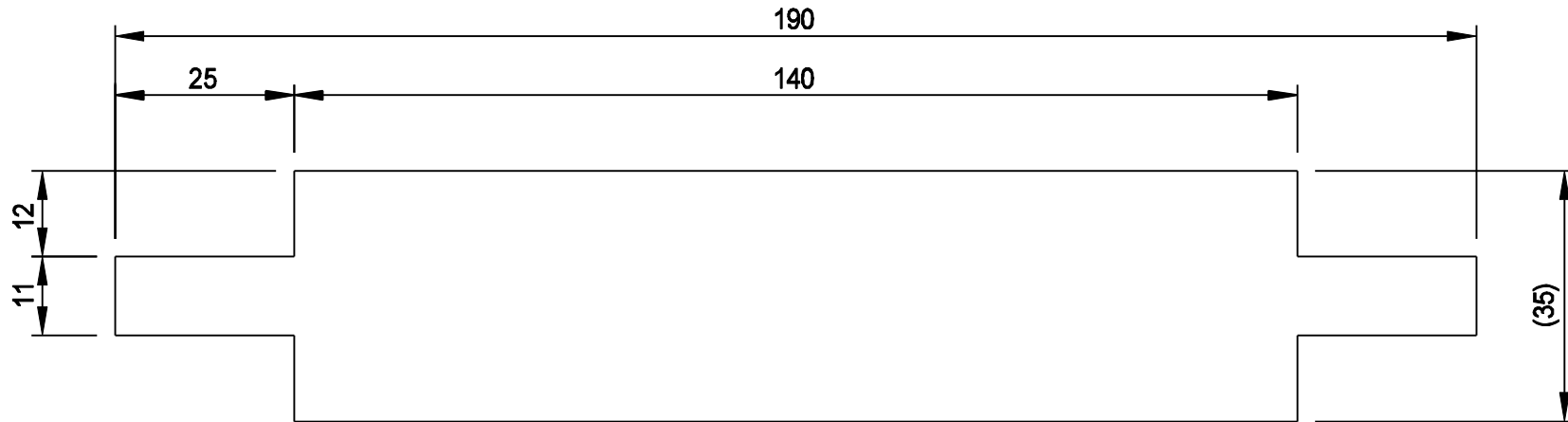


U-BOLT M12 SINGLE SUSPENSION CLAMP

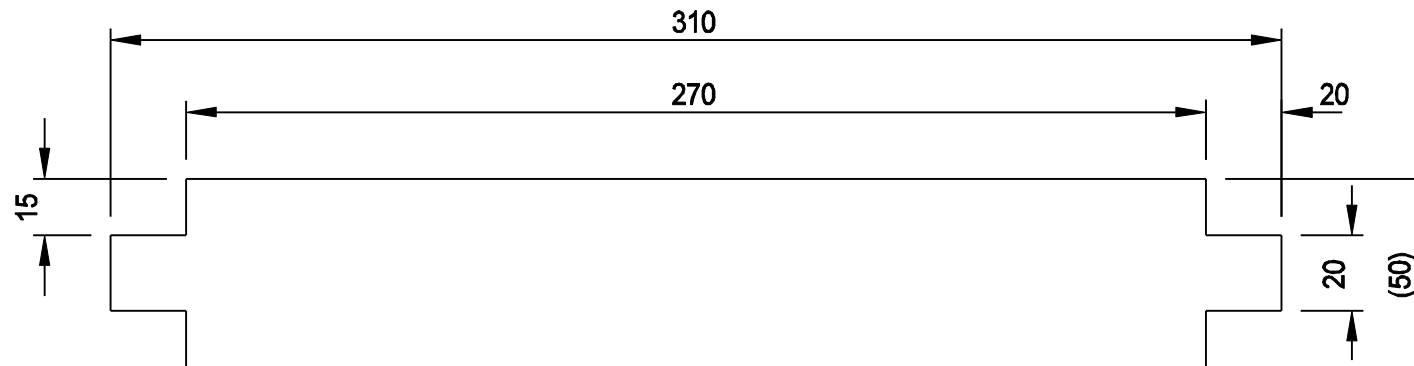
500 / 800mm² CONDUCTORS

DRG NO CEE-
TNB-91

SHT 5 OF 6



ITEM 1: UPPER LINER



ITEM 2: LOWER LINER

SCALE: 1:2

AMENDMENTS

NO	NAME	DATE

DIMENSIONS: mm
SCALE: 1:1

MATERIAL: SOFT ANNEALED PURE ALUMINIUM, 1,2 THICK TO B.S.1470 GRADE S1C CON. 0

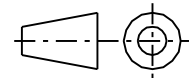
DO REF: T98/027	GEN TOL: LIN± 1	ANG± -
DRN: JVT	CKD: JVT	DATE: 98-7-15
ENG: HA SLIER	HA SLIER	for CHIEF ENG

CENTRAL DRAWING OFFICE



LINERS SINGLE SUSPENSION CLAMP

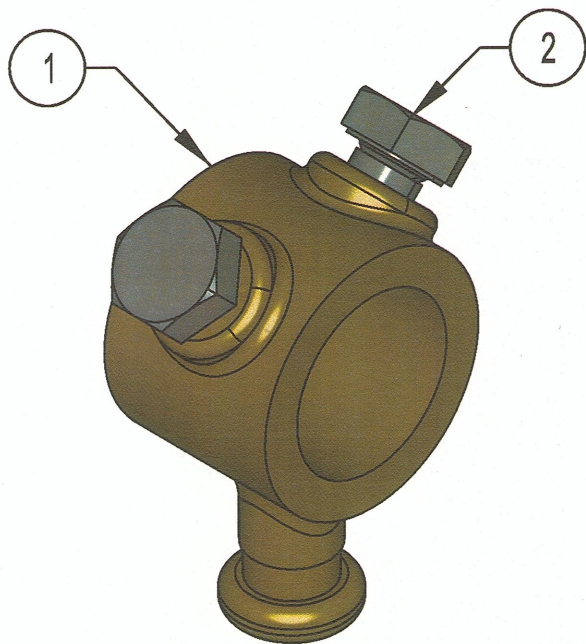
500 / 800mm² CONDUCTORS



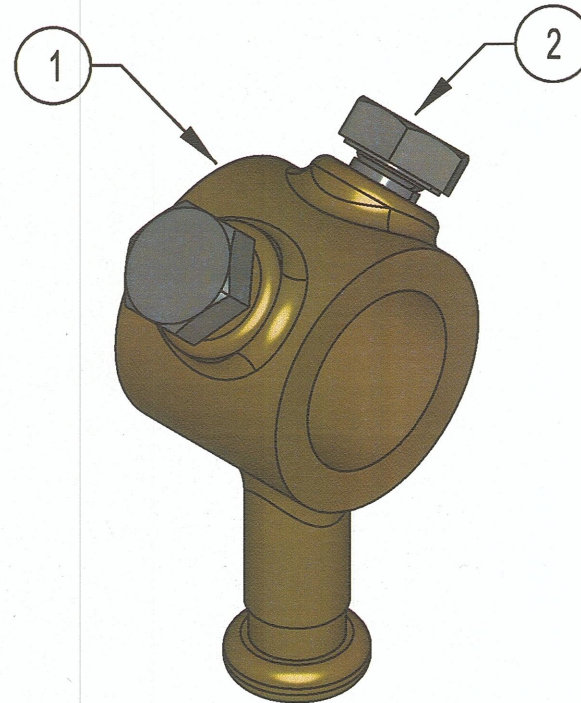
A4

DRG NO CEE-
TNB-91

SHT 6 OF 6

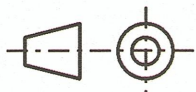


SWIVEL FITTING
FOR STEADY ARM



SWIVEL FITTING
FOR KNUCKLE

NOTE
SWIVEL CLAMP TO SPECIFICATION CEE 0063.



2	BOLT, HEXAGON, STAINLESS STEEL TO SPEC CEE 0063, M10	2	-	-
1	SWIVEL CLAMP BODY FOR STEADY ARM	1	-	CEE-TND-0001 SHT 1
	SWIVEL CLAMP BODY FOR KNUCKLE	1	-	CEE-TND-0001 SHT 2
ITEM NO	DESCRIPTION	QTY	STORES ITEM NO	DRAWING NO

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DIMENSIONS : mm SCALE : 1 : 1
TOLERANCE : LIN $\pm$ 0,5 ANG $\pm$ 1° ITEM NO :-
MATERIAL : Cu-Ni-Si TO SPEC CEE 0063 ALT.
STAINLESS STEEL TO SPEC AISI GRADE 304.
VERSION INFO : REDRAW AND REVISED.

03/10/2019

APPROVED: S SMIT

3-10-2019

AUTHORISED: L O BORCHARD

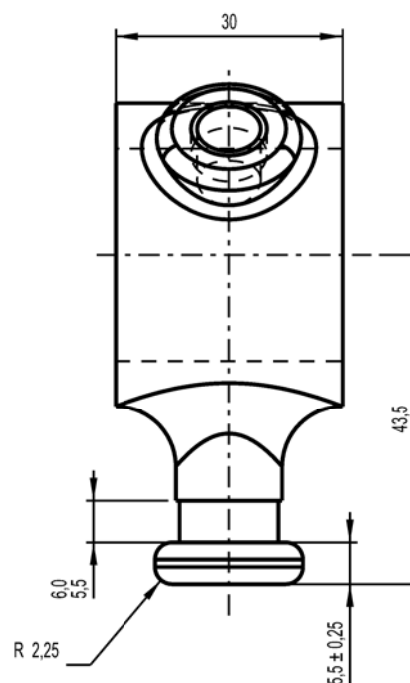
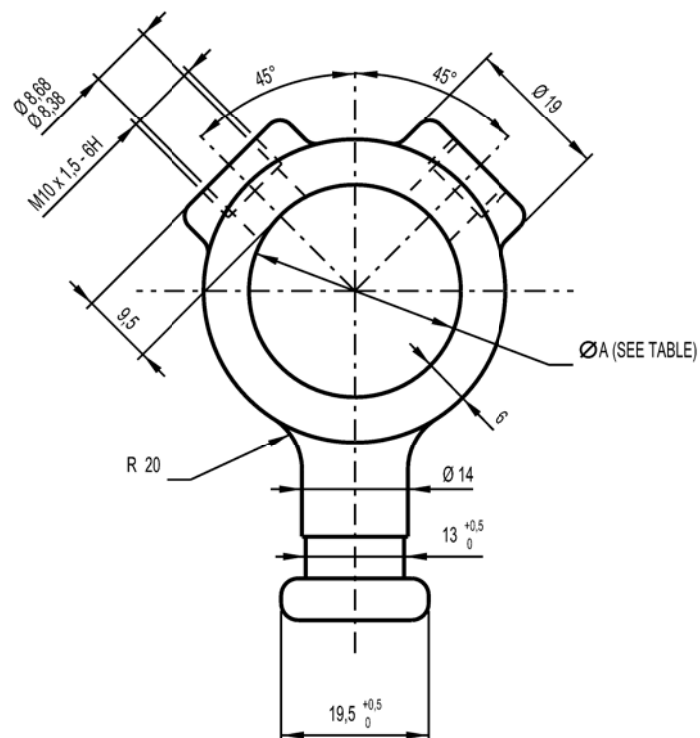
SWIVEL FITTING
KNUCKLE OR STEADY ARM
SWIVEL TYPE CONTACT WIRE CLAMP

 **TRANSNET**
freight rail

CEE-TND-0001
VERSION 5

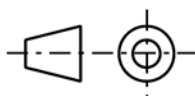
A4

APPLICATION	DIMENSION 'A'	STORES ITEM NO.
GENERAL	26 ^{+0,5} ₀	54033595
COAL LINK ONLY	28 ^{+0,5} ₀	54033611



NOTES

1. SWIVEL CLAMP TO SPECIFICATION CEE 0063.
2. THE FOLLOWING PERMANENT MARKINGS MUST APPEAR ON THIS ARTICLE:
 - a) TRANSNET LOGO.
 - b) MANUFACTURERS IDENTIFICATION.
 - c) DATED BATCH NUMBER.
3. ALL UNSPECIFIED RADII R2.
4. REMOVE ALL BURRS.



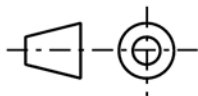
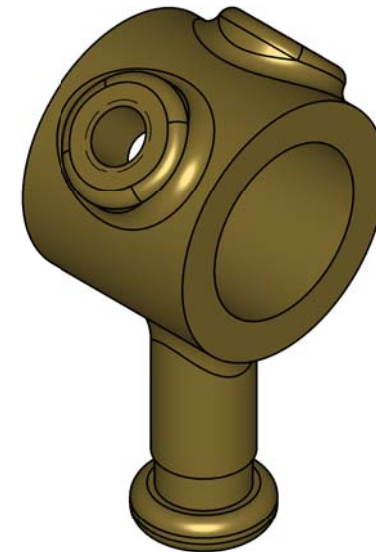
DIMENSIONS : mm SCALE : 1 : 1
 TOLERANCE : LIN ± 0,5 ANG ± 1°
 MATERIAL : Cu-Ni-Si TO SPEC CEE 0063 ALT.
 STAINLESS STEEL TO SPEC AISI GRADE 304.

DRAWN : D HATTINGH CHECKED : D HATTINGH

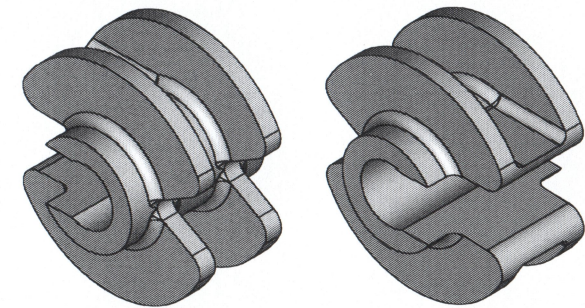
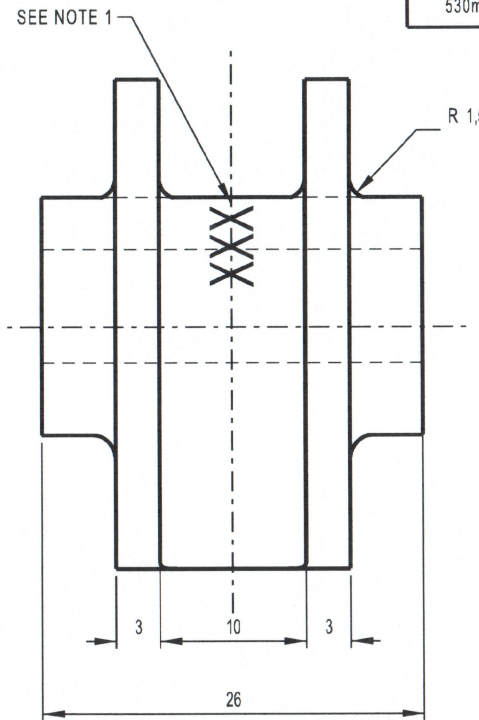
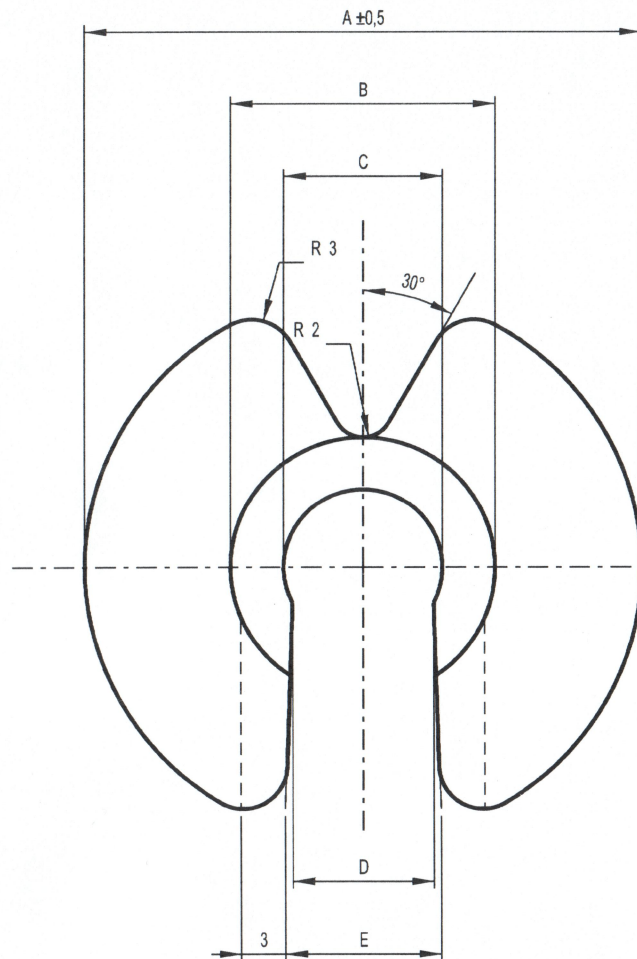
SWIVEL FITTING
 FOR STEADY ARM
 SWIVEL TYPE CONTACT WIRE CLAMP

