



A Division of Transnet SOC Limited

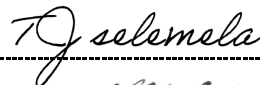
TECHNOLOGY MANAGEMENT

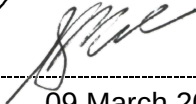
SPECIFICATION

REQUIREMENTS FOR METAL OXIDE SURGE ARRESTERS WITHOUT GAPS FOR TRACTION AND DISTRIBUTION SUBSTATIONS

Author: Engineer
Technology Management T J Selemela

Authorised: Principal Engineer (Acting)
Technology Management S Smit





Date: 09 March 2022

Circulation Restricted To:

Transnet and Relevant Third Parties

"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."

© This document as a whole is protected by copyright. The information herein is the sole property of Transnet SOC Ltd. It may not be used, disclosed or reproduced in part or in whole in any manner whatsoever, except with the written permission of and in a manner permitted by the proprietors.

LIST OF AMENDMENTS TO THE SPECIFICATION

Version No.	Date Issued	Clause No.	Page No.	Remarks
04	21/09/2009	-	-	Original edition
05	07/09/2020			Title amended
				Additional SANS standards
				Service conditions amended
				Added energy absorption and charge transfer to the operating duty of surge arrester
				Changed arrester classification and added minimum creepage and minimum thermal energy rating
				Added arrester housing requirements
				Added end fittings requirements
				Added surge counter and leakage current meter requirements
				Added inspection and tests requirements
				Added marking requirements of arrester
				Added packaging and storage requirements
				Added documentation requirements
				Added quality assurance requirements
				Added statement on guarantee and defects
				Added schedule of requirements (Appendix A)
				Added technical datasheet (Appendix B)
06	09/03/2022			Added POPI Act disclaimer statement
				Amended document requirements clauses
				Amended Appendix B
				Method of tendering changed to technical compliance

TABLE OF CONTENTS

1.0	SCOPE.....	4
2.0	NORMATIVE REFERENCES	4
2.1	SANS	4
3.0	SERVICE CONDITIONS	4
3.1	ENVIRONMENTAL CONDITIONS.....	4
3.2	MECHANICAL SERVICE CONDITIONS	5
3.3	ELECTRICAL SERVICE CONDITIONS.....	5
4.0	ARRESTER OPERATING DUTY.....	5
5.0	TECHNICAL REQUIREMENTS.....	6
5.1	INSULATION LEVEL	6
5.2	SCHEDULE OF RATING OF SURGE ARRESTER	7
5.3	SURGE ARRESTER HOUSING REQUIREMENTS.....	8
5.4	END FITTINGS REQUIREMENTS	8
5.5	ADDITIONAL EQUIPMENT REQUIREMENTS.....	8
6.0	TESTING AND INSPECTIONS	9
7.0	MARKING OF THE SURGE ARRESTER	9
8.0	PACKAGING AND STORAGE OF SURGE ARRESTERS.....	9
9.0	DOCUMENTATION REQUIREMENTS.....	9
10.0	QUALITY ASSURANCE	10
11.0	GUARANTEE AND DEFECTS	10
12.0	TECHNICAL COMPLIANCE.....	10
	APPENDIX A: SCHEDULE OF REQUIREMENTS.....	11
	APPENDIX B: TECHNICAL DATA SHEET	12

1.0 SCOPE

- 1.1 This specification covers Transnet's requirements for the supply of gapless metal oxide surge arrester of the station class to be installed in Transnet's traction and distribution substations.
- 1.2 This specification contains schedule of requirements (Appendix A) which must be completed by the relevant Transnet Representative.
- 1.3 This specification contains technical datasheet (Appendix B) which must be completed by the tenderer and must 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 South African National Standards (SANS) and Transnet publications.

