A Division of Transnet SOC Limited

TECHNOLOGY MANAGEMENT

SPECIFICATION

REQUIREMENTS FOR
ROOF BUSBAR AND BUSBAR CONNECTIONS FOR
3 KV DC, 25 KV AC, DUAL VOLTAGE (3 KV DC AND 25 KV AC) AND 50 KV AC LOCOMOTIVES

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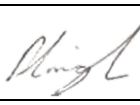
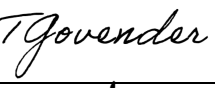
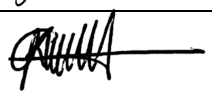
Author:	Chief Engineering Technician Technology Management	A Singh	
Author and Approved:	Senior Engineer Technology Management	T Govender	
Authorised:	Principal Engineer Technology Management	K Motupa	
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LIST OF AMENDMENTS TO THE SPECIFICATION

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1.0 SCOPE

1.1 This specification details Transnet's requirements for the roof busbar and busbar connections for 3 kV DC, 25 kV AC, dual voltage (3 kV DC and 25 kV AC) and 50 kV AC locomotives.

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

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

2.0 ABBREVIATIONS AND DEFINITIONS

Busbar	Rigid conductor intended for use as a common junction between a number of electrical circuits connected separately to it
Busbar connection	A conductor that forms the electrical connection between a busbar and an individual piece of apparatus that is within reasonable proximity
Tube	Hollow product of round or rectangular cross-section, with or without a longitudinal joint or seam, and supplied in straight lengths [SANS1195]
AC	Alternating Current
DC	Direct Current
SANS	South African National Standards
IEC	International Electrotechnical Commission
ISO	International Organization for Standardization
BS	British Standard
UV	Ultraviolet
ETP	Electrolytic Tough Pitch
TFR	Transnet Freight Rail
SANAS	South African National Accreditation System
QMS	Quality Management System
PDF	Portable Document Format

3.0 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.

3.1 IEC STANDARDS:

3.1.1 IEC 62271-1 High voltage switchgear and control gear part 1: Common specification

3.2 ISO STANDARD:

3.2.1 ISO 9001 Quality management systems – Requirements

3.3 SANS STANDARD:

3.3.1 SANS 121 Hot dip galvanized coatings on fabricated iron and steel articles – Specifications and test methods

3.3.2 SANS 1195 Busbars

3.4 BRITISH STANDARD:

3.4.1 BS EN 61373 Railway applications – Rolling stock equipment –shock and vibration tests.

3.5 TRANSNET SPECIFICATIONS/STANDARD/DRAWING

3.5.1 RT_TE_POL_0017 Rolling stock electrical safety instructions, Section 9 (Design)

4.0 SERVICE CONDITIONS

4.1 ENVIRONMENTAL CONDITIONS

Altitude:	0 – 1800 m above sea level
Relative humidity:	10% to 90%
Ambient temperature:	-5° C to +55° C
Wind pressure:	750 Pa
Lightning conditions:	20 ground flashes/km² per annum
Pollution:	Heavily salt laden with industrial pollutants (PD4)
	Including diesel – electric locomotive emissions.

4.2 MECHANICAL SERVICE CONDITIONS

4.2.1 The Busbar must be capable of withstanding the shock and vibration tests as per IEC 61373, Class A, for body mounted equipment.

4.2.2 The natural frequency of the busbar shall not be near 50 Hz or any of its multiples.

4.2.3 Insulating or coating material of the busbar shall be UV resistant and non-flammable.

4.2.4 The paint primer must be RAL 3012 (M red epoxy primer, dry film thickness: 60 - 200). The paint finish must be RAL 3020 (Traffic red acrylic polyurethane paint, dry film thickness: ≥40) with gloss ≥80/20º.

4.2.5 The paint coating must adhere to BN918-340.

4.2.6 The welding joints must comply with EN 15085.

5.0 TECHNICAL REQUIREMENTS

5.1 Electrical requirements

Table 1: Electrical design requirements

Requirement	3 kV DC	25 kV AC & Dual Voltage	50 kV AC
5.1.1 Highest permanent voltage	4.8 kV	30 kV	57.5 kV
5.1.2 Lightning impulse withstand	40 kV	170 kV	320 kV
5.1.3 Rated short-time withstand current	40 kA / 1 s		
5.1.4 Rated peak withstand current	100 kA		
5.1.5 The busbar and busbar connections must have a rated continuous current according to the power rating and voltage of the respective locomotive class.	Class 20E: 3000 kW, 3 kV DC (Minimum safety factor (Copper)**:** 70%) Class 21E: 3000 kW, 3 kV DC (Minimum safety factor (Copper)**:** 70%) Class 22E: 4500 kW, 3 kV DC (Minimum safety factor (Copper)**:** 14%)		

5.2 Copper busbar

5.2.1 The busbar maximum volume resistivity at 20 ˚C shall be 0.017774 μΩ·m in accordance with clause 4.1 of SANS1195.

5.2.2 The busbar material must be electrolytic tough pitch (ETP) high conductivity copper that complies with the requirements of SANS 804 in accordance with SANS1195.