TRANSNET
 freight rail

CEE-TND-0001 SHT 1
 VERSION 5



CATENARY	ACSR CODE NAME	A	B	C	D	E	ITEM NO.
80mm ²	-	Ø38	Ø18	Ø10,8	9,6	10,6 ±1	54006840
100mm ²	SKUNK	Ø40,8	Ø20,8	Ø12,8	11,4	12,6 ±1	54016861
148mm ²	LEOPARD	Ø44,5	Ø24,5	Ø15,5	13,9	15,3 ±1	-
160mm ²	TIGER	Ø46,7	Ø26,7	Ø16,2	14,4	16 ±1	54016836
250mm ²	-	Ø54	Ø33,9	Ø20,5	18,2	20,0 ±1,5	54016848
530mm ²	DEER	Ø68	Ø48,1	Ø29,4	26	28,5 ±1,5	54031701



NOTE

1. APPLICABLE CONDUCTOR SIZE * XXXmm² TO BE CAST OR PUNCHED IN POSITION SHOWN. (3mm CHARACTER HEIGHT)
2. A MANUFACTURERS IDENTIFICATION MARK MUST BE CAST OR PUNCHED ON THE CLIP.

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DIMENSIONS : mm SCALE : 2:1
TOLERANCE : LIN ± 0,2 ANG ± 0,5° ITEM NO : -
MATERIAL : NYLON 66 PIGMENT: BLACK

VERSION INFO : 148mm² CATENARY ADDED

+ 28/5/2020

[Signature]

APPROVED S. Smit

+ 28/5/2020

[Signature]

AUTHORISED S. Smit

CATENARY DROPPER CLIP CLIP-ON TYPE

80mm², 100mm², 148mm², 160mm², 250mm² AND 530mm² CATENARIES

TRANSNET
freight rail

CEE-TND-0005

VERSION 7

A4

DO REF: CDO/ 9539

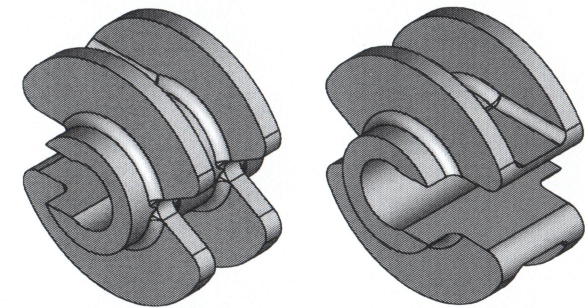
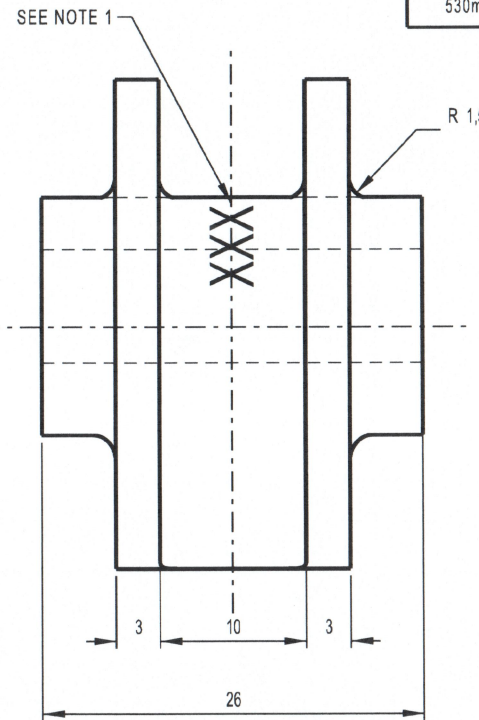
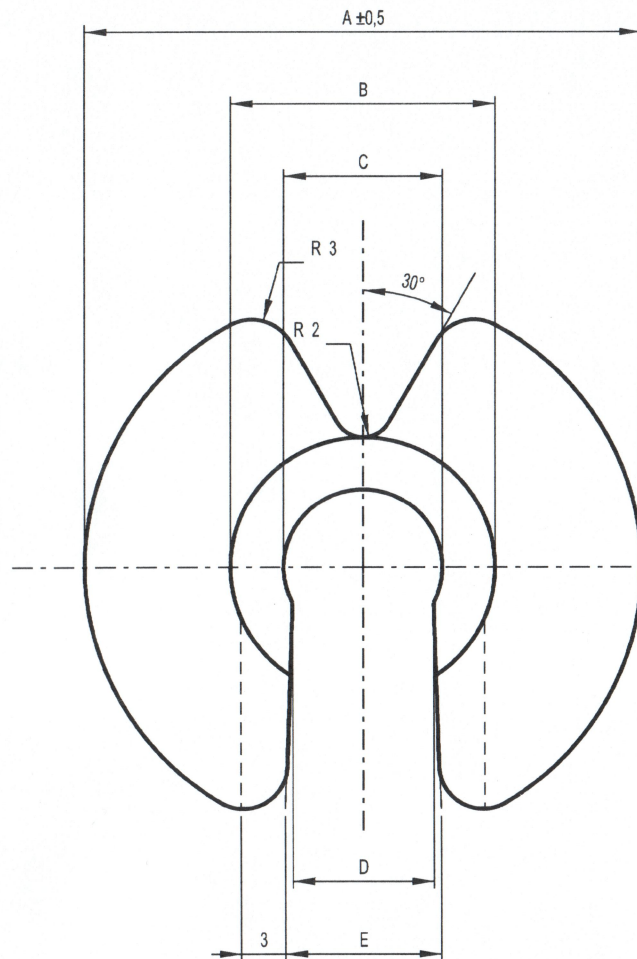
ECP REF: -

DRAWN: S. MAZIBUKO

DESIGNED: -

CHECKED: S. MAZIBUKO

CATENARY	ACSR CODE NAME	A	B	C	D	E	ITEM NO.
80mm ²	-	Ø38	Ø18	Ø10,8	9,6	10,6 ±1	54006840
100mm ²	SKUNK	Ø40,8	Ø20,8	Ø12,8	11,4	12,6 ±1	54016861
148mm ²	LEOPARD	Ø44,5	Ø24,5	Ø15,5	13,9	15,3 ±1	-
160mm ²	TIGER	Ø46,7	Ø26,7	Ø16,2	14,4	16 ±1	54016836
250mm ²	-	Ø54	Ø33,9	Ø20,5	18,2	20,0 ±1,5	54016848
530mm ²	DEER	Ø68	Ø48,1	Ø29,4	26	28,5 ±1,5	54031701



NOTE

1. APPLICABLE CONDUCTOR SIZE * XXXmm² TO BE CAST OR PUNCHED IN POSITION SHOWN. (3mm CHARACTER HEIGHT)
2. A MANUFACTURERS IDENTIFICATION MARK MUST BE CAST OR PUNCHED ON THE CLIP.

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DIMENSIONS : mm SCALE : 2:1
TOLERANCE : LIN ± 0,2 ANG ± 0,5° ITEM NO : -
MATERIAL : NYLON 66 PIGMENT: BLACK

VERSION INFO : 148mm² CATENARY ADDED

+ 28/5/2020

[Signature]

APPROVED S. Smit

+ 28/5/2020

[Signature]

AUTHORISED S. Smit

CATENARY DROPPER CLIP CLIP-ON TYPE

80mm², 100mm², 148mm², 160mm², 250mm² AND 530mm² CATENARIES

TRANSNET
freight rail

CEE-TND-0005

VERSION 7

A4

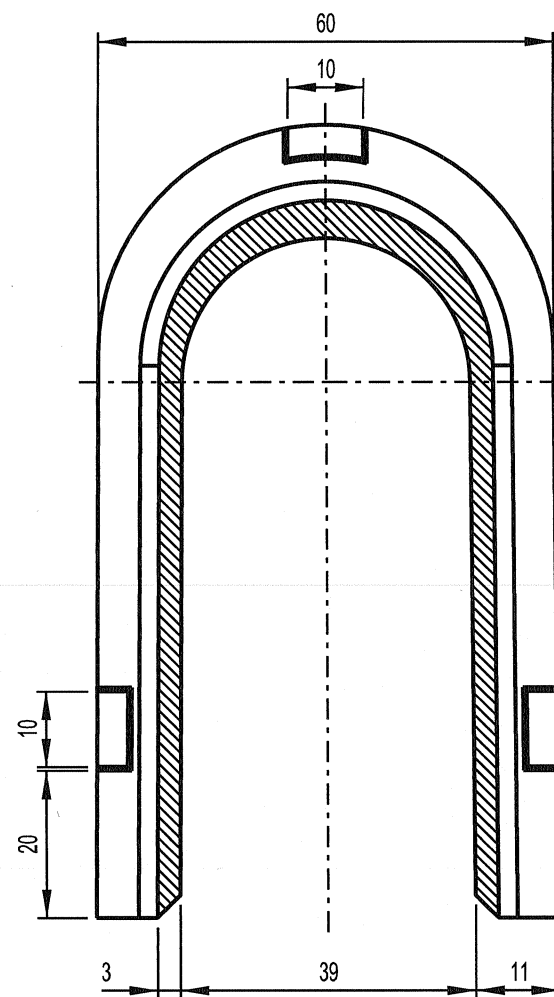
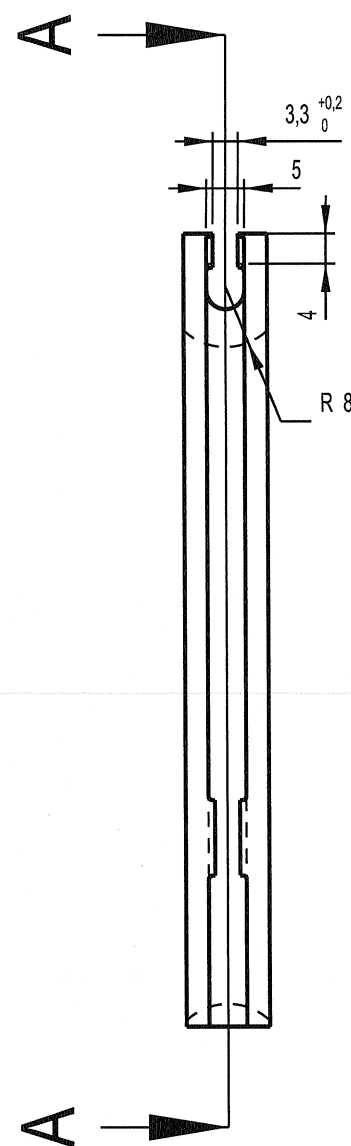
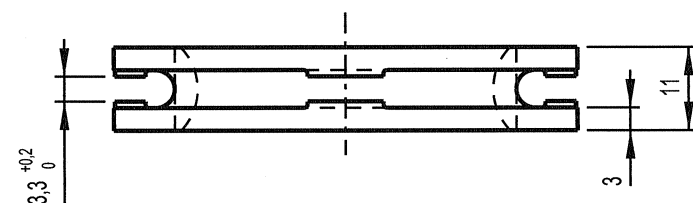
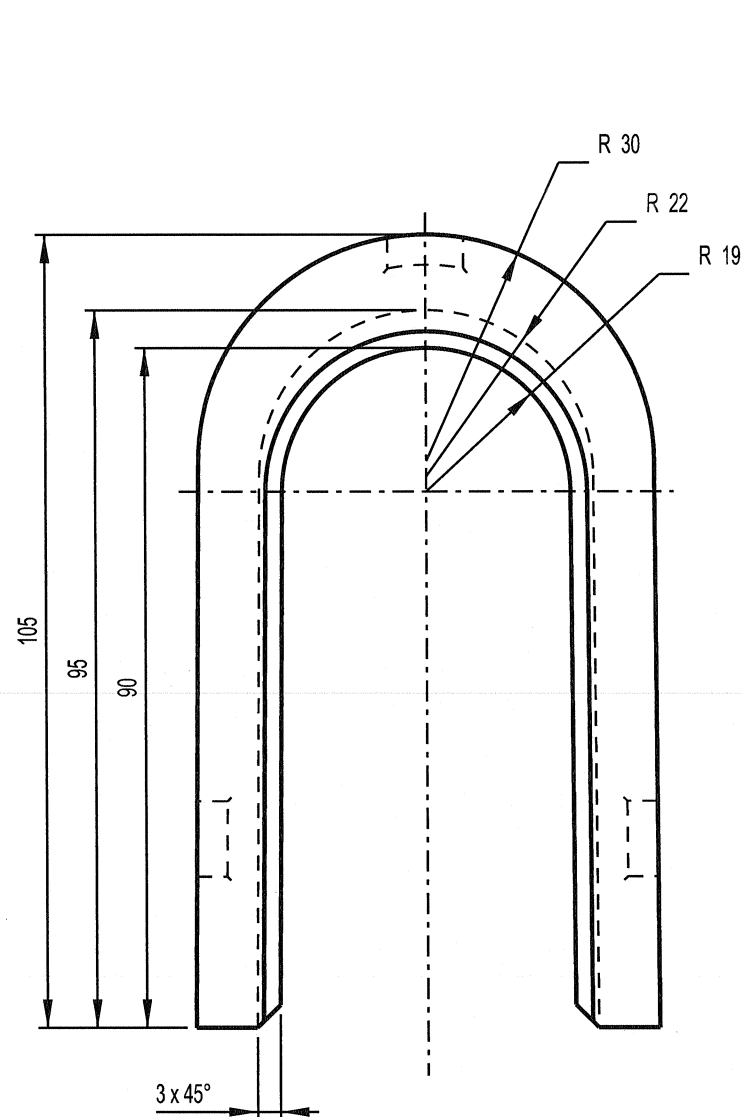
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ECP REF: -

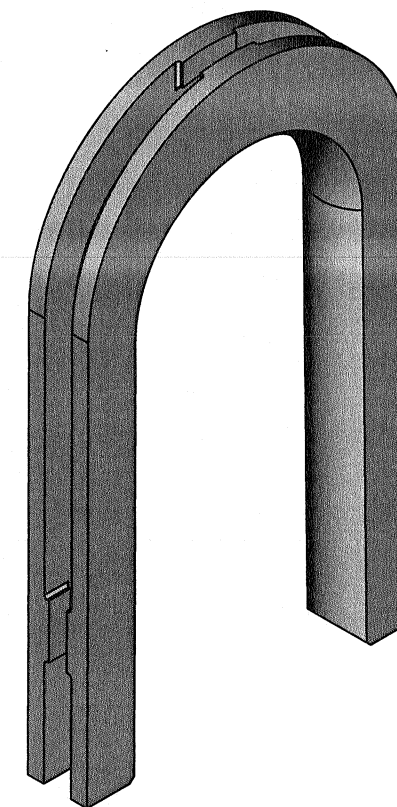
DRAWN: S. MAZIBUKO

DESIGNED: -

CHECKED: S. MAZIBUKO



SECTION A-A



NOTE
THE FOLLOWING PERMANENT MARKINGS MUST APPEAR ON THIS ARTICLE:
(a) MANUFACTURER'S IDENTIFICATION.
(b) DATED BATCH NUMBER.

