



A division of Transnet limited

## TECHNOLOGY MANAGEMENT

### SPECIFICATION

## Bonding Specification for 3kV DC Traction Systems.

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1.0	<b>SCOPE</b>
1.1	This specification covers Spoornet's requirements for bonding methods and equipment to be applied to Spoornet 3kV DC electrified track systems.
2.0	<b>Background</b>
2.1	Spoornet electrification has three types of bonding covered by this specification, that is:
2.1.1	<b>Mast to rail bonds:</b> These bonds are installed between the rail and mast, to maintain mast to earth potential to a low value as possible.
2.1.2	<b>Continuity bonds:</b> These bonds are installed across the rail joints to maintain continuity for return current in traction rail.
2.1.3	<b>Cross bonds:</b> These bonds are installed between traction rails, where more than one track runs in parallel. Their main aim is to share the return current between the tracks. These bonds are normally installed at the end of a line, regular intervals and also provided at the traction substations to ensure that the current is evenly distributed between the tracks at the feed-in points.
2.2	In this specification, continuity bonds and cross bonds installation preparation and installation procedures are covered under rail bond installation preparation and rail bond installation clauses.
3.0	<b>STANDARDS AND PUBLICATIONS</b>
3.1	Unless otherwise specified all materials and equipment supplied shall comply with the applicable and latest editions of Spoornet publications.
3.2	The following publications are referred to in this specification:
3.2.1	<b>Specifications:</b>
	<b>British Standard:</b>
	BS. 1872 Sn. 12C – Specification for electroplated coatings of tin.
	<b>Spoornet Specifications:</b>
	BBB5985 – Supply of tools for attaching Du Buis expanded collar type fastenings to rails for electrification bonds.
	BBB6017 – Rail bond fasteners.
	BBB1679 – Portable equipment for earthing or earthing and short-circuiting for AC and DC traction, HV transmission lines and 3kV DC traction substation and tie-station busbars.

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3.2.2      **Spoornet Reports:**

BBB5608 – Replacement of copper bonds with steel equivalent.  
BBC0313 – Comparison test between Wam/Spoornet and Dubuis rail and mast fastener for mast to rail, continuous, etc. bonding.

3.2.3      **Spoornet Drawings:**

BBC1798 – Track bond positioning at turnouts for 3kV DC sections.  
CEE – TU – 72 – SHT 7 – Jumping when traction rail is to be replaced.  
CEE – TU – 120 – Connection of bonds to web of rail with ring grooved rivet.  
CEE – TNB – 58 – Terminal, Lug  
CEE – PP – 15 – Dies for crimping lug: For EI & P and traction use standard type, not insulated.

#### **4.0      TENDERING PROCEDURE**

4.1      Tenderers shall submit their main offers in terms of this specification.

4.2      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.

4.3      Tenderers shall provide Spoornet a history of bonding systems supplied or work done in the past.

4.4      Any items offered in accordance with other standards shall be considered at the sole discretion of Spoornet and approved by Technology Management. 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 with which it complies.

4.5      Failure to comply with clauses 4.1, 4.2, 4.3, and 4.4 could preclude a tender from consideration.

#### **5.0      SERVICE CONDITIONS**

5.1      The service climatic conditions are as follows:  
Altitude: 0 - 1 800 m above sea level  
Relative humidity: 10% to 90%  
Ambient temperature range: -5°C to +45 °C.  
Lightning conditions: 12 ground flashes per square kilometre per annum.  
Pollution: Normal, unless otherwise specified in particular locations.

## 6.0 TECHNICAL REQUIREMENTS

### 6.1 Material and Sizes

6.1.1 The material of the bond conductor to be installed shall be selected by the Depot Maintenance Manager for their specific section based on the level of theft in that particular area of installation.

Where the level of theft is high copper bonds shall not be used, where the level of theft is average copper magnesium composite bonds shall be used and where the level of theft is low copper bonds shall be used. Spoornet report BBB 5608 shall be used as a guideline on the type, size and quantity of bonds to be used.

6.1.2 Where a Copper bond is used, one 96mm<sup>2</sup> (on the main lines) or 50mm<sup>2</sup> (at the yards) bond cable shall be installed.