2.1 SANS

- 2.1.1 SANS 121 Hot dip galvanized coatings on fabricated iron and steel articles - Specifications and test methods
- 2.1.2 SANS 936 Spheroidal graphite iron castings
- 2.1.3 SANS 1019 Standard voltages, currents and insulation levels for electricity supply
- 2.1.4 SANS 2230 Rubber products: Guidelines for storage
- 2.1.5 SANS 9001 Quality management systems – Requirements
- 2.1.6 SANS 60099-4 Surge arresters Part 4: Metal-oxide surge arresters without gaps for AC systems
- 2.1.7 SANS 60815-1 Selection and dimensioning of high-voltage insulators intended for use in polluted conations Part 1: Definitions, information and general principles
- 2.1.8 SANS 60815-3 Selection and dimensioning of high-voltage insulators intended for use in polluted conations Part 3: Polymer insulators for AC systems

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 MECHANICAL SERVICE CONDITIONS

- 3.2.1 The surge arrester shall be mounted on a steel structure and shall be exposed to intermittent vibration due to passing trains.

3.3 ELECTRICAL SERVICE CONDITIONS

- 3.3.1 Nominal system frequency is 50 Hz.
- 3.3.2 Maximum duration of the earth fault is less than 1 second.
- 3.3.3 Transnet Freight Rail's traction and distribution substations are considered to be effectively earthed.
- 3.3.4 The nominal supply voltages from power utility to the traction and distribution substations are 22 kV, 33 kV, 44 kV, 66 kV, 88 kV, 132 kV, and 220 kV.
- 3.3.5 The surge arresters will be connected vertically between phase and earth.

4.0 ARRESTER OPERATING DUTY

- 4.1 Arresters shall be able to absorb energy from switching events or transfer charge from lightning events and subsequently thermally recover under applied temporary overvoltage and following continuous operating voltage conditions as stated in SANS 60099-4, clause 6.11.
- 4.2 The following equipment shall be protected by the surge arrester
- 4.2.1 Traction and distribution power transformers
 - 4.2.1 Current Transformers
 - 4.2.2 Circuit breakers
 - 4.2.3 Auxiliary transformer
 - 4.2.4 Voltage transformer
 - 4.2.5 Rectifiers

5.0 TECHNICAL REQUIREMENTS

The surge arresters shall be single column (series stack) and shall comply with the following technical requirements:

5.1 INSULATION LEVEL

- 5.1.1 The recommended insulation level in accordance with SANS 1019 is indicated in Table1 for medium and high voltage electrical systems.

Table 1 Standard voltages and insulation levels

Highest phase-to-phase RMS voltage for equipment (Um)	Nominal system RMS voltage (Un)	Rated lightning impulse withstand voltage peak	Rated short duration power frequency withstand r.m.s voltage
24 kV	22 kV	150kV	50 kV
36 kV	33 kV	200 kV	70 kV
52 kV	44 kV	250 kV	95 kV
72,5 kV	66 kV	350 kV	140 kV
100 kV	88kV	380 kV	150 kV
145 kV	132 kV	550 kV	230 kV
245 kV	220 kV	850 kV	360 kV
Insulation levels for highest voltage for equipment $U_m < 100$ kV are based on an earth fault factor equal to $\sqrt{3}$ and for $U_m > 100$ kV an earth fault factor equal to $0,8\sqrt{3}$.			

5.2 SCHEDULE OF RATING OF SURGE ARRESTER

Table 2 indicates schedule of ratings of surge arresters for effectively earthed systems in accordance with SANS 60099-4 employed for protection of electrical equipment mentioned in section 4.2. Deviations from the table are permissible subject to approval from Technology Management (Electrical Technology) in writing.