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DIMENSIONS : mm SCALE : 1 : 1
TOLERANCE : LIN ± 0,5 ANG ± 0,5° ITEM NO : 54017070
MATERIAL : NYLON 66. PIGMENT : BLACK

VERSION INFO : REDRAWN

+ 18-9-2019

APPROVED : S SMIT

+ 18-9-2019

AUTHORISED : L O BORCHARD

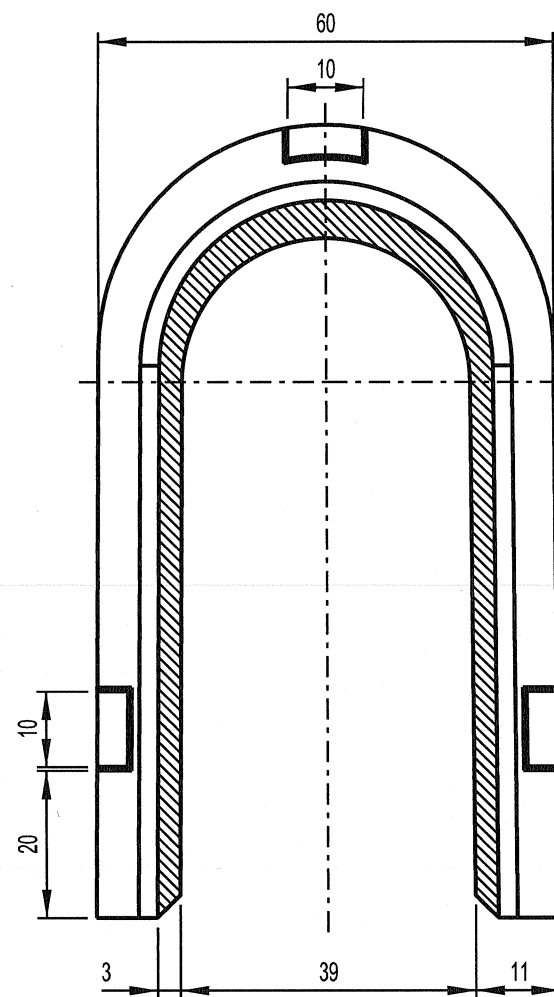
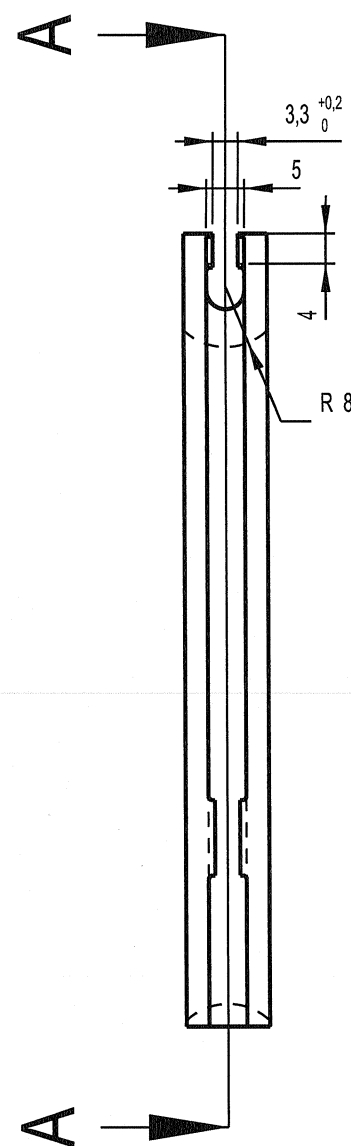
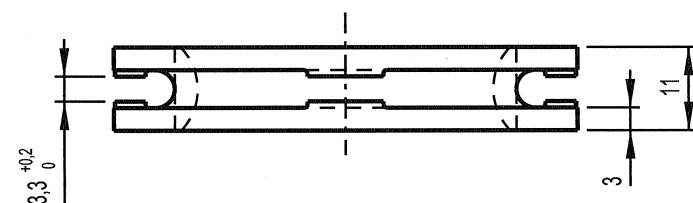
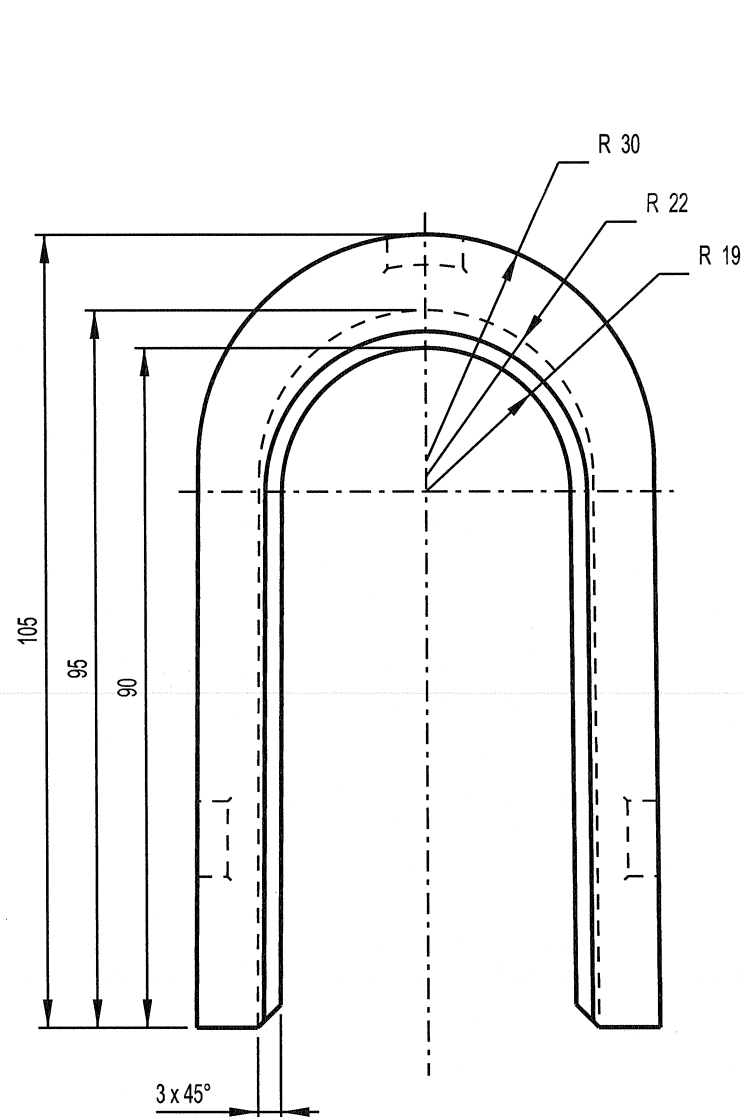
PROTECTIVE SLEEVE
LOOP DROPPER (CLIP-ON-TYPE)

TRANSNET
freight rail

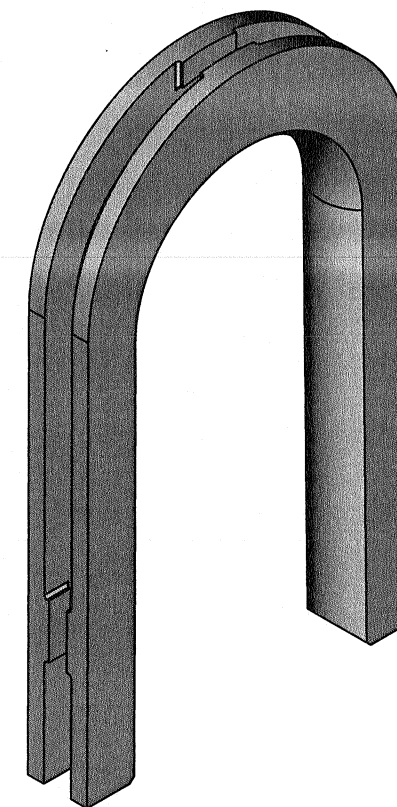
CEE-TND-0011

VERSION 3

A3



SECTION A-A



NOTE
THE FOLLOWING PERMANENT MARKINGS MUST APPEAR ON THIS ARTICLE:
(a) MANUFACTURER'S IDENTIFICATION.
(b) DATED BATCH NUMBER.

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DIMENSIONS : mm SCALE : 1 : 1
TOLERANCE : LIN ± 0,5 ANG ± 0,5° ITEM NO : 54017070
MATERIAL : NYLON 66. PIGMENT : BLACK

VERSION INFO : REDRAWN

+ 18-9-2019

[Signature]

APPROVED : S SMIT

+ 18-9-2019

[Signature]

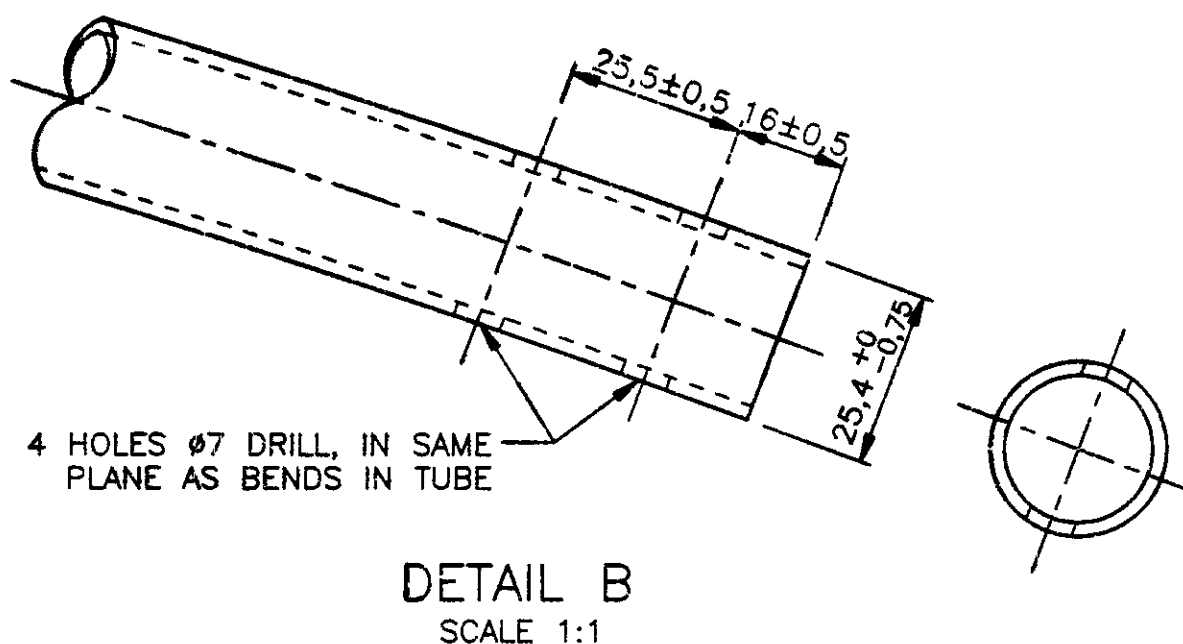
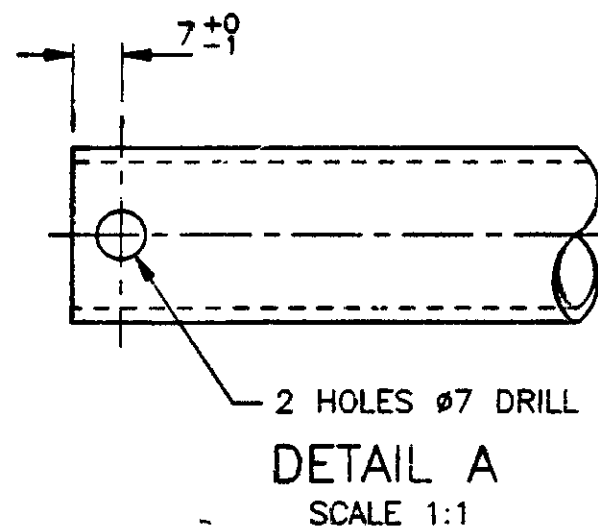
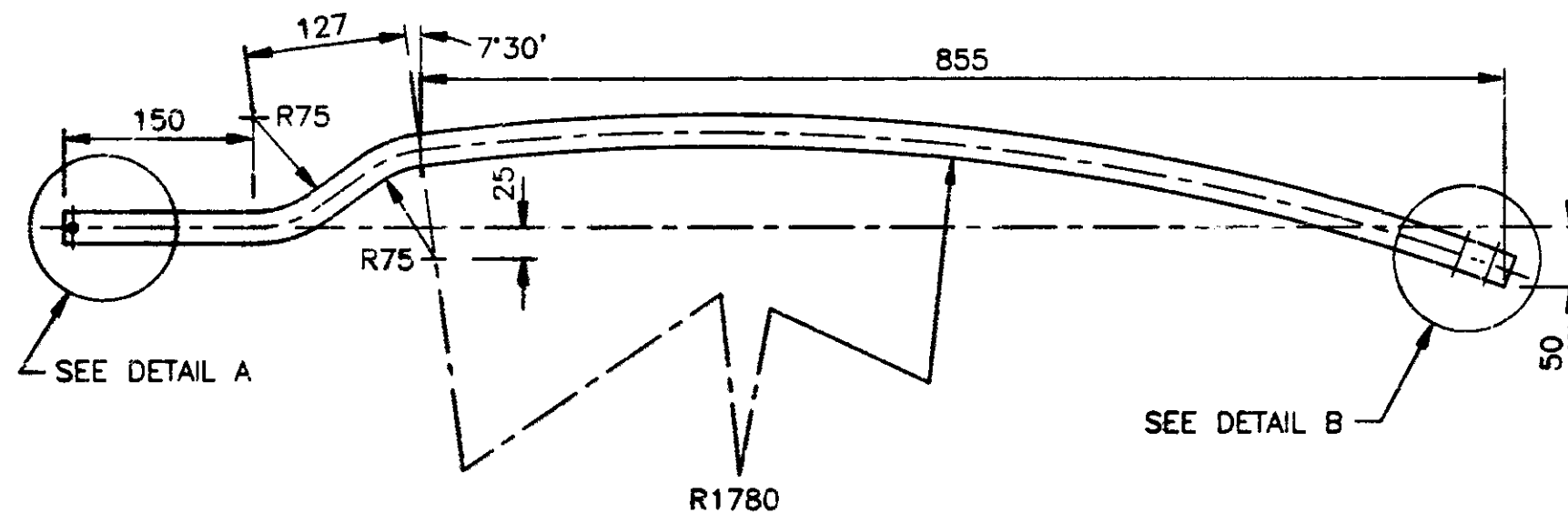
AUTHORISED : L O BORCHARD

PROTECTIVE SLEEVE
LOOP DROPPER (CLIP-ON-TYPE)

TRANSNET
freight rail

CEE-TND-0011
VERSION 3

A3



AMENDMENTS

NO	NAME	DATE
1	W. BRIGHT	92-09-28

16 DIM WAS 19.
DRG. NO. WAS
CEE-TN-150.
DO REF: T92/045

2	J van Dijk	94-06-23
---	------------	----------

REVISED AND UPDATED.
DO REF: T94/025

STORES ITEM NO
54/9314

DIMENSION: mm
SCALE: 1:5



A3

DRAWING NO CEE-
TND-19

SHEET — OF —

MATERIAL: STAINLESS STEEL TUBE 2,03 WALL THK TO SPEC AISI GRADE 304.