6.1.3 Where a Steel-Copper Composite is used, two 97mm<sup>2</sup> bond cables shall be installed.

6.1.4 Where a Steel is used, six 97mm<sup>2</sup> steel bond cables shall be installed.

6.1.5 Cembre, Du Buis or Wam/Spoornet fasteners shall be used. It is within the tenderer's discretion to select which fastener to apply.

6.1.6 The fastening system selected shall comply with Spoornet Specification BBB6017 – Rail Bond Fasteners.

6.1.7 For different positioning of bonds at turnouts, the tenderer shall refer to drawing BBC1798.

6.1.8 A 13.5 mm hole shall be drilled by trained personnel on the neutral axis of the rail web no closer than 310 mm from the end of the rail at the fish-plate rail joints.

6.1.9 The supply of tools required for affixing the expanded collar rail bond type fastening system and the associated bond termination shall be done in conjunction with the Spoornet specification BBB5985.

### 6.2 Bonding on all Types of Rails

6.2.1 All bonds shall be attached to the web of rail by means of an approved expanding collar bonding system.

6.2.2 Expanding collar bonding system:

6.2.2.1 This system involves drilling a 13.5 mm diameter hole on the neutral axis of the rail's web, inserting collar, the crimping of lugs onto ends of the bonding cable and the connection of the lugs to the rail using the prescribed system ensuring maximum contact pressure.

6.2.3 Lug description and crimping; drawing CEE-TNB-0058 shall be used:

6.2.3.1 Hole: After punching or drilling, burrs shall be removed.

6.2.3.2 Lug shall be completely tinned, sealing the edges marked seal to specification BS. 1872 Sn. 12C.

6.2.3.3 Surfaces shall be spaded flat.

6.2.3.4 Lug shall be crimped into hexagonal configuration by means of a hydraulic compression tool (drawing No. CEE – PP – 0015).

6.2.4 The stud for attaching the bond to the rail is standard as per the approved design, which allows for easy removal/re-installation of the bond during work on track. In areas where theft is a high risk, a Huckbolt as per drawing CEE-TU-0120 shall be used to secure the bond to the collar of the approved system.

### 6.3 **Different types of Bonding Systems and Bonding Installation Procedures**

An existing bond shall not be removed unless it has been bridged out by a portable jumper cable that complies with specification BBB1679 and in accordance with drawing CEE – TU – 72 – SHT 7.

#### 6.3.1 **Du Buis tapered rail and mast bonding system**

##### 6.3.1.1 **Rail bond:**

The Du Buis tapered rail bond consists of a tapered shank stainless steel bolt, washer/nut and a tapered stainless steel bush.

###### 6.3.1.1.1 **Installation Preparation:**

The web of rail shall be cleaned. All the dirt and rust on the area where the bond must be installed shall be removed. The size of the hole to be drilled shall be 13.5 mm in diameter as indicated in clause 6.2.2.1. Bonding cables shall be prepared as required.

#### 6.3.1.1.2 **Installation:**

The hole(s) shall be chamfered and cleaned. The rail bond shall be prepared and set into the drilled hole with a calibrated hydraulic tool. The nut shall be locked with a calibrated torque wrench. For back-to-back installation of two bonds, two short tapered shank bonds shall be installed back-to-back. The bond shall be packed with grease on both sides for extra protection against the impregnation of moisture.

#### 6.3.1.2 **Mast bond:**

The Du Buis tapered mast bond consists of a tapered shank stainless steel bolt, washer/nut and a tapered stainless steel bush.

##### 6.3.1.2.1 **Installation Preparation:**

The web of the mast shall be cleaned. All the dirt and rust on the area where the bond must be installed shall be removed.

The size of the hole to be drilled shall be 13.5 mm in diameter as indicated in clause 6.2.2.1. Bonding cables shall be prepared as required.

##### 6.3.1.2.2 **Installation:**

The hole(s) shall be chamfered and cleaned. The mast bond shall be prepared and set into the drilled hole with a calibrated hydraulic tool. The nut shall be locked with a calibrated torque wrench. The bond shall be packed with grease on both sides for extra protection against the impregnation of moisture.