Table 2 Surge arrester schedule of rating

	Nominal system r.m.s. voltage (Us)	22 kV	33 kV	44 kV	66 kV	88 kV (All areas)*	88 kV (Between Antra and Moolman)	132 kV	220 kV
5.2.1	Rated voltage of surge arrester (Ur)	21 kV	36 kV	42 kV	60 kV	84 kV	96 kV	120 kV	204 kV
5.2.2	Continuous operating voltage of surge arrester (Uc)	17 kV	26 kV	34 kV	48 kV	67 kV	77 kV	96 kV	163 kV
5.2.3	Nominal discharge current (8/20 μ s)	10 kA	10 kA	10 kA	10 kA	10 kA	20 kA	10 kA	10 kA
5.2.4	High current (4/10 μ s)	100 kA	100 kA	100 kA	100 kA	100 kA	100 kA	100 kA	100 kA
5.2.5	Pressure relieve capability (0.2s)	40 kA	40 kA	40 kA	40 kA	40 kA	40 kA	40 kA	40 kA
5.2.6	Arrester designation	SM	SM	SM	SM	SM	SH	SM	SM
5.2.7	Minimum Repetitive charge transfer rating (Qrs)	1.6 Q	1.6 Q	1.6 Q	1.6 Q	1.6 Q	2.4 Q	1.6 Q	1.6 Q
5.2.8	Minimum thermal energy rating (Wth), in kJ/kV of Ur	7	7	7	7	7	10	7	7
5.2.9	Rated short circuit current	100 kA	100 kA	100 kA	100 kA	100 kA	100 kA	100 kA	100 kA
5.2.10	Minimum creepage distance (mm), Site pollution severity class e (Very heavy) in accordance with SANS 60815-1	744	1116	1488	2248	3100	3100	4495	7595

* All areas except for the section between Antra and Moolman substations in the coal line

5.3 SURGE ARRESTER HOUSING REQUIREMENTS

- 5.3.1 The arrester shall be designed such that the housing is able to adequately withstand surges during conduction of lightning and switching impulse currents and during anticipated maximum power frequency overvoltage as stated in clause 6.1 of SANS 60099-4.
- 5.3.2 The surge arrester housing shall be made of polymeric insulation and profiles to be designed in accordance with the requirements in SANS 60815-3. An epoxy resin will NOT be considered to be acceptable as an arrester housing material.
- 5.3.3 The housing shall be designed to suite application and meet specified minimum creepage distance as per Table 2.
- 5.3.4 The sheds shall be stabilized against the effects of ultraviolet, other solar radiation and against the effects of airborne contaminants.
- 5.3.5 The preferred colour for the shed material is grey.

5.4 END FITTINGS REQUIREMENTS

- 5.4.1 The end fittings shall preferably be made of spheroidal graphite cast iron to grade SG 50 in accordance with SANS 936. Alternatively, stainless steel material can be used on request and subject to Technology Management formal approval.
- 5.4.2 The metal fittings and associated locking devices shall be hot-dip galvanized in accordance with SANS 121. The galvanized surface shall be smooth.
- 5.4.3 End fittings of the surge arresters shall be permanently protected from moisture ingress with a flexible and weather-resistant sealant.

5.5 ADDITIONAL EQUIPMENT REQUIREMENTS

- 5.5.1 Each surge arrester installed in substations between Antra to Moolman must be fitted with a surge counter and a leakage current meter. However, in other sections it is optional as per schedule of requirements.
- 5.5.2 Surge counter and leakage current meter shall be in weather-proof enclosures suitable for mounting on structure of lightning arrester.
- 5.5.3 Insulating base shall be provided for the connection of surge counter and leakage current meter.
- 5.5.4 Relevant Transnet Representative should indicate the requirement for a surge counter and a leakage current meter as per schedule of requirements.

6.0 TESTING AND INSPECTIONS

- 6.1 Transnet reserves the right to be present at all tests and inspections as called for in this clause.
- 6.2 The responsibility of arranging the tests called for in this clause rests with the successful tenderer.
- 6.3 A Transnet Freight Rail, Technology Management (Electrical Technology) department representative may request any additional test deemed necessary to ensure compliance.
- 6.4 The surge arrester shall be subjected to type and routine tests in accordance with SANS 60099-4.
- 6.5 The insulating base and mounting brackets shall be tested separately in accordance with SANS 60099-4.