DO REF: T79/9 GEN TOL: LIN ± 3 ANG ±0°30'

DRN: A. JOUBERT CKD: J. JACKSON DATE: 79-11-22

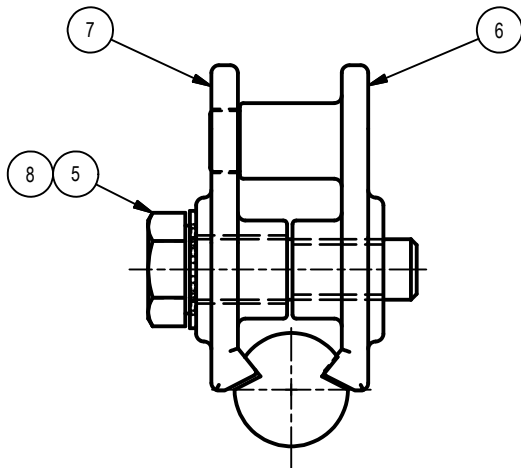
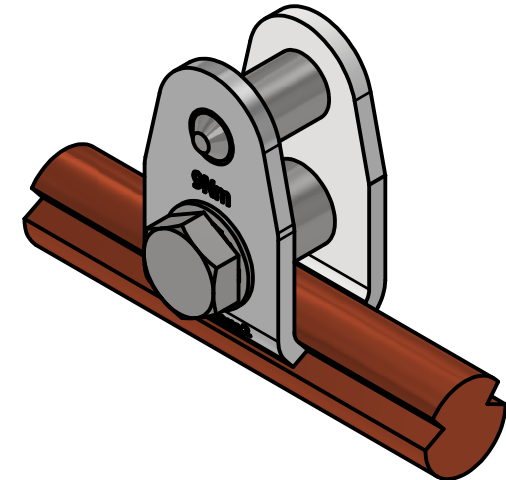
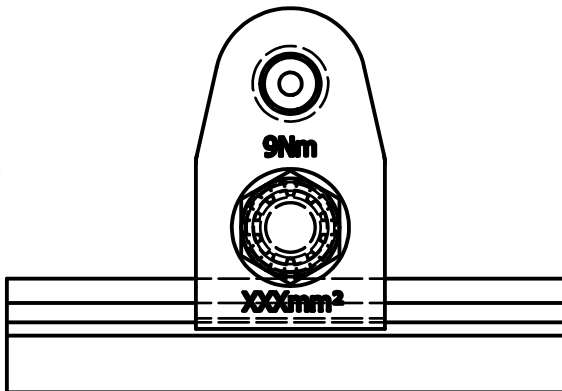
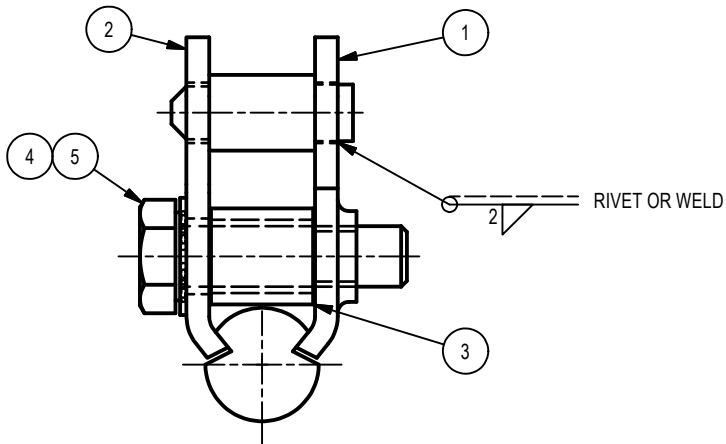
ENG: — F. PIENAAR for CHIEF ENG

INFRASTRUCTURE
(ELECTRICAL)

SPOORNET

STEADY ARM: CURVED TYPE

T0000580



ALTERNATIVE DROPPER CLIP

TABLE 1	
CONTACT WIRE	STORES ITEN NO.
161mm²	54017312
107mm²	54006787

TABLE 2		
CONTACT WIRE	ITEM NO	BOLT LENGTH
107mm²	8	25mm
161mm²	8	30mm

NOTES

1. STOPPER TO PREVENT OVER TORQUE, STOPPER MAY NOT INTERFERE WITH CONTACT WIRE.
2. ASSEMBLES DROPPER MINIMUM WORKING LOAD OF 4kN.
3. ASSEMBLED DROPPER CLIP MUST BE PERMANENTLY MARKED WITH THE FOLLOWING
 - (a) TRANSNET LOGO
 - (b) MANUFACTURERS IDENTIFICATION.
 - (c) DATED BATCH NUMBER.
 - (d) WIRE SIZES.
 - (e) TORQUE = 9Nm.

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DIMENSIONS : mm
TOLERANCE : LIN ± - ANG ± -
MATERIAL : -

SCALE : 1:1
ITEM NO: -

VERSION INFO : ITEM 6 AND 7 ADDED.

29/02/2024

APPROVED : W SCHOEMAN

AUTHORISED : T GOVENDER

DROPPER CLIP
107mm² / 161mm² CONTACT WIRE

TRANSNET
freight rail

CEE-TND-0022

VERSION 8

A4

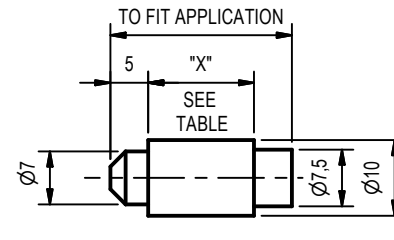
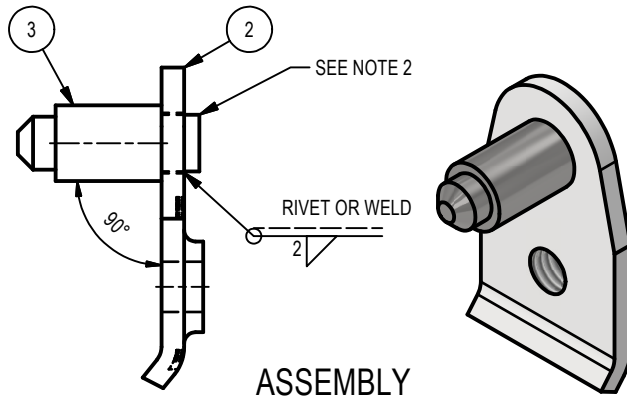
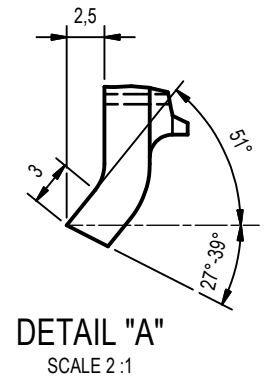
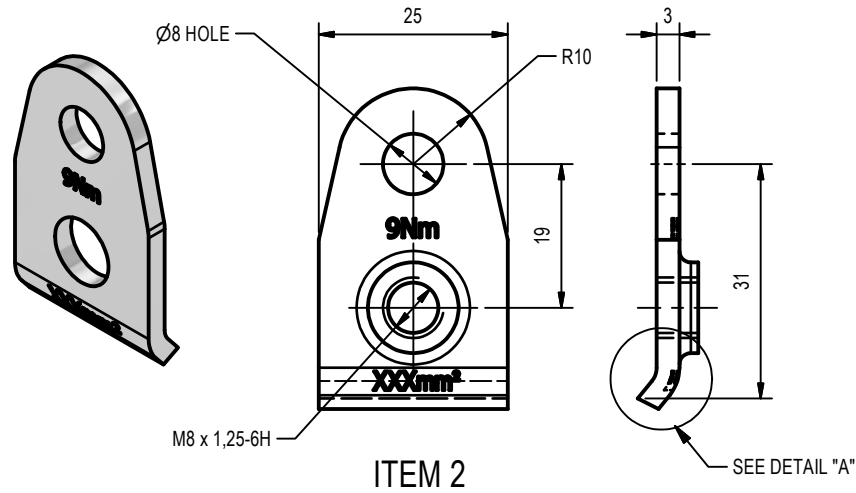
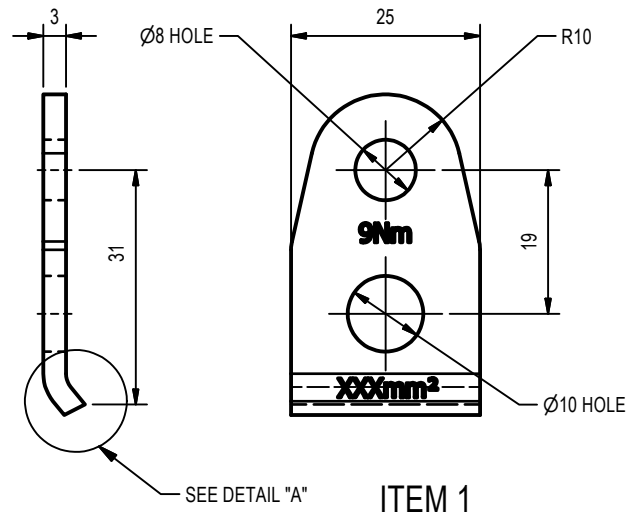
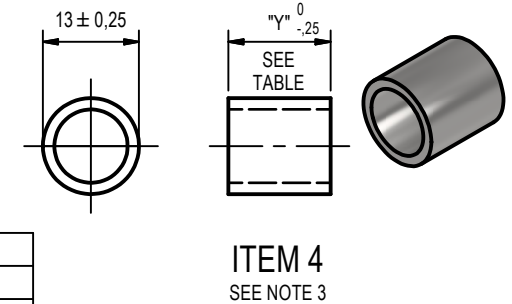
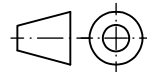


TABLE		
CONTACT WIRE	"X"	"Y"
107mm ²	11	10,5
161mm ²	14	13,5



NOTES

- THE FOLLOWING PERMANENT MARKINGS MUST APPEAR ON THIS ARTICLE:
 - TRANSNET LOGO
 - MANUFACTURERS IDENTIFICATION.
 - DATED BATCH NUMBER.
 - WIRE SIZES.
 - TORQUE = 9Nm.
- DRAW THROUGH FOR INCREASED THREAD LENGTH.
- THE LENGTH OF THE TUBE MUST NOT INTERFERE WITH THE CLAMPING OF THE DROPPER CLIP.



4	STOPPER, STAINLESS STEEL TUBE TO AISI GRADE 304, Ø12,7 O.D. 1,5mm WALL THICKNESS.	1	-	-
3	SPACER PIN, ROUND BAR, STAINLESS STEEL TO AISI GRADE 304, Ø10 x 24mm LONG.	1	-	-
2	DROPPER CLIP WITH THREAD, STAINLESS STEEL TO AISI GRADE 304.	1	-	-
1	DROPPER CLIP WITHOUT THREAD, STAINLESS STEEL TO AISI GRADE 304.	1	-	-
ITEM NO.	DESCRIPTION	QTY	STORES ITEM NO.	DRAWING NO.

DIMENSIONS : mm SCALE : 1:1
TOLERANCE : LIN ± 0,5 ANG ± 1° ITEM NO: -
MATERIAL : -

DRAWN : D HATTINGH CHECKED : D HATTINGH

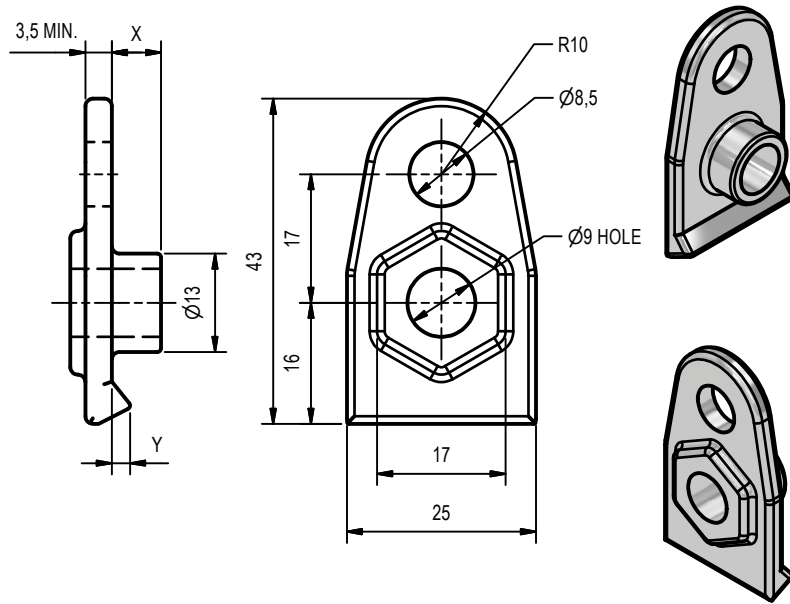
COMPONENTS OF 107mm² / 161mm²
STAINLESS STEEL DROPPER CLIP

TRANSNET
freight rail

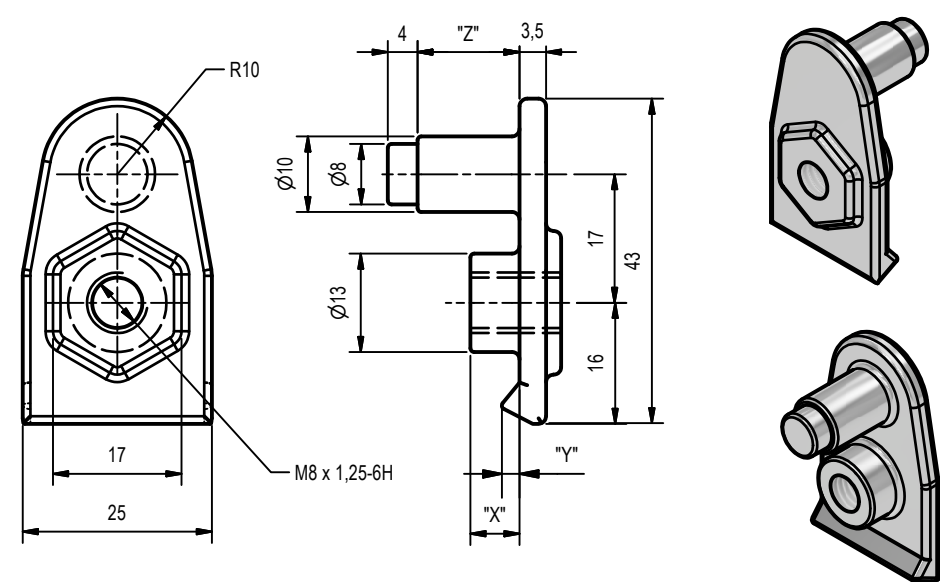
CEE-TND-0022 SHT 1

VERSION 8

A4



ITEM 1

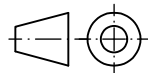


ITEM 2

NOTES

1. THE FOLLOWING PERMANENT MARKINGS MUST APPEAR ON THIS ARTICLE:
 - (a) TRANSNET LOGO.
 - (b) MANUFACTURER'S IDENTIFICATION.
 - (c) DATED BATCH NUMBER.
 - (d) WIRE SIZE.
 - (e) TORQUE = 9Nm.
2. DIMENSION "Y" SHOULD NOT INTERFERE WITH THE CLAMPING OF THE DROPPER CLIP.