5.2.3 The busbar condition of temper must be H2 in accordance with SANS1195.

5.2.4 The busbar must have a minimum tensile strength of 250Mpa in accordance with SANS1195.

5.3 Aluminium busbar

5.3.1 The busbar maximum volume resistivity at 20 ˚C shall be 0.028264 μΩ·m in accordance with clause 4.1 of SANS1195.

5.3.2 The busbar material must be aluminium of metal designation EN AW-EAI 99,5: numeric code No. EN AW 1350 in accordance with SANS1195.

5.3.3 The busbar condition of temper must be H2 in accordance with SANS1195.

5.3.4 The busbar must have a minimum tensile strength of 85Mpa in accordance with SANS1195.

5.3.5 The busbar mounting dimensions and shape shall be identical to that of a copper busbar, thereby ensuring interchangeability of the components.

5.4 General requirements for copper and aluminium busbar

5.4.1 The arc of curvature of a rounded edge shall be symmetrical in relation to the axis of the busbar, and the radius of the arc shall be approximately half the thickness of the bar.

5.4.2 Provision must be made to allow for expansion and contraction of the busbar and busbar connections caused by temperature variations.

5.4.3 The busbar and busbar connection must withstand wind, rain, snow, dirt deposits, condensation, ice and hoar frost.

5.4.4 Busbar and busbar connections including bolts, nuts, washers, etc., required to install the busbar on the roof of the locomotive must be supplied together with the busbar by the manufacturer.

5.4.5 All ferrous parts of the busbar connections (including bolts, nuts, washers, etc.) exposed to the atmosphere must be stainless steel or mild steel hot dip galvanized in accordance with specification SANS 121.

5.4.6 The quality of the busbar and busbar connections offered must be in accordance with ISO 9001. The tenderer shall provide documentation that shows compliance with ISO 9001 upon request.

5.4.7 The busbars shall be suitably marked with the following information:

Manufacturer’s name
Locomotive class
Serial number

5.4.8 The busbar and busbar connections must not have any sharp edges which could give rise to corona discharge.

Note 1: The supplier must confirm per order with Transnet Engineering whether copper busbars or aluminium busbars must be supplied.

Note 2: The supplier must confirm per order with Transnet Engineering the dimension and shape of the busbar and quantity that must be supplied.

6.0 TESTING AND INSPECTIONS

6.1 Transnet reserves the right to be present at all tests and inspections called for in SANS 121, SANS 1195 and BS EN 61373 that verifies the clauses in this specification.

6.2 The responsibility of arranging the tests called for in this specification rests with the successful tenderer.

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

7.0 DOCUMENTATION REQUIREMENTS

7.1 Drawings and documents shall be written in English.

7.2 All units indicated in the documentation shall be in metric system.

7.3 The file containing documents and drawings should be numbered for easy identification and reference purposes.

7.4 The following technical documents shall be submitted with tender:

7.4.1 Completed technical datasheet (Appendix B).

7.4.2 Type test certificates from a SANAS/international accredited laboratory to verify conformance with the requirements.

7.4.3 ISO 9001 certificate.

7.4.4 One PDF and one hard copy of the technical specification of the busbar offered.

7.4.5 One PDF and one hard copy of relevant drawings of the busbar. Where the tenderer doesn't have the ability to create drawings, the tenderer can submit a stamped version of the Transnet drawing.

7.4.6 Manuals and catalogues if available

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 Each busbar must be packed in a suitable crate/container to withstand handling stresses during transportation.

9.2 The crate/container of the busbar must be marked with manufacturer's name, mass of the busbar and handling instructions.

10.0 GUARANTEES AND DEFECTS

10.1 The successful tenderer shall accept liability for makers' defects, which may appear in design, material and workmanship.

10.2 The successful tenderer shall provide all information regarding guarantees and warranties in writing.

11.0 TECHNICAL COMPLIANCE

11.1 Tenderer(s) 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 Tenderer(s) shall submit all technical documents called for in the specification.

11.4 Any items offered in accordance with other standards will be considered at the sole discretion of Transnet. The tenderer(s) 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 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.

