



TRANSNET ENGINEERING TECHNICAL SPECIFICATION

For

20E, 21E, and 22E PCC Charge and Discharge Resistor Specification

Date of release

06 February 2024

RD_RD_KDS_SPEC_0090

Revision 2

The information contained herein is the sole property of Transnet Engineering. It may not be used, disclosed or reproduced in part or in whole in any manner, except with the written permission of and in a manner permitted by the proprietors.

Document Name: 20E, 21E, and 22E PCC Charge and Discharge Resistor Specification	Doc. No.: RD_RD_KDS_SPEC_0090
Classification: Restricted – Technical Specification Document	Revision: 2
Date: 06 February 2024	Page 1 of 18

Summary of Revision

First Issue: October 2021

Document No.: RD_RD_KDS_SPEC _0090

The following changes have been made in these revisions:

Rev	Description	Author	Date
0	Initial Release	Nhlanhla Mackenzie	October 2021
1	Amended section 4.4 and section 5.1	Nhlanhla Mackenzie	September 2022
2	Amended section 4, added sections 13 and 14	Nhlanhla Mackenzie	February 2024

Document Name: 20E, 21E, and 22E PCC Charge and Discharge Resistor Specification	Doc. No.: RD_RD_KDS_SPEC _0090
Classification: Restricted – Technical Specification Document	Revision: 2
Date: 06 February 2024	Page 2 of 18

Symbols and Abbreviations

TE	Transnet Engineering
TFR	Transnet Freight Rail
PCC	Transnet Freight Rail
EN	Power Conversion Cubicle
IEC	European Standard
ISO	International Electrotechnical Commission
TBD	International Organization for Standardization

Document Name: 20E, 21E, and 22E PCC Charge and Discharge Resistor Specification	Doc. No.: RD_RD_KDS_SPEC_0090
Classification: Restricted – Technical Specification Document	Revision: 2
Date: 06 February 2024	Page 3 of 18

TABLE OF CONTENTS

1. BACKGROUND AND INTRODUCTION.....	5
2. DOCUMENT SCOPE.....	5
3. APPICABLE STANDARDS.....	5
4. RESPONSE TO TECHINICAL SPECIFICATION	5
4.1. General.....	5
4.2. Bidder's Technical Response	6
4.3. Alternatives Offered.....	7
4.4. Quotation Requirements	8
5. SCOPE OF GOODS AND SERVICES	10
5.1. General.....	10
6. TECHNICAL SPECIFICATION.....	11
6.1. General.....	11
6.2. Environment Requirement	12
6.3. Charging Resistor	12
6.4. Discharging Resistor	13
7. CHARGING/DISCHARGING RESISTOR DIMENSIONS	14
8. CLARIFICATION	15
9. TYPE TEST	15
10. IN-SERVICE EVALUATION	15
11. PROJECT TIMELINES	16
12. QUALITY ASSURANCE	16
13. Data Pack and training	16
14. Maintenance Support	16
15. Warranty	16
16. STANDARDS ADHERENCE.....	17

Document Name: 20E, 21E, and 22E PCC Charge and Discharge Resistor Specification	Doc. No.: RD_RD_KDS_SPEC _0090
Classification: Restricted – Technical Specification Document	Revision: 2
Date: 06 February 2024	Page 4 of 18

1. BACKGROUND AND INTRODUCTION

Transnet Engineering (TE) is an Engineering, Manufacturing and Maintenance organisation specialising in Rail Rolling stock and Port Equipment. Over the years, Transnet took delivery of a new generation of electrical locomotives that are now due for maintenance. One of the components to be replaced is the charge and discharge resistors. These resistors are used to charge and discharge the capacitors found in the PCC of the 20E, 21E and 22E class locomotives.