TABLE			
DIMENSIONS	"X"	"Y"	"Z"
107mm ²	4,3	1,9	9,5
161mm ²	6,5	2,4	13,5



2	HALF DROPPER CLIP WITH THREAD.	1	-	-
1	HALF DROPPER CLIP WITHOUT THREAD.	1	-	-
ITEM NO.	DESCRIPTION	QTY	STORES ITEM NO.	DRAWING NO.

DIMENSIONS : mm SCALE : 1 : 1
 TOLERANCE : LIN $\pm 0,2$ ANG $\pm 0,5$ ITEM NO : -
 MATERIAL : TIN BRASS

DRAWN : D HATTINGH CHECKED : D HATTINGH

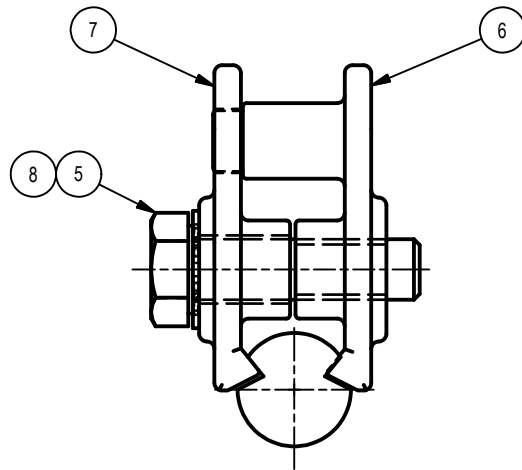
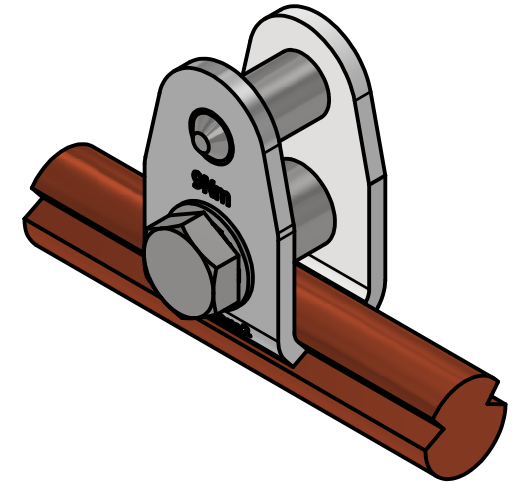
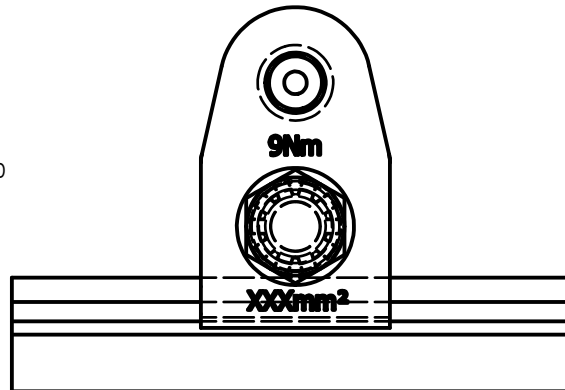
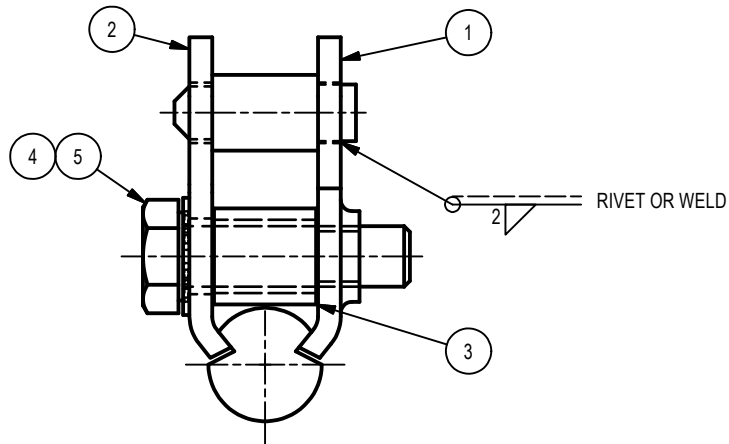
COMPONENTS OF 107mm² / 161mm²
 TIN BRASS DROPPER CLIP

TRANSNET
 freight rail

CEE-TND-0022 SHT 2

VERSION 8

A4



ALTERNATIVE DROPPER CLIP

TABLE 1	
CONTACT WIRE	STORES ITEN NO.
161mm²	54017312
107mm²	54006787

TABLE 2		
CONTACT WIRE	ITEM NO	BOLT LENGTH
107mm²	8	25mm
161mm²	8	30mm

NOTES

1. STOPPER TO PREVENT OVER TORQUE, STOPPER MAY NOT INTERFERE WITH CONTACT WIRE.
2. ASSEMBLES DROPPER MINIMUM WORKING LOAD OF 4kN.
3. ASSEMBLED DROPPER CLIP MUST BE PERMANENTLY MARKED WITH THE FOLLOWING
 - (a) TRANSNET LOGO
 - (b) MANUFACTURERS IDENTIFICATION.
 - (c) DATED BATCH NUMBER.
 - (d) WIRE SIZES.
 - (e) TORQUE = 9Nm.

8	HEXAGON BOLT, STAINLESS STEEL, GRADE AISI 304, M8 x SEE TABLE 2.	1	-	-
7	HALF DROPPER CLIP WITHOUT THREAD. (TIN-BRASS)	1	-	CEE-TND-0022 SHT 2
6	HALF DROPPER CLIP WITH THREAD (TIN-BRASS)	1	-	CEE-TND-0022 SHT 2
5	LOCK WASHER, INTERNAL TOOTH, STAINLESS STEEL, AISI GRADE 316, M8	1	-	-
4	HEXAGON BOLT, STAINLESS STEEL, GRADE AISI 316, M8 x 30mm LONG.	1	-	-
3	STOPPER.	1	-	CEE-TND-0022 SHT 1
2	HALF DROPPER CLIP WITHOUT THREAD.	1	-	CEE-TND-0022 SHT 1
1	HALF DROPPER CLIP WITH THREAD AND SPACER PIN ASSEMBLY	1	-	CEE-TND-0022 SHT 1
ITEM NO.	DESCRIPTION	QTY	STORES ITEM NO.	DRAWING NO.

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DIMENSIONS : mm SCALE : 1:1
TOLERANCE : LIN ± - ANG ± - ITEM NO: -
MATERIAL : "

VERSION INFO : ITEM 6 AND 7 ADDED.

29/02/2024

APPROVED : W SCHOEMAN

AUTHORISED : T GOVENDER

DROPPER CLIP
107mm² / 161mm² CONTACT WIRE

TRANSNET
freight rail

CEE-TND-0022

VERSION 8

A4

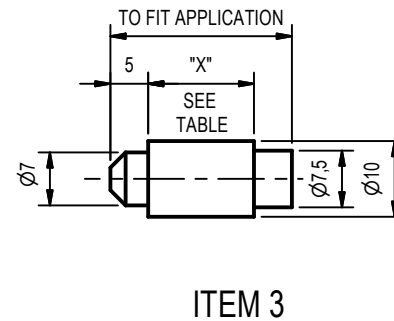
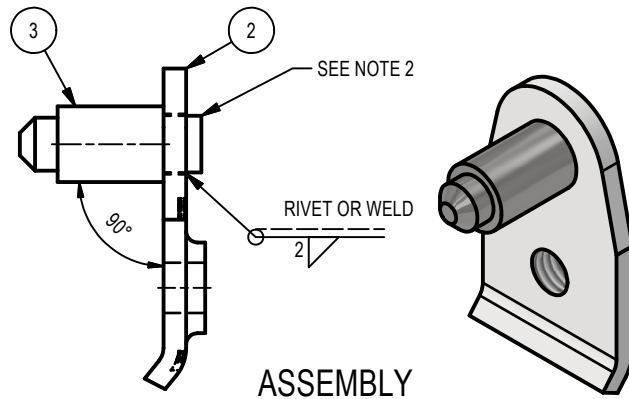
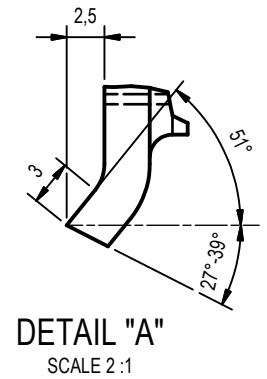
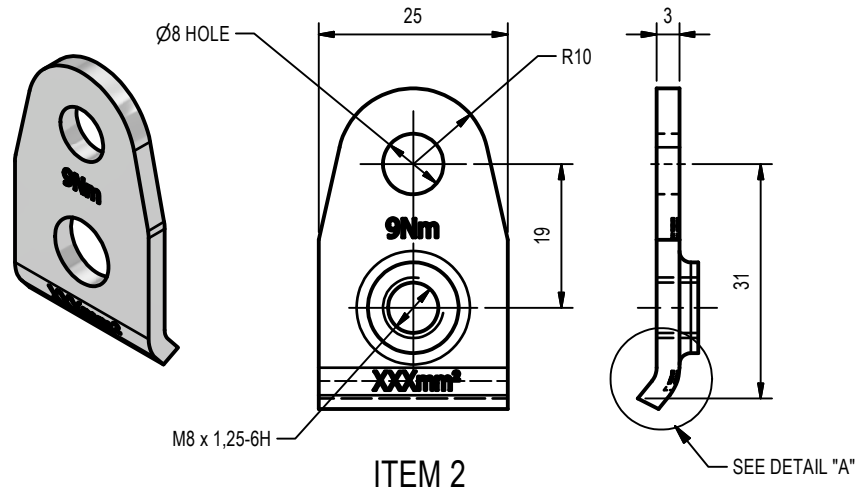
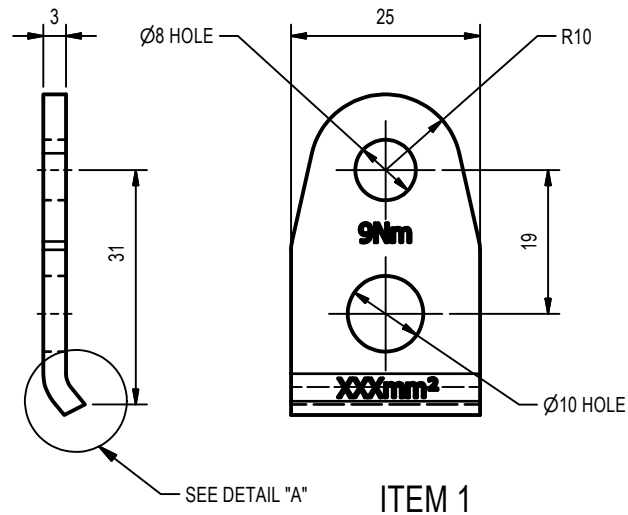
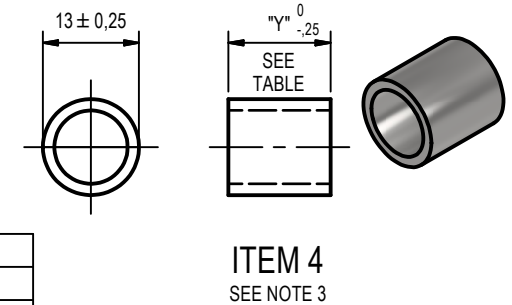
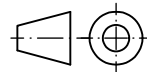


TABLE		
CONTACT WIRE	"X"	"Y"
107mm ²	11	10,5
161mm ²	14	13,5



NOTES

- THE FOLLOWING PERMANENT MARKINGS MUST APPEAR ON THIS ARTICLE:
 - TRANSNET LOGO
 - MANUFACTURERS IDENTIFICATION.
 - DATED BATCH NUMBER.
 - WIRE SIZES.
 - TORQUE = 9Nm.
- DRAW THROUGH FOR INCREASED THREAD LENGTH.
- THE LENGTH OF THE TUBE MUST NOT INTERFERE WITH THE CLAMPING OF THE DROPPER CLIP.



4	STOPPER, STAINLESS STEEL TUBE TO AISI GRADE 304, Ø12,7 O.D. 1,5mm WALL THICKNESS.	1	-	-
3	SPACER PIN, ROUND BAR, STAINLESS STEEL TO AISI GRADE 304, Ø10 x 24mm LONG.	1	-	-
2	DROPPER CLIP WITH THREAD, STAINLESS STEEL TO AISI GRADE 304.	1	-	-
1	DROPPER CLIP WITHOUT THREAD, STAINLESS STEEL TO AISI GRADE 304.	1	-	-
ITEM NO.	DESCRIPTION	QTY	STORES ITEM NO.	DRAWING NO.

DIMENSIONS : mm SCALE : 1:1
TOLERANCE : LIN ± 0,5 ANG ± 1° ITEM NO: -
MATERIAL : -

DRAWN : D HATTINGH CHECKED : D HATTINGH

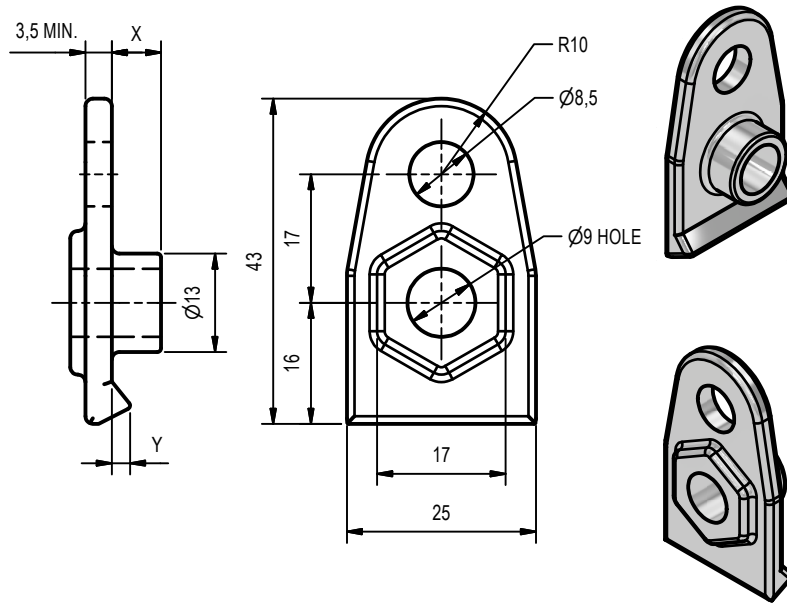
COMPONENTS OF 107mm² / 161mm²
STAINLESS STEEL DROPPER CLIP

TRANSNET
freight rail

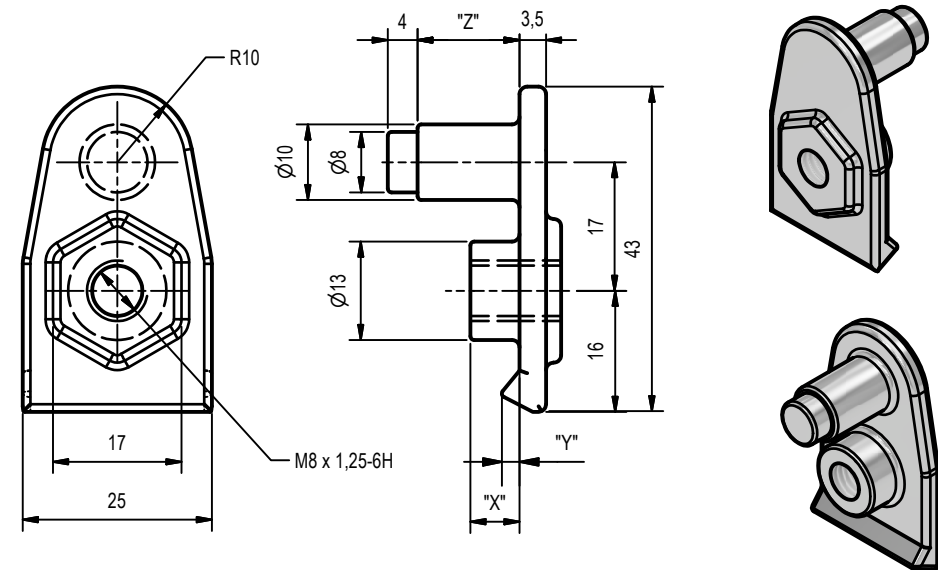
CEE-TND-0022 SHT 1

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A4



ITEM 1

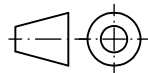


ITEM 2

NOTES

- THE FOLLOWING PERMANENT MARKINGS MUST APPEAR ON THIS ARTICLE:
 - TRANSNET LOGO.
 - MANUFACTURER'S IDENTIFICATION.
 - DATED BATCH NUMBER.
 - WIRE SIZE.
 - TORQUE = 9Nm.
- DIMENSION "Y" SHOULD NOT INTERFERE WITH THE CLAMPING OF THE DROPPER CLIP.