END

APPENDIX A: SCHEDULE OF REQUIREMENTS

(To be completed by Transnet Representative)

1	Name of depot / Department	
2	Quantity	
4	Special requirements	…… …… …… …… …… …… …… ……

Completed by:	
Capacity:	
Signature:	
Date:	

"I acknowledge that this document contains personal information as defined in the Protection of Personal Information Act, 2013 (the "Act"). By accessing/using this document, I consent to the processing of personal information in accordance with the requirements of the Act. Personal information contained herein will only be used for purposes of this document."

APPENDIX B: TECHNICAL DATA SHEET

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

a) Supplier:

b) Manufacture's trade name:

Clause	Technical specifications and Requirements	Value	Proof required
4.2.1	The Busbar must be capable of withstanding the shock and vibration tests given by IEC 61373, Class A, for body mounted equipment.	g	Type test certificate
4.2.2	The natural frequency of the busbar shall not be near 50 Hz or any of its multiples.		Type test certificate
4.2.3	Insulating or coating material of the busbar shall be UV resistant and non-flammable.		Datasheet
4.2.4	The paint primer must be RAL 3012 (M red epoxy primer, dry film thickness: 60 - 200). The paint finish must be RAL 3020 (Traffic red acrylic polyurethane paint, dry film thickness: ≥40) with gloss ≥80/20º.		Datasheet
4.2.5	The paint coating must adhere to BN918-340.		Datasheet
4.2.6	The welding joints must comply with EN 15085.		Type test certificate
5.1.1	Highest permanent voltage	kV	Type test certificate
5.1.2	Lightning impulse withstand	kV	Type test certificate
5.1.3	Rated short-time withstand current	kA/s	Type test certificate
5.1.4	Rated peak withstand current	kA	Type test certificate
5.1.5	Busbar and busbar connections rated continuous current	kA	Type test certificate
5.2.1	For Copper: The busbar maximum volume resistivity at 20 ˚C shall be 0.017774 μΩ·m in accordance with clause 4.1 of SANS1195.	μΩ·m	Type test certificate
5.2.2	The busbar material must be electrolytic tough pitch (ETP) high conductivity copper that complies with the requirements of SANS 804 in accordance with SANS1195.		Datasheet
5.2.3	The busbar condition of temper must be H2 in accordance with SANS1195.		Datasheet
5.2.4	The busbar must have a minimum tensile strength of 250MPa in accordance with SANS1195.	MPa	Type test certificate
5.3.1	For Aluminium: The busbar maximum volume resistivity at 20 ˚C shall be 0.028264 μΩ·m in accordance with clause 4.1 of SANS1195.	μΩ·m	Type test certificate

5.3.2	The busbar material must be aluminium of metal designation EN AW-EAI 99,5: numeric code No. EN AW 1350 in accordance with SANS1195.		Datasheet
5.3.3	The busbar condition of temper must be H2 in accordance with SANS1195.		Datasheet
5.3.4	The busbar must have a minimum tensile strength of 85MPa in accordance with SANS1195.		Type test certificate
5.3.5	The busbar mounting dimensions and shape shall be identical to that of a copper busbar, thereby ensuring interchangeability of the components.		Drawing
5.4.1	The arc of curvature of a rounded edge shall be symmetrical in relation to the axis of the busbar, and the radius of the arc shall be approximately half the thickness of the bar.		Drawing
5.4.2	Provision must be made to allow for expansion and contraction of the busbar and busbar connections caused by temperature variations.		Drawing
5.4.3	The busbar and busbar connection must withstand wind, rain, snow, dirt deposits, condensation, ice and hoar frost.		Datasheet
5.4.4	Busbar and busbar connections including bolts, nuts, washers, etc., required to install the busbar on the roof of the locomotive must be supplied together with the busbar by the manufacturer.		Datasheet
5.4.5	All ferrous parts of the busbar connections (including bolts, nuts, washers, etc.) exposed to the atmosphere must be stainless steel or mild steel hot dip galvanised in accordance with specification SANS 121.		Datasheet
5.4.6	The quality of the busbar and busbar connections offered must be in accordance with ISO 9001. The tenderer shall provide documentation that shows compliance with ISO 9001 upon request.		Documentation
5.4.7	The busbars shall be suitably marked with the following information: Manufacturer's name, Locomotive class, Serial number		Declare
5.4.8	The busbar and busbar connections must not have any sharp edges which could give rise to corona discharge. Note 1: The supplier must confirm per order with Transnet Engineering whether copper busbars or aluminium busbars must be supplied. Note 2: The supplier must confirm per order with Transnet Engineering the dimension and shape of the busbar and quantity that must be supplied.		Drawing Declare Declare
Completed by:			
Capacity:			
Signature:			
Date:			