2. DOCUMENT SCOPE

- 2.1. This Technical Specification is for the supply of resistors for the Class 20E, 21E and 22E locomotive.
- 2.2. The specification states the minimum requirements relating to the required service of supplying resistors for the Class 20E, 21E and 22E locomotive, and in no way absolves the supplier from additional duties of ensuring the supplied resistors are suitable for the mentioned locomotives.
- 2.3. For clarity, when used in the context of this document the entities listed below shall have the following meanings:
 - 2.3.1. Resistor(s) – Refers to following resistors for the class 20E, 21E and 22E:
 - 2.3.1.1. Charging resistor
 - 2.3.1.2. Discharging resistor
 - 2.3.2. Resistor assembly – Refers to the following resistor rack with its resistors for the 20E, 21E and 22E:
 - 2.3.2.1. Charging resistor assembly
 - 2.3.2.2. Discharging resistor assembly
 - 2.3.3. Respondent – the person/organisation tendering along with others for the supply of the Goods/Services.
 - 2.3.4. Successful Bidder – the person/organisation who after submitting the tender response, has successfully passed the evaluation and has been awarded the business, thereafter, referred to as the Supplier.

3. APPICABLE STANDARDS

The respondent shall adhere to the standards that are identified in this document, should the respondent be the successful bidder. The respondent must also provide a list of standards and applicable clauses that they have adhered to other than those mentioned in this specification document, which address the requirements of the requested standards. Refer to section 14 for a comprehensive list of SANS, IEC, EN and Transnet standards to be adhered to.

4. RESPONSE TO TECHNICAL SPECIFICATION

4.1. General

The Respondent must adhere to all the requirements included in this document. Failure to adhere to these requirements may result in the disqualification of the Respondent's submission, subject to the decision of the adjudication panel.

Document Name: 20E, 21E, and 22E PCC Charge and Discharge Resistor Specification	Doc. No.: RD_RD_KDS_SPEC_0090
Classification: Restricted – Technical Specification Document	Revision: 2
Date: 06 February 2024	Page 5 of 18

Transnet reserves the right to disqualify any Respondent should its submission not adhere to all the requirements specified in this document.

4.2. Bidder's Technical Response

- 4.2.1. Respondents shall provide a clause-by-clause response to this Technical Specification. Failure to comply with this requirement may result in the disqualification of a Respondent.
- 4.2.2. The responses shall therefore contain a clause-by-clause response for each clause in this document, containing at least one of the following answers:
 - FULLY COMPLIANT: When the current solution complies already.
 - PARTIAL COMPLIANT: In case of partial compliance by the bidder.
 - NOT COMPLIANT: To state that the clause is not met currently and not an option at all.
- 4.2.3. The Respondent must supply an outline proposal of the design, and/or datasheets along with corresponding test results if an existing Unit is quoted. This includes comprehensive information on performance and efficiency.
- 4.2.4. Respondents shall provide drawings, diagrams, and additional literature to clearly describe the operation of the proposed system and highlight any noteworthy features.
- 4.2.5. There shall be an optional tender briefing to provide every bidder an opportunity to come view and assess the correct measurements and configuration for the resistors before, responding to the technical specification and making the tender submission.

Table 1: Technical Documentation Checklist

Information Description	Content	Bidder Checklist
Cover letter	Contains information on: - Warranty	
Detailed Technical Offering	Evidence for the responses given in Section 4.3 - 13 . (Please be very detailed in the information provided)	
List of Documents Supplied	List of technical documents, data sheets and other documents supplied as part of the offering.	
Previous Experience information	- Contact information of relevant reference where a similar type of product was supplied, - List of relevant projects and detail, - Company brochure, - OEM authorization letters.	
Technical Documentation	Filled in, signed and stamped Technical Specification Document.	

Document Name: 20E, 21E, and 22E PCC Charge and Discharge Resistor Specification	Doc. No.: RD_RD_KDS_SPEC_0090
Classification: Restricted – Technical Specification Document	Revision: 2
Date: 06 February 2024	Page 6 of 18

4.3. Alternatives Offered

- 4.3.1. In addition to offers which in the first instance comply with the requirements set forth in this Specification, Respondents may also offer, as alternatives, variations of detail that they consider might be advantageous and acceptable to TE.
- 4.3.2. The respondent may also offer additions to the scope, either being requested or of their own accord. The final decision on the addition's rests upon TE.
- 4.3.3. This will include existing approved units or Commercial Off-The-Shelf (COTS) that is already in used for railway locomotive system application. In all instances where alternatives are offered for consideration, the following information shall be furnished:
 - Type test report.
 - All relevant technical information (datasheet, previous application used, etc.)
 - Provide samples for viewing, static testing, and test fitting.