TABLE			
DIMENSIONS	"X"	"Y"	"Z"
107mm ²	4,3	1,9	9,5
161mm ²	6,5	2,4	13,5



2	HALF DROPPER CLIP WITH THREAD.	1	-	-
1	HALF DROPPER CLIP WITHOUT THREAD.	1	-	-
ITEM NO.	DESCRIPTION	QTY	STORES ITEM NO.	DRAWING NO.

DIMENSIONS : mm SCALE : 1 : 1
 TOLERANCE : LIN $\pm 0,2$ ANG $\pm 0,5$ ITEM NO : -
 MATERIAL : TIN BRASS

DRAWN : D HATTINGH CHECKED : D HATTINGH

COMPONENTS OF 107mm² / 161mm²
 TIN BRASS DROPPER CLIP

TRANSNET
 freight rail

CEE-TND-0022 SHT 2

VERSION 8

A4

- 5.1.6 All ferrous parts of the arrester i.e. terminals, connecting clamps, nuts and bolts shall be stainless steel or mild steel galvanized in accordance with specification SANS 121.
- 5.1.7 In the event of an internal flash-over, of which the surge energy exceeds the energy discharge capacity of the arrester, provision should be made to relieve the pressure and prevent the arrester from exploding resulting in the scattering porcelain fragments over a wide area with the consequent possible damage to equipment and injury to staff. In accordance with SANS 60099-4 the short circuit requirements must be met and be of Design A with a pressure-relief device.
- 5.1.8 The arrester shall be designed to give a clear visible indication in the event of failure in order to easily identify faulty arresters. The visual indication shall be visible from ground level. A description of the visual indication system shall be given in the "Technical data sheet" Appendix 1.
- 5.1.9 The minimum outdoor earth clearance between the line connection and any other part of the arrester that is connected to earth, shall be 150mm.
- 5.1.10 The arrester shall be pedestal mounted, with an adapter plate according to drawing number CEE-TLE-6.

5.2 ARRESTER RATINGS

- | | | |
|-------|--|-------------|
| 5.2.1 | Rated voltage of the arrester U_r : | 4.8kV DC |
| 5.2.2 | Rated nominal discharge current: | 10kA |
| 5.2.3 | Discharge current withstand capability (4/10 μ s two shots): | 100kA |
| 5.2.4 | Continuous operating voltage (U_c): | 4,0 kV DC |
| 5.2.5 | Pressure Relief Capability: | 40 kA/0,2 s |
| 5.2.6 | Line Discharge | 6.7 kJ/kV |
| 5.2.7 | The residual peak voltage shall not exceed the insulation level of the traction substation. The substation is capable of withstanding a test voltage of 10,5 kV (rms) AC @ 50 Hz for one minute. | |

6.0 MARKING

In addition to the identification and labelling required by BS 50526-1 section 4.1 each arrester shall be legibly and indelibly marked with the following information in a position where the information can readily be seen;

- Manufacturer's name
- Year of manufacture
- Rated DC Voltage
- Continuous Operating Voltage (U_c)
- Serial Number
- The words "Metal Oxide" and "Outdoor" and type
- Insulating medium
- The word "live" on or near the connecting terminal if the arrester has a metal casing that is connected to the earth, and the word "earth" on or near the earth terminal.

7.0 TESTS

- 7.1 Test certificates to verify requirements shall be submitted with tender documents.
- 7.2 The required tests shall be performed according to BS 50526-1 and SANS 60099-4.
- 7.3 Transnet Freight Rail reserves the right to carry out any check tests on data submitted. However, the successful tenderer will still be responsible for efficient operation of the equipment in service and its compliance with the specification.
- 7.4 Transnet Freight Rail reserves the right to inspect the equipment at any stage during or after manufacture and be represented at any tests. Transnet Freight Rail shall have full power to reject any item that is considered defective or inferior in quality of material, workmanship or design to that required by this specification.

8.0 PACKING

- 8.1 All equipment shall be packed in such a manner that it will be adequately protected against damage during handling and transport.

9.0 WARRANTEE/AFTER SALES SUPPORT

- 9.1 Tenderers should give a warrantee on the workmanship of the manufactured items and provide a full disclosure of any warrantee conditions with the tender.
- 9.2 Tenderers should state the extent of after sales support provided by them.
- 9.3 Tenderers should provide a spare parts list with contact details with each item.
- 9.4 Lead time must be clearly indicated by tenderers.

END

APPENDIX 1

TECHNICAL DATA SHEET
(To be completed by tenderer)

1.0	Type of arrester:	
2.0	Manufacturer:	
3.0	Rated DC voltage (Ur):	kV
4.0	Continuous operating DC voltage:	kV
5.0	Nominal discharge current:	kA
6.0	High current impulse withstand capability (4/10µs):	kA
7.0	Maximum residual voltage at steep or lightning impulse current.	kV
8.0	Long duration current impulse:	 A / µs
9.0	Pressure relief withstand:	 kA / s
10.0	Energy discharge capability:	kJ/KV _{ur}
11.0	Vibration resistance:	g
12.0	Mechanical bump strength:	g
13.0	Creepage distance:	mm
14.0	Height:	mm
15.0	Mass:	kg
16.0	Temperature range:	° C
17.0	Maximum Altitude:	m
18.0	Visible indication – description:	
19.0	Additional information:	

END



A Division of Transnet SOC Limited

TECHNOLOGY MANAGEMENT

SPECIFICATION

REQUIREMENTS: COMPRESSION TYPE FITTINGS FOR STRANDED ALUMINIUM AND ALUMINIUM STEEL REINFORCED CONDUCTORS

Author:	Engineer Technology Management	T.G. Mangwegape	<u><i>tumelo.</i></u>
Approved by:	Principal Engineer Technology Management	S.E. Sibande	<u><i>SE Sibande</i></u>
		Date:	22 February 2021

Circulation Restricted To:

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LIST OF AMENDMENTS TO THE SPECIFICATION

Version No.	Date Issued	Page No.	Clause No.	Remarks
01	1983	Document	All	First Publication (CEE.0038.83)
02	1987	Document	All	CEE.0038.87 cancels CEE.0038.83.
03	02 October 2020	Document	All	CEE.0038.83 transferred to the latest Technology Management Specification Template.
		Document	All	Requirements for aluminium conductors, steel reinforced incorporated.
		2.0	4	Nominative References added.
		2.4	4	New drawing form 800mm ² to 500mm ² Tension splice developed.
4	22 February 2021	7	7.1	Clause updated to include the non-compliance letter.
		8	9.4	Clause added to include makers' defects during transportation of fittings.
		8	10.2	Clause edited and moved to 9.4.
		9	11.2	Clause edited to include the non-compliance letter.
		9	11.3	Clause updated.
		10	Appendix A	Removed the name of the supplier.
		11	Appendix B	Added the current carrying capacity for compression type lug. Added number of supplied fittings per type.

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1.0 SCOPE

- 1.1. This specification details Transnet's requirements for the design and supply of the aluminum compression fitting type for stranded aluminum conductor (AAC) and stranded aluminum steel reinforced conductor (ACSR). Conductor sizes are 250 mm², 500 mm² and 800 mm².
- 1.2. Compression fittings are as follows:
 - 1.2.1. Tee-off clamps – AAC application;
 - 1.2.2. Tension splices – AAC and ACSR application;
 - 1.2.3. Strain clamps – AAC and ACSR application;
 - 1.2.4. Compression type lugs – AAC application.
- 1.3. This specification contains the schedule of requirements (Annexure A) which must be completed by the relevant Transnet Representative.
- 1.4. This specification contains the technical datasheet (Annexure B) which must be completed by the supplier and shall be submitted as part of the tender documents.

2.0 NORMATIVE REFERENCES

Unless otherwise specified all materials used, equipment developed and supplied shall comply with the latest edition of the relevant International Electro-technical Commission (IEC), International Organization for Standardization (ISO), South African National Standards (SANS) or Transnet publications.

2.1. SANS STANDARDS

SANS 121, Hot dip galvanized coatings on fabricated iron and steel articles Specifications and test methods.

SANS 182-3, Conductors for overhead electrical transmission lines Part 3: Aluminum conductors, steel reinforced.

SANS 2063, Metallic and other inorganic coatings-thermal spraying-zinc, aluminum and their alloys.

SANS 9001, Quality management systems – Requirements.

SANS 15614-2, Specification and qualification of welding procedures for metallic materials - Welding procedure test Part 2: Arc welding of aluminum and its alloys.

2.2. TRANSNET FREIGHT RAIL DRAWING

BBH3942 included all technical drawing for this specifications.

3.0 SERVICE CONDITIONS

3.1. ENVIRONMENTAL CONDITIONS

Altitude:	0 - 1800 m above sea level.
Relative humidity:	10% to 90%.
Ambient temperature:	-10° C to +55° C.
Wind pressure:	750 Pa.
Lightning conditions:	20 ground flashes/km ² per annum.
Pollution:	Heavily salt laden with industrial pollutants including diesel- electric locomotive emissions.

3.2. ELECTRICAL SERVICE CONDITIONS

- 3.2.1. Nominal power system frequency shall be 50Hz.
- 3.2.2. AAC or ACSR fittings shall be exposed to the following system voltages:
- 3.3kV DC electrification system.
 - 25kV and 50kV AC electrification system.
- 3.2.3. The supplied AAC and ACSR fittings shall withstand without annealing the following operating currents shown below in table 1.

Table 1: Minimum breaking strength

Conductors Size	250 mm ²	500 mm ²		800 mm ²	
Conductors Type	AAC	Scorpion	Deer	Bull	Lapwing
Continuous current (A)	610	890	800	1200	1300
5 Minutes rating (A)	1010	1900	1560	3060	-
1 Minutes rating (A)	2080	4040	3287	6620	-

3.3. MECHANICAL SERVICE CONDITIONS

The supplied AAC or ACSR fittings shall be capable to endure the minimum breaking strengths as shown in table 2. The breaking strength of the conductor conforms to table A and B of SANS 182-3.

Table 2: Minimum breaking strength.

Conductors Size	250 mm ²	500 mm ²		800 mm ²	
Conductors Type	AAC	Scorpion	Deer	Bull	Lapwing
Breaking strength (kN)	44.03	86.75	204.49	141.84	286.59

4.0 TECHNICAL REQUIREMENTS

4.1. GENERAL TECHNICAL REQUIREMENTS

- 4.1.1. The material used to manufacture the supplied AAC or ASCR fittings shall be aluminum.
- 4.1.2. The supplied AAC or ASCR fittings shall be designed in such a way that it is easy to insert the conductor before crimping as per the method of crimping, see BBH3942.
- 4.1.3. The Transnet technical drawing shall be provided by the relevant Transnet representative upon request during the procurement process.
- 4.1.4. The welding executed on the aluminum parts of the procured AAC or ASCR fittings shall conform to clause 5 of the SANS 15614-2.
- 4.1.5. Execution of welding procedure tests and the range of qualification for welding procedures shall conform to those listed in Clause 8 of SANS 15614-2.
- 4.1.6. Part where welding took place on the fittings shall be clean and safe for use and handling.
- 4.1.7. The end of the main body of the AAC or ASCR fittings shall be suitably designed to provide gradual stress relief where the conductor becomes crimped in the body to eliminate the strands failure of the conductor.
- 4.1.8. The thermal-sprayed metallic coatings for the protection of material against corrosion by applying zinc or aluminum to uncoated surface shall be applied in accordance to clause 6 of SANS 2063.

4.2. TENSION SPLICE REQUIREMENTS.

- 4.2.1. Tension splice for “AAC” to “AAC” application shall be designed with a stop blocker placed in the middle of the body, see BBH3942.
- 4.2.2. The stopper may take the form of indentation or dowel and shall be secured to the splicer to prevent loss during storage.
- 4.2.3. The material of the stopper shall be aluminum.
- 4.2.4. Tension splice for different size for “AAC” to “ACSR” or “ACSR” to “ACSR” application shall be designed with a steel and or aluminum tubing to compensate for the area of the smaller conductor, see BBH3942.
- 4.2.5. Tension splice shall have 4 crimps minimum on both side as shown in BBH3942.

4.3. STRAIN CLAMP REQUIREMENTS.

- 4.3.1. The strain clamp shall be supplied complete with clevis size $\varnothing 16 \times 60$ LG with the length 50 ± 1 mm and locking split pins including necessary items for attachment of the clamp to the insulator tongue or turnbuckle.
- 4.3.2. For ASCR application – “Deer” or “Lapwing”, the steel inner splice shall be provided together with the clamp, See BBH3942.
- 4.3.3. The rivet, steel, snap head shall be galvanized as per SANS 121.

4.4. TEE-CLAMP REQUIREMENT.

- 4.4.1. The lug of the tee-off clamp to which the bi-metallic spade terminal is attached shall be located on the main body such that crimping of the main body takes place on both side of the lug.
- 4.4.2. The lug of the tee-clamp and the bimetallic spade terminal must be so arranged that the copper conductor lies in a plate parallel to the main conductor.
- 4.4.3. The center to center spacing of the conductor must not exceed 120 mm when assembled.

-
- 4.4.4. The number of crimps on the tee-clamp shall be equal on both side and not be less than 2 on each side.

4.5. JUMPER LUG REQUIREMENT

- 4.5.1. The lug shall be designed to suit the left, right and downwards position when bolted to the strain clamp.
- 4.5.2. Suitable bolts, nuts, flat washers and heavy duty spring washer shall be supplied with the jumper lug.

5.0 TESTING AND INSPECTIONS

- 5.1. Transnet reserves the right to be present at all tests and inspections as called for in this clause.
- 5.2. During inspections, the fittings shall be assembled prior supply.
- 5.3. A pre-production sample shall be supplied to Technology Management, Electrical department for approval prior supply of the procured batch. The design is provided in BBH3942 for this arrangement.
- 5.4. The responsibility of arranging the tests called for in this clause rests with the successful supplier.
- 5.5. A Transnet Freight Rail, Technology Management (Electrical Technology) department representative may request any additional test deemed necessary to ensure compliance.
- 5.6. All certificates of the listed tests shall be supplies to TFR Technology Management for verification and inspection.

6.0 RATING PLATE, MARKINGS AND INSTRUCTION LABELS

- 6.1. The supplied AAC or ASCR fittings shall be identified but not limited to the following information. These parameters shall be visible and permanently marked on the fittings:
- 6.2. Name/logo of the original manufacturer.
- 6.3. Name of the AAC or ASCR fittings.
- 6.4. Transnet Logo.
- 6.5. Dated batch number.
- 6.6. Conductor size on the fitting.