7.0 MARKING OF THE SURGE ARRESTER

- 7.1 Each surge arrester shall be clearly and permanently marked with the following information:
 - 7.1.1 Designation of surge arrester
 - 7.1.2 Continuous operating voltage
 - 7.1.3 Rated voltage
 - 7.1.4 Rated short circuit current
 - 7.1.5 Name or trademark of the manufacturer
 - 7.1.6 The year of manufacture
 - 7.1.7 Serial number or similar means of production identification

8.0 PACKAGING AND STORAGE OF SURGE ARRESTERS

- 8.1 The packaging and storage of the surge arresters shall comply with SANS 2230.
- 8.2 No part should be tied or tagged in such a way as to cause damage on the sheds of the arrester.
- 8.3 Installation, storage and transportation instructions must accompany each packaging.

9.0 DOCUMENTATION REQUIREMENTS

- 9.1 Drawings and documents shall be written in English.
- 9.2 All units indicated in the documentation shall be in metric system.
- 9.3 TFR reserves the right to require any additional information: manuals, catalogues, drawings, etc. that may contribute to complete information supplied by the manufacturer.
- 9.4 The following documents shall be submitted with tender:
 - 9.4.1 Surge arrester technical datasheet and drawing.
 - 9.4.2 Completed Appendix B.
- 9.5 The following technical documents shall be submitted by the successful tenderer.
 - 9.5.1 The method of installation of the complete surge arrester.
 - 9.5.2 The type test certificates.

10.0 QUALITY ASSURANCE

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

11.0 GUARANTEE AND DEFECTS

- 11.1 The appointed tenderer shall accept liability for makers' defects, which may appear in design, material and workmanship.
- 11.2 The appointed tenderer shall provide all information regarding guarantees and warranties in writing.

12.0 TECHNICAL COMPLIANCE

- 12.1 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.
- 12.2 Statement of non-compliance shall be motivated by the tenderer, as per 12.1.
- 12.3 Tenderer(s) shall submit all technical documents called for in the specification.
- 12.4 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.
- 12.5 Failure to comply with clauses 12.1, 12.2, 12.3 and 12.4 could preclude a tenderer from consideration.
- 12.6 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 the Depot	
2.	Substation between Antra and Moolman? (Yes/No)	
3.	System voltage	
4.	Quantity	
5.	Surge counter required? (Yes/No)	
6.	Earth leakage current meter required? (Yes/No)	
7.	End fittings material (Cast iron/ Stainless steel)	
8.	Special requirements	

Completed by:	
Capacity	
Signature	
Date	

APPENDIX B: TECHNICAL DATASHEET

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

1.0	Surge arrester identification		
1.1	Supplier		
1.2	Manufacturer name		
2.0	Electrical characteristics of arrester		
2.1	Arrester classification		
2.2	Arrester designation		
2.3	Nominal discharge current (8/20 μ s)		kA
2.4	Arrester rated voltage (U_r)		kV
2.5	Continuous operating voltage (U_c)		kV
2.6	Thermal energy rating (W_{th})		kJ/kV
2.7	Repetitive charge transfer rating (Q_{rs})		Q
2.8	Creepage distance		mm
2.9	Reference voltage		kV
2.10	Reference current		kA
2.11	Rated frequency		Hz
3.0	Arrester minimum temporary overvoltage withstand capability, with prior duty		
3.1	Minimum TOV applied for 1 s		kV
3.2	Minimum TOV applied for 10 s		kV
4.0	Mechanical Properties		
4.1	Specified long-term load (SLL) kN		
4.2	Specified short-term load (SSL) kN		
5.0	Arrester mounting		
5.1	Orientation		
5.2	Overall height of arrester		
6.0	Miscellaneous		
6.1	Housing material		
6.2	Color of housing		
6.3	Total mass of assembled unit		kg
6.4	Minimum expected life of arrester at standard conditions		Years