Document Name: 20E, 21E, and 22E PCC Charge and Discharge Resistor Specification	Doc. No.: RD_RD_KDS_SPEC_0090
Classification: Restricted – Technical Specification Document	Revision: 2
Date: 06 February 2024	Page 7 of 18

4.4. Quotation Requirements

4.4.1. TE requires that the price breakdown be made available in at least the following detail:

- Prototyping or development cost (if applicable).
- Prototype resistor assembly unit.
- Pre-production resistor assembly unit.
- Installation and maintenance cost (if applicable).

4.4.2. The quantities for the prototype and pre-production unit are as follow:

Table 2: 20E and 21E resistor band assembly and quantity.

	20E and 21E resistor type	Number of resistors per assembly	Unit resistors on the rack (Labelling)	Resistance Ω	QTY of resistor assembly
Prototype	Charge Resistor Assembly	6	R1A	65	2
			R1B	65	
			R2A	65	
			R2B	65	
			R3A	65	
			R3B	65	
	Discharge Resistor Assembly	5	R4A	30K	2
			R4B	30K	
			R5A	30K	
			R5B	30K	
			R5C	30K	
Preproduction	Charge Resistor Assembly	6	R1A	65	4
			R1B	65	
			R2A	65	
			R2B	65	
			R3A	65	
			R3B	65	
	Discharge Resistor Assembly	5	R4A	30K	4
			R4B	30K	
			R5A	30K	
			R5B	30K	
			R5C	30K	

Document Name: 20E, 21E, and 22E PCC Charge and Discharge Resistor Specification	Doc. No.: RD_RD_KDS_SPEC_0090
Classification: Restricted – Technical Specification Document	Revision: 2
Date: 06 February 2024	Page 8 of 18

Table 3: 22E resistor band assembly and quantity.

	22E resistor type	Number of resistors per assembly	Unit resistors on the rack (labelling)	Resistance Ω	QTY of resistor assembly
Prototype	Charge Resistor Assembly 1	6	R1A	65	1
			R1B	65	
			R1C	65	
			R2A	65	
			R2B	65	
			R2C	65	
	Charge Resistor Assembly 2	3	R3A	65	1
			R3B	65	
			R3C	65	
	Discharge Resistor Assembly	5	R4A	30K	1
			R4B	30K	
			R5A	30K	
			R5B	30K	
			R5C	30K	
Preproduction	Charge Resistor Assembly 1	6	R1A	65	2
			R1B	65	
			R1C	65	
			R2A	65	
			R2B	65	
			R2C	65	
	Charge Resistor Assembly 2	3	R3A	65	2
			R3B	65	
			R3C	65	
	Discharge Resistor Assembly	5	R4A	30K	2
			R4B	30K	
			R5A	30K	
			R5B	30K	
			R5C	30K	

Document Name: 20E, 21E, and 22E PCC Charge and Discharge Resistor Specification	Doc. No.: RD_RD_KDS_SPEC_0090
Classification: Restricted – Technical Specification Document	Revision: 2
Date: 06 February 2024	Page 9 of 18