#### 6.3.2 **Wam / Spoornet expandable rail and mast bonding system**

##### 6.3.2.1 **Rail bond:**

The Wam / Spoornet expandable rail bond consists of a stainless steel bolt and nut, two similar expandable collars, two stainless steel washers and an anti-vibration washer.

##### 6.3.2.1.1 **Installation Preparation:**

The web of rail shall be cleaned. All the dirt and rust on the area where the bond must be installed shall be removed. The size the hole to be drilled shall be 13.5 mm in diameter as indicated in clause 6.2.2.1. Bonding cables shall be prepared as required.

**6.3.2.1.2 Installation:**

The collars shall be inserted into the rail. The bolt containing the inside bond and washer shall be placed through the collars. A bond shall be placed on the outside of the rail with a flat anti-vibration washer. The nut shall be added and the system shall be torque to 85Nm as specified. The bond shall be packed on both sides with grease for extra protection against the impregnation of moisture. No Special tools are required for the application of these bonds.

**6.3.2.2 Mast bond:**

The Wam / Spoornet Expandable mast bond consists of a stainless steel bolt and nut, two similar expandable collars, two stainless steel washers and an anti-vibration washer.

**6.3.2.2.1 Installation Preparation:**

The web of mast shall be cleaned. All the dirt, paint and rust on the area where the bond must be installed shall be removed. The size of the hole to be drilled shall be 13.5 mm diameter as indicated in clause 6.2.2.1. Bonding cables shall be prepared as required.

**6.3.2.2.2 Installation:**

The collars shall be inserted into the mast. The bolt containing the inside bond and washer shall be placed through the collars. A bond shall be placed on the outside of the rail with a flat anti-vibration washer. The nut shall be added and the system shall be torqued to 85 Nm as specified. The bond shall be packed with grease on both sides for extra protection against the impregnation of moisture. No Special tools are required for the application of these bonds.

**6.3.3 Cembre rail bonding system****6.3.3.1 Rail bond:**

Cembre only consist of a Rail Bond system. No Mast bond system available. The Cembre electrical contact (bonding system) consists of a electrolytically cadmium-plated copper bush for a M10 screw, a high resistance M10 steel screw with a hollow hexagonal head, a flat steel washer and an auto-lock nut.

#### 6.3.3.1.1 **Installation Preparation:**

The web of rail shall be cleaned. All the dirt and rust on the area where the bond must be installed shall be removed. The size of the hole to be drilled shall be 13.5 mm in diameter as indicated in clause 6.2.2.1. Bonding cables shall be prepared as required. If the rail was already drilled, the surface of the shall be suitably reamed and a GO/NO GO gauge shall be inserted. The hole shall be used for successive operations only if the green part on the GO/NO GO gauge passes and the red part does not pass. If the green part does not pass, the hole shall be re-drilled with a 13.5 mm drill bit, but if the red part passes, the rail web shall be re-drilled in a different position.

#### 6.3.3.1.2 **Installation:**

The copper bush shall be inserted into the rail web hole. The calibrated plunger shall be inserted into the bush flange side, ensuring that the threaded end projects to the other side. The tool pressure discharge lever shall be depressed to ensure that the piston is fully retracted. The plunger shall be tightened by means of the relevant gauge in the threaded tool seating. The tool shall be actuated. In this way the calibrated plunger applies a tensile force passing through the bush hole thus shaping it, to ensure close contact with the rail. The bush excess projection from the hole ensures additional locking to the rail itself. The hollow hex head stud shall be inserted into the copper bush so that the thread projects from the bush flange side. The stud head will surround the projected part of the bush without touching it. The lug of the bond shall be inserted and located on the bush with the stud in the palm hole. The washer shall be inserted and the auto-lock nut shall be tightened.

### **7.0 INSPECTION AND TESTING**

- 7.1 Spoornet reserves the right to carry out inspection and tests on the equipment at the works of the supplier/manufacturer.
- 7.2 Arrangements must be made timeously for such inspections and type/routine tests in accordance with the equipment specifications carried out before delivery of the equipment to the site.
- 7.3 Type/routine test sheets of the equipment shall be forwarded to the Project Manager.