7.0 DOCUMENTATION REQUIREMENTS

- 7.1. Technical drawings shall be submitted with tender if there's any deviations as per the provided Transnet drawings. Deviations shall be accompanied in a non-compliance letter as required in 11.2 of this specification.
- 7.2. The supplier shall provide one soft copy and two hard copies of the technical specification of the AAC or ASCR fittings.
- 7.3. Supplier shall advise how to proceed with the equipment at the end of its operating life, taking into consideration environmental requirements and regulations.

8.0 QUALITY ASSURANCE

- 8.1. The successful supplier shall maintain a Quality Management System (QMS) based on or certified to SANS 9001.

9.0 PACKAGING, STORAGE AND HANDLING

- 9.1. AAC or ASCR fittings shall be packed in less than 25kg per pack.
- 9.2. The pack shall be labelled with the store item number and the purchase order number.
- 9.3. Where necessary, installation instructions, storage instructions including technical drawings shall be accompanied with package.
- 9.4. The appointed supplier shall accept liability for makers' defects during transportation of all fittings, which may appear in design, material and workmanship at the time of tender (7 days after delivery).

10.0 GUARANTEE AND DEFECTS

- 10.1. The appointed supplier shall guarantee in a letter format that the supplied AAC or ASCR fittings conforms to the Transnet's technical requirements in 4.0.
- 10.2. The supplier shall state the extent of sales support provided by them in a letter format.

11.0 METHOD OF TENDERING

- 11.1. Tenderer shall indicate clause-by-clause compliance document with the specification. This shall take the form of a separate document listing each of the specification's clause and sub-clause numbers, indicating the individual statements of compliance or non-compliance.
- 11.2. Statement of non-compliance shall be motivated by the tenderer in a letter format, as per 11.1. The letter and evidence of deviation shall be submitted as part of the tender document.
- 11.3. Tenderer shall submit comprehensive literature consisting of a detailed technical specification in accordance to clause 4.0 (Technical Requirements) if required, the general constructional details and principal dimensions **if not** indicated on the provided Transnet Drawings, maintenance schedules if required in any of the Appendix and datasheets **if required** in any of the Appendix or in the specifications.
- 11.4. Any items offered in accordance with other standards will be considered at the sole discretion of Transnet Freight Rail, Technology Management, Electrical Technology Department. The tenderer shall supply full details stating where the item differs from these specifications as well as supplying a copy (in English) of the recognized standard specification(s) with which it complies. Any deviations must be approved by the relevant Transnet Freight Rail, Technology Management, Electrical Technology Department in writing.
- 11.5. Failure to comply with clauses 11.1, 11.2, 11.3 and 11.4 could preclude a tenderer from consideration.
- 11.6. In the event of any conflict between the various submitted relevant documents, the order of precedence shall be, and in consultation with Transnet Freight Rail, Technology Management, Electrical Technology Department:
 - a) Legal and safety requirements.
 - b) This Specification.

APPENDIX A: SCHEDULE OF REQUIREMENTS

(To be completed by relevant Transnet Freight Rail Representative)

Descriptions	Values	
Name of the Depot		
Fitting procured:	Tee-off clamp	Yes No
	Tension splice	Yes No
	Strain clamp	Yes No
	Compression type lug	Yes No
Size of the fitting procured:	Tee-off clamp:	
	Strain clamp:	
	Compression type lug:	
	Tension splice: AAC - AAC AAC – Scorpion AAC – Deer Scorpion – Bull Scorpion – Lapwing Deer – Lapwing	

Completed by

Capacity

Signature

Date

[illegible]



A Division of SOC Transnet Limited

TECHNOLOGY MANAGEMENT

SPECIFICATION

SPECIFICATION FOR SECTION INSULATORS FOR 25 KV AC OVERHEAD TRACK EQUIPMENT FOR BOTH HIGH AND LOW SPEED TRAFFIC

Author: Technician In Training M.R Masupha
Technology Management

A handwritten signature in black ink, appearing to read 'Masupha', written over a dotted line.

Approved: Engineer S. Smith
Technology Management

A handwritten signature in black ink, appearing to read 'Smith', written over a dotted line.

Authorised: Senior Engineer L.O Borchard
Technology Management

A handwritten signature in black ink, appearing to read 'L.O Borchard', written over a dotted line.

Date: 13 July 2016

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1.0 SCOPE

- 1.1 This specification covers the Transnet Freight Rail requirements for bi-directional 25 kV AC section insulators, excluding catenary insulation.
- 1.2 A section insulator is an in-line insulator inserted into the contact wire which is so designed as to electrically separate sections of OHTE and also provide a smooth transition for a pantograph current collection. Both insulator material and air clearance have an effect on insulation properties.

2.0 REFERENCES

- 2.1 Unless otherwise specified, all materials, equipment and testing methods shall comply with the current edition of the relevant IEC, SANS or Transnet Freight Rail publications where applicable.

- 2.2 The following specifications and drawings (latest edition) are referred to herein:

2.3 AMERICAN STANDARD AND TEST METHODS (ASTM)

ASTM D2303-97: 2004	Standard Test Methods for Liquid Contaminant, Inclined-Plane, Tracking and Erosion of Insulating Materials.
---------------------	---

2.4 SOUTH AFRICAN NATIONAL STANDARDS (SANS)

SANS 60383-2:	Insulators for overhead lines with a nominal voltage above 1 000 V Part 2.
---------------	--

2.5 TRANSNET FREIGHT RAIL SPECIFICATIONS

Transnet Drawing CEE-TA-0062:	Standard Electrification Symbols.
-------------------------------	-----------------------------------

2.6 SIEMENS DRAWING

Siemens Drawing No. 8WLO 119-6ZG30:	Pantograph for AC/DC locomotive.
-------------------------------------	----------------------------------

3.0 METHOD OF TENDERING

- 3.1 Tenderers shall indicate clause-by-clause compliance with this specification. This shall take the form of a separate document listing all the specifications clause numbers indicating the individual statement of compliance or non-compliance. This document can be used by tenderers to elaborate on their response to a clause.
- 3.2 A statement of non-compliance shall be motivated by the tenderer.
- 3.3 Tenderers shall submit descriptive literature consisting of a detailed technical specifications, general constructional details and principal dimensions, together with clear illustrations of the equipment offered.
- 3.4 Failure to comply with clauses 3.1, 3.2 and 3.3 could preclude a tender from consideration.

4.0 SERVICE CONDITIONS

4.1 ENVIRONMENTAL CONDITIONS

Altitude:	0 - 1800 m above sea level
Relative humidity:	10% to 90%
Ambient temperature:	-10° C to +50° C

Wind pressure:	750 Pa
Lightning conditions:	20 ground flashes/km ² per annum
Pollution:	Heavily salt laden with industrial pollutants including diesel- electric locomotive emission.

4.2 MECHANICAL CONDITIONS

Contact wire tension (new wire):	11 kN (min) to 19.5 kN (max.)
Required safety factor (overall):	x2 for 107 mm ² contact wire x2.7 for 161 mm ² contact wire.
Contact wire size:	107 mm ² or 161 mm ² Cu

4.3 ELECTRICAL CONDITIONS

Highest voltage of system:	30 kV AC
Lowest voltage of system:	19.9 kV AC
Maximum commutated current:	800 A
Maximum short circuit current:	8000 A
Lightning impulse withstand voltage:	95 kV

Note: The circuit breakers opening time on the occurrence of a fault is 60-150 milliseconds for 25 kV AC.

5.0 DRAWINGS AND INSTRUCTIONS

- 5.1 All drawings must use standard symbols as per CEE-TA-0062.
- 5.2 Tenderers shall provide the following information at time of tendering to enable a proper adjudication to be made. Failure to do so shall be indicated in the "Statement of Compliance" and may lead to rejection of the tender. Where feasible the information may be provided on the drawing:
 - 5.2.1 A detailed drawing showing insulation inserts, runners, arcing horns and suspension arrangements with all relevant dimensions and in particular deviation, if any, from a plane surface after installation. (See clause 6 for design requirements.)
 - 5.2.2 Details of insulating materials used. Resistance to Ultra-violet radiation shall be stated.
 - 5.2.3 Detail and composition of metallic components used.
 - 5.2.4 Minimum distance to be allowed between section insulator and catenary.
 - 5.2.5 Details of adjusting height and level at rights angles, as well as longitudinal, to the track.
 - 5.2.6 Gross mass.
 - 5.2.7 Details of adjustment of arcing horns.
 - 5.2.8 Comprehensive instructions for installation and details of any special tools or equipment required.
 - 5.2.9 List of railway organisations and service conditions where the section insulator offered, is in successful use.
 - 5.2.10 Test certificates for tests called for in clause 7.2.
- 5.3 Photocopies of original documentation shall be clearly legible.

6.0 DESIGN REQUIREMENTS

- 6.1 The section insulators shall be of durable design and shall be capable of carrying out their functions reliably under the service conditions stated. They shall be suitable for bi-directional traffic at speeds of up to 120 km/h.
- 6.2 The overall mass of the section insulator shall not exceed 21 kg. (The mass of support droppers and fittings excluded.)
- 6.3 The overall width of that part of the section insulator in contact with the pantograph shall not exceed 330 mm.
- 6.4 The section insulator shall be provided with suitable runners of either metal or insulating material such that a smooth continuous running surface is present for the passage of a pantograph,
- 6.5 The design shall be such that electrical contact between pantograph and the overhead system will under no circumstances be completely broken whilst being traversed by the pantograph. Designs incorporating a gap longitudinally across the section insulator (i.e. with in-line runners) the gap width shall not exceed 300 mm such that the gap can be bridged out by the pantograph. (See Appendix 1 for a detailed drawing of a pantograph).
- 6.6 Allowance shall be made in the design to ensure that no obstruction shall be formed to the passing pantograph should the section insulator fail to be set perfectly level in all planes with respect to the track.
- 6.7 The section insulator shall preferably present a perfectly plane running surface to the pantograph, when installed at the normal tension of 14.5 kN. If not perfectly plane, or if variations in tension can result in deviations from a perfect plane, the maximum allowable deviation shall be 6 mm at any point on the running surface, within the range of operating tensions quoted in clause 4.2.
- 6.8 All runners or parts in contact with the pantograph shall be of rigid design such that no part shall deflect by more than that specified in clause 6.7 whilst being subjected to the upward force of the pantograph of up to 90 N.
- 6.9 Arcing horns shall be provided and designed such to assist in extinguishing any arc. They shall also be placed such that the insulation used will not be damaged by the arcs drawn during operation and shall be of rigid design. The air-gap between arcing horns at different potential shall not be less than 150 mm. Each horn shall have a straight length above this air gap between 120 mm to 350 mm.
- 6.10 The main insulating material forming the insulation between the two circuits shall have a creepage length greater than 750 mm. It shall also be able to withstand abrasion resulting from the passage of pantographs (if applicable) as well as electric arcing and ultra-violet radiation.
- P.T.F.E. (Teflon) shall not be used if in direct contact with the pantograph.
- 6.11 Where composite insulators are used as main insulation the protective coating on the outside shall be bonded to the core such that no cavities are formed between the coating and the core. The protective coating shall be sealed at the ends to prevent the possibility of tracking along the insulator underneath the protective coating.
- Each insulator of this type shall be subjected to the water immersion test described in clause 7.3.
- 6.12 Clause 6.11 also applies to any other protection material provided to protect the insulation against arcing/flashover.
- 6.13 Supporting droppers shall (if provided) be insulated to prevent any arcing between the catenary wire and the droppers. The supporting droppers shall be adjustable either by means of turnbuckles or some other means of providing fine adjustments to its length. Droppers shall be protected by thimbles or similar means to prevent wear taking place at sharp edges.
- 6.14 Supporting droppers must be provided if the mass of the section insulator exceeds 5 kg or if its overall width is in excess of 75 mm.

- 6.15 Supporting droppers shall be of material type stainless steel.
- 6.16 Only non-corrosive materials shall be used in the construction of the section insulator. Brass may not be used.
- 6.17 Means of locking all bolts and screws shall be provided. All screw threads shall be of metal.

7.0 TESTS

7.1 GENERAL

- 7.1.1 The first section insulator shall be subjected to type tests as specified in clauses 7.2.
- 7.1.2 All main insulators of the composite type shall be subjected to the routine test as specified in clause 7.3.
- 7.1.3 A further five samples of the main insulator material shall be subjected to the type test as specified in clause 7.2.1.
- 7.1.4 The responsibility for arranging these tests shall rest with the tenderer although the Transnet Freight Rail reserves the right to perform such tests independently.
- 7.1.5 Transnet Freight Rail reserves the right to call for further type tests.
- 7.1.6 Transnet Freight Rail reserves the right to be present at all tests.

7.2 TYPE TESTS

- 7.2.1 The insulating material (if of synthetic type) shall be tested for resistance to tracking in accordance with the test method described in ASTM D 2303. The average time to track 13 mm for five samples shall not be less than 24 hours at a constant test voltage of 2 kV with a constant contaminating flow rate as prescribed in ASTM D 2303. The cabinet in which the tracking test is performed shall be open at the top in order to create sufficient ventilation, thus limiting the relative humidity inside the chamber to a value that will not give false results. The flow rate of the contaminant should be accomplished by a gravity feed from a large reservoir mounted at a sufficient height to obtain the desired flow rate.
- 7.2.2 Impulse and power frequency tests shall be carried out on a complete section insulator in accordance with SANS 60383-2.
- 7.2.3 Mechanical load tests shall be carried out to establish whether the section insulator can withstand the maximum tension called for in clause 4.2 at a safety factor as specified in clause 4.2.
- 7.3 Water immersion tests shall be carried out as follows: (Routine test)
 - 7.3.1 Immerse the sample in hot tap water (50 °C) and allow water to cool over 8 hours to approximately 20°C.
 - 7.3.2 Repeat 7.3.1 nine times.
 - 7.3.3 After the 10th cycle, remove the sample from the water, wipe the surface dry with a paper towel and apply a DC test voltage of 25 kV/m length of insulator within 10 minutes. Measure the current after one minute on a DC ammeter capable of reading 1 nA.
 - 7.3.4 Insulators conducting more than 100 nA have failed the test and must be rejected.

8.0 SPARES

- 8.1 Tenderers shall quote separately for the following spares:
 - 8.1.1 Arcing horns
 - 8.1.2 Main insulators

- 8.1.3 Metal runners (if not integrated with arcing horns)
- 8.2 The following information shall be made available for spares:
 - 8.2.1 Complete ordering description
 - 8.2.2 Name of manufacturer
 - 8.2.3 Catalogue description number
 - 8.2.4 Type and ordering number

9.0 TOOLS

- 9.1 Special tools for installation of the section insulators shall be quoted separately, but must be clearly stated in tender that the tool is required for installation.

10.0 PACKING

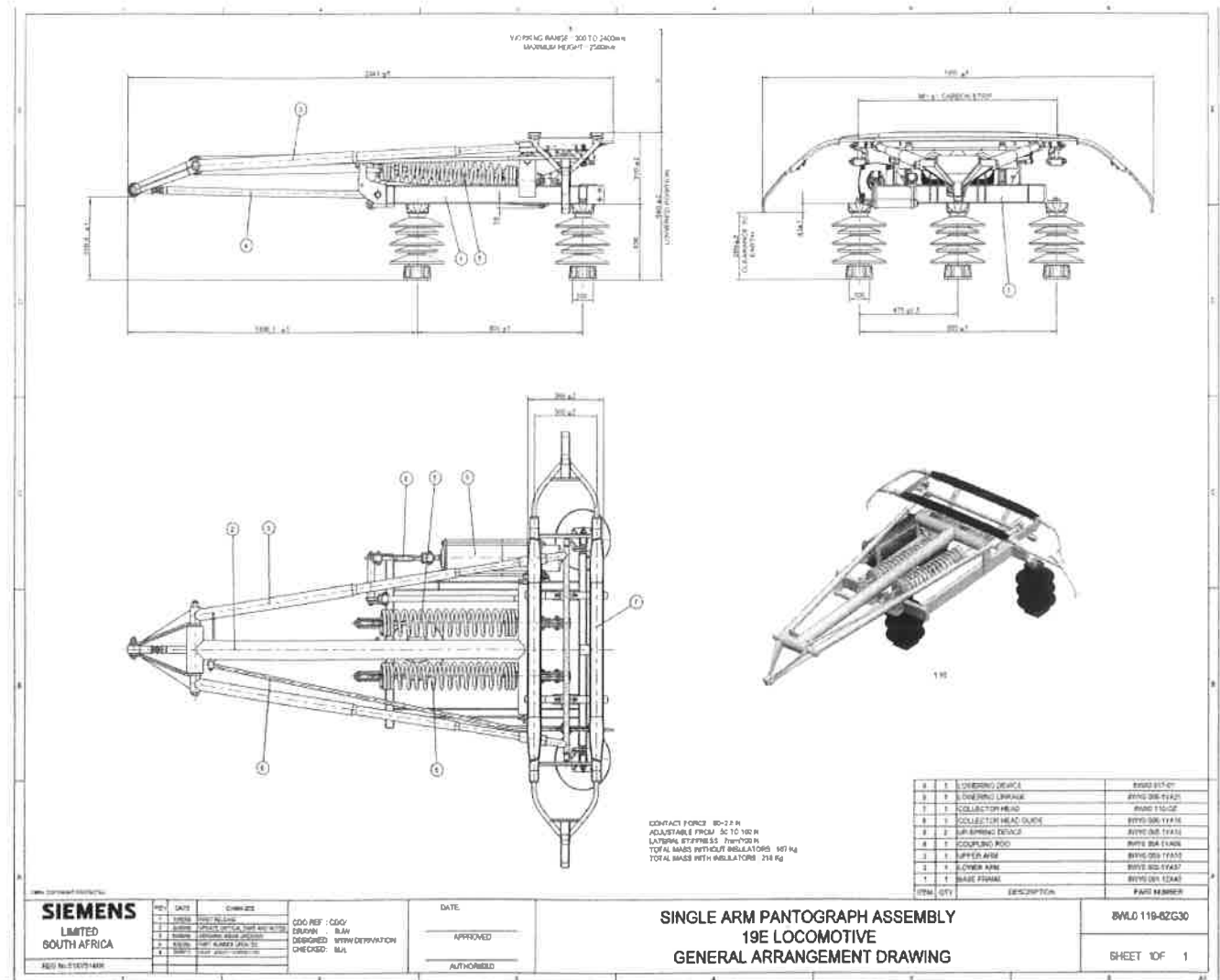
- 10.1 Each section insulator shall be packaged individually complete with arcing horns, suspension fittings, etc.

11.0 WARRANTEE/ AFTER SALES SUPPORT

- 11.1 Tenderers should give a warrantee on the workmanship of the manufactured items and provide a full disclosure of any warrantee conditions with the tender.
- 11.2 Tenderers should state the extent of after sales support provided by them.
- 11.3 Tenderers should provide a spare parts list with contact details with each item , including the installation instructions.
- 11.5 Lead time must be clearly indicated by tenderers.

END

Appendix 1





A Division of Transnet SOC Limited

TECHNOLOGY MANAGEMENT

SPECIFICATION

SPECIFICATION FOR SECTION INSULATORS FOR COMBINED 3 KV DC AND 25 KV AC OVERHEAD TRACK EQUIPMENT FOR CHANGE-OVER YARDS

Author: Technician In Training M.R Masupha
Technology Management

A handwritten signature in black ink, appearing to read 'Masupha', written over a dotted line.

Approved: Engineer S. Smith
Technology Management

A handwritten signature in black ink, appearing to read 'Smith', written over a dotted line.

Authorised: Senior Engineer L.O Borchard
Technology Management

A handwritten signature in black ink, appearing to read 'Borchard', written over a dotted line.

Date: 13 July 2016

"I acknowledge that this application contains personal information as defined in the Protection of Personal Information Act, 2013 (the "Act"). By accessing/using this application, I consent to the processing of my personal information in accordance with the requirements of the Act. I acknowledge that I cannot unreasonably withhold my consent. I acknowledge that the purpose for processing my personal information is in terms of this application."

Circulation Restricted To:

Transnet Freight Rail

Transnet and Relevant Third Parties

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1.0 SCOPE

- 1.1 This specification covers the Transnet Freight Rail requirements for bidirectional 3 kV DC /25 kV AC section insulators, excluding catenary insulation, for changeover yards.
- 1.2 A section insulator is an in-line insulator inserted on the contact wire which is designed to electrically separate sections of OHTE and also provide a smooth transition for a pantograph current collection. Both insulator material and air clearance, affect the insulating properties.

2.0 REFERENCES

- 2.1 Unless otherwise specified, all materials, equipment and testing methods shall comply with the current edition of the relevant IEC, SANS or Transnet Freight Rail publications where applicable.
- 2.2 The following specifications and drawings (latest edition) are referred to herein:

2.3 SOUTH AFRICAN NATIONAL STANDARDS (SANS)

SANS 60383-2:	Insulators for overhead lines with a nominal voltage above 1 000 V Part 2
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2.4 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 2303-97:2004:	Standard Test Methods for Liquid contaminant, inclined-plane tracking and erosion of insulating materials
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2.5 TRANSNET FREIGHT RAIL SPECIFICATIONS

Transnet Drawing CEE-TA-0062:	Standard Electrification Symbols.
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2.6 SIEMENS DRAWING

Siemens Drawing 8WLO 119-6ZG30:	Pantograph Drawing for AC/DC Locomotive.
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3.0 METHOD OF TENDERING

- 3.1 Tenderers shall indicate clause-by-clause compliance with this specification. This shall take the form of a separate document listing all the specifications clause numbers indicating the individual statement of compliance or non-compliance. This document can be used by tenderers to elaborate on their response to a clause.
- 3.2 A statement of non-compliance shall be motivated by the tenderer.
- 3.3 Tenderers shall submit descriptive literature consisting of a detailed technical specifications, general constructional details and principal dimensions, together with clear illustrations of the equipment offered.
- 3.4 Failure to comply with clauses 3.1, 3.2 and 3.3 could preclude a tender from consideration.

4.0 SERVICE CONDITIONS

4.1 ENVIRONMENTAL CONDITIONS

Altitude:	0 - 1800 m above sea level
Relative humidity:	0% to 90%
Ambient temperature:	-10° C to +50° C

Wind pressure:	750 Pa
Lightning conditions:	20 ground flashes/km ² per annum
Pollution:	Heavily salt laden with industrial pollutants including diesel-electric locomotive emissions.

4.2 MECHANICAL CONDITIONS

Contact wire tension (new wire):	5.5 kN(min) to 22.5 kN(max.)
Required safety factor (overall):	x2 for 161 mm ² x2.7 for 107 mm ²
Contact wire size:	161 mm ² or 107 mm ² Cu

4.3 ELECTRICAL CONDITIONS

Highest voltage of system:	30 kV AC
Lowest voltage of system:	19.9 kV AC
Maximum commutated current:	2.7 kA
Maximum short circuit current:	35 kA
Lightning impulse withstand voltage:	95 kV

Note: The circuit breakers opening time on the occurrence of a fault is 60-150 milliseconds for 25 kV AC systems and 30-100 milliseconds for 3 kV DC systems.

5.0 DRAWINGS AND INSTRUCTIONS

- 5.1 All drawings must use standard symbols as per CEE-TA-0062.
 - 5.2 Tenderers shall provide the following information at the time of tendering to enable a proper adjudication to be made. Failure to do so shall be indicated in the "Statement of Compliance" and may lead to rejection of the tender. Where feasible the information may be provided on the drawing:
 - 5.2.1 A detailed drawing showing insulation inserts, runners, arcing horns and suspension arrangements with all relevant dimensions and in particular deviation, if any, from a plane surface after installation. (See clause 6 for design requirements.)
 - 5.2.3 Details of insulating materials used. Resistance to Ultra-violet radiation shall be stated.
 - 5.2.4 Details and composition of metallic components used.
 - 5.2.5 Minimum distance to be allowed between section insulator and catenary.
 - 5.2.6 Details of adjusting height and level at rights angles, as well as longitudinal, to the track.
 - 5.2.7 Gross mass.
 - 5.2.8 Details of adjustment of arcing horns.
 - 5.2.9 Comprehensive instructions for installation and details of any special tools or equipment required.
 - 5.2.10 List of railway organisations and service conditions where the section insulator offered, is in successful use.
 - 5.2.11 Test certificates for tests called for in clause 7.2.
 - 5.3 Photocopies of original documentation shall be clearly legible.
-

6.0 DESIGN REQUIREMENTS

- 6.1 The section insulators shall be of durable design and shall be capable of carrying out their functions reliably under the service conditions stated. They shall be suitable for bi-directional traffic at speeds of up to 120 km/h.
- 6.2 The gross mass of the section insulator shall not exceed 21 kg. (The mass of support droppers and fittings excluded.)
- 6.3 The overall width of that part of the section insulator in contact with the pantograph shall not exceed 330 mm.
- 6.4 The section insulator shall be provided with suitable runners of either metal or insulating material such that a smooth continuous running surface is present for the passage of a pantograph,
- 6.5 The design shall be such that electrical contact between pantograph and the overhead system will under no circumstances be completely broken whilst being traversed by the pantograph. Designs incorporating a gap longitudinally across the section insulator (i.e. with in-line runners) the gap width shall not exceed 300 mm such that the gap can be bridged out by the pantograph. (See Appendix 1 for details of the pantograph).
- 6.6 Allowance shall be made in the design to ensure that no obstruction shall be formed to the passing pantograph should the section insulator fail to be set perfectly level in all planes with respect to the track.
- 6.7 The section insulator shall preferably present a perfectly plane running surface to the pantograph, when installed at the normal tension of 14.5 kN. If not perfectly plane, or if variations in tension can result in deviations from a perfect plane, the maximum allowable deviation shall be 6 mm at any point on the running surface, within the range of operating tensions quoted in clause 4.2.
- 6.8 All runners or parts in contact with the pantograph shall be of rigid design such that no part shall deflect by more than that specified in clause 6.7 whilst being subjected to the upward force of the pantograph of up to 90 N.
- 6.9 Arcing horns shall be provided and designed such to assist in extinguishing any arc. They shall also be placed such that the insulation used will not be damaged by the arcs drawn during operation and shall be of rigid design. The air-gap between arcing horns at different potential shall not be less than 150 mm. Each horn shall have a straight length above this air gap between 120 mm to 350 mm.
- 6.10 The main insulating material forming the insulation between the two circuits shall have a creepage length greater than 750 mm. It shall also be able to withstand abrasion resulting from the passage of pantographs (if applicable) as well as electric arcing and ultra-violet radiation.
- P.T.F.E. (Teflon) shall not be used if in direct contact with the pantograph.
- 6.11 Where composite insulators are used as main insulation the protective coating on the outside shall be bonded to the core such that no cavities are formed between the coating and the core. The protective coating shall be sealed at the ends to prevent the possibility of tracking along the insulator underneath the protective coating.
- Each insulator of this type shall be subjected to the water immersion test described in clause 7.3.
- 6.12 Clause 6.11 also applies to any other protection material provided to protect the insulation against arcing/flashover.
- 6.13 Supporting droppers shall (if provided) be insulated to prevent any arcing between the catenary wire and the droppers. The supporting droppers shall be adjustable either by means of turnbuckles or some other means of providing fine adjustments to its length. Droppers shall be protected by thimbles or similar means to prevent wear taking place at sharp edges.
- 6.14 Supporting droppers must be provided if the mass of the section insulator exceeds 5 kg or if its overall width is in excess of 75 mm.

- 6.15 All supporting droppers of material type stainless steel are to be used to prevent arcing between the catenary wire and the droppers.
- 6.16 Only non-corrosive materials shall be used in the construction of the section insulator. Brass may not be used.
- 6.17 Means of locking all bolts and screws shall be provided. All screw threads shall be of metal.

7.0 TESTS

7.1 GENERAL

- 7.1.1 The first section insulator shall be subjected to type tests as specified in clauses 7.2.
- 7.1.2 All main insulators of the composite type shall be subjected to the routine test as specified in clause 7.3.
- 7.1.3 A further five samples of the main insulator material shall be subjected to the type test as specified in clause 7.2.1.
- 7.1.4 The responsibility for arranging these tests shall rest with the tenderer although the Transnet Freight Rail reserves the right to perform such tests independently.
- 7.1.5 Transnet Freight Rail reserves the right to call for further type tests.
- 7.1.6 Transnet Freight Rail reserves the right to be present at all tests.

7.2 TYPE TESTS

- 7.2.1 The insulating material (if of synthetic type) shall be tested for resistance to tracking in accordance with the test method described in ASTM D 2303. The average time to track 13 mm for five samples shall not be less than 24 hours at a constant test voltage of 2 kV with a constant contaminating flow rate as prescribed in ASTM D 2303. The cabinet in which the tracking test is performed shall be open at the top in order to create sufficient ventilation, thus limiting the relative humidity inside the chamber to a value that will not give false results. The flow rate of the contaminant should be accomplished by a gravity feed from a large reservoir mounted at a sufficient height to obtain the desired flow rate.
- 7.2.2 Impulse and power frequency tests shall be carried out on a complete section insulator in accordance with SANS 60383-2.
- 7.2.3 Mechanical load tests shall be carried out to establish whether the section insulator can withstand the maximum tension called for in clause 4.2 at a safety factor as specified in clause 4.2.
- 7.3 Water immersion tests shall be carried out as follows: (Routine test)
 - 7.3.1 Immerse the sample in hot tap water (50 °C) and allow water to cool over 8 hours to approximately 20 °C.
 - 7.3.2 Repeat 7.3.1 nine times.
 - 7.3.3 After the 10th cycle, remove the sample from the water, wipe the surface dry with a paper towel and apply a DC test voltage of 25 kV/m length of insulator within 10 minutes. Measure the current after one minute on a DC ammeter with a resolution of 1 nA.
 - 7.3.4 Insulators conducting more than 100 nA have failed the test and must be rejected.

8.0 SPARES

8.1 Tenderers shall quote separately for the following spares:

8.1.1 Arcing horns

8.1.2 Main insulators

8.1.3 Metal runners (if not integrated with arcing horns)

8.2 The following information shall be made available for spares:

8.2.1 Complete ordering description

8.2.2 Name of manufacturer

8.2.3 Catalogue description number

8.2.4 Type and ordering number

9.0 TOOLS

9.1 Special tools for installation of the section insulators shall be quoted for separately, but it must be clearly stated in tender that tool is required for installation.

10.0 PACKING

10.1 Each section insulator shall be packaged individually complete with arcing horns, suspension fittings, etc.

11.0 WARRANTEE/ AFTER SALES SUPPORT

11.1 Tenders should give a warrantee on the workmanship of the manufactured items and provide a full disclosure of any warrantee conditions with the tender.

11.2 Tenderers should state the extent of after sales support provided by them.

11.3 Tenderers should provide a spare parts list with contact details with each item.

11.4 Lead times must be clearly indicated by tenderers.

END

Appendix 1