5. SCOPE OF GOODS AND SERVICES

5.1. General

- 5.1.1. The successful bidder shall supply the following Resistors assembly rack, for the class 20E, 21E and 22E locomotive.
- 5.1.1.1. Discharging resistor assembly: The successful bidder shall provide the discharge resistor assembly that will be made up of five resistors R4A, R4B, R5A, R5B, and R5C with 30K ohms each on the same mounting rack. The constructed rack must fit within the dimensions of the designated area for the discharging resistor rack in the PCC. Refer to section 6 for the detailed specification. This will be supplied for the class 20E, 21E and 22E.
- 5.1.1.2. Charging resistor assembly: The successful bidder shall provide two charge resistor assemblies for the 22E. Assembly 1 consist of six resistors R1A, R1B, R2A, R2B, R3A and R3B with 65 ohms each on the same mounting, and assembly 2 consists of three resistors R1C, R2C and R3C with 65 Ohms each on the same mounting rack. The class 20E and 21E only has one charge resistor assembly that consists of six resistors R1A, R1B, R2A, R2B, R3A and R3B with 65 ohms each on the same mounting rack. The constructed rack must fit within the dimensions of the designated area for the charging resistor racks in the PCC. Refer to section 6 for the detailed specification, and section 4.4 for the resistor assembly layouts.
- 5.1.1.3. It is the responsibility of the successful bidder to make sure that the resistor assemblies have the correct dimension and will fit in the designated area of the charge and discharge resistor racks respectively.
- 5.1.2. The successful bidder shall provide the type test report or service proven reports for the supplied resistors as per section 9. Only once the type test report or service proven report is satisfactory then shall the resistors be approved for in-service evaluation.
- 5.1.3. The successful bidder shall collaborate with Transnet for the installation, integration, and in-service evaluation on the locomotive.
- 5.1.4. The resistors supplied by the successful bidders shall undergo in-service evaluation (as per section 10) before further approval will be made for further purchasing.
- 5.1.5. The respondent shall respond to the following table in the right hand most column, with FULLY COMPLIENT, PARTIALLY COMPLIENT, or NOT COMPLIENT, with respect to compliance with the requirement.

Note: Scope of Goods and Service is mandatory. A respondent will be disqualified if the answer "Not Compliant" (i.e. response No/blank) to any point in the table below.

Document Name: 20E, 21E, and 22E PCC Charge and Discharge Resistor Specification	Doc. No.: RD_RD_KDS_SPEC_0090
Classification: Restricted – Technical Specification Document	Revision: 2
Date: 06 February 2024	Page 10 of 18

#	Scope of Goods and Service Required		Response (FULLY COMPLIANT/ PARTIALLY COMAPLIANT/ NOT COMPLIANT)
D.1	Supply	Source and supply of new resistor as per section 6.	
D.2	Delivery	Delivery of resistors as mentioned to site (including all freight forwarding and custom cost): - Koedoespoort Depot, - Cnr. Lynette Street and Koedoespoort Rd, - Koedoespoort, - Pretoria - Gauteng - 0186	
D.3	Documentation of Supplied Equipment	Technical Data Sheet	
D.4		Type Test report or service proven report	
D.5	Installation, Testing and Commissioning	Support during the in-service evaluation of the system into the locomotive.	

6. TECHNICAL SPECIFICATION

6.1. General

- 6.1.1. The respondent shall supply and complete the right most column in response to the requirements of the equipment.
- 6.1.2. The respondent shall supply supporting documentation that can demonstrate the ability to supply the required resistors according to the specified technical requirements.

Document Name: 20E, 21E, and 22E PCC Charge and Discharge Resistor Specification	Doc. No.: RD_RD_KDS_SPEC_0090
Classification: Restricted – Technical Specification Document	Revision: 2
Date: 06 February 2024	Page 11 of 18

- 6.1.3. The Resistors shall come with a mounting bracket and correct configuration, without any modification to the original PCC cubicle and connectors for the resistor.

6.2. Environment Requirement

The equipment shall have the following environmental operating requirement:

- 6.2.1. Shock and Vibration resistance: IEC61373:2010
6.2.2. Operating Altitude: 2000m

6.3. Charging Resistor Technical data

#	Parameter	Resistor characteristics	Unit	Response [Comply/ Not Comply/ Partially Comply]
6.3.1	Resistor rating	65	Ω	
6.3.2	Power rating	750	W	
6.3.3	Energy requirements	Min. 20	KJ	
6.3.4	Resistance tolerance	± 5	%	
6.3.5	Ambient temperature	-40 TO +70	$^{\circ}\text{C}$	
6.3.6	Maximum altitude	2000	m	
6.3.7	Short-term overload (surge)	10 X rated power for 5 s		
6.3.8	Maximum working voltage	5000	V	
6.3.9	Cooling method	Natural cooling		
6.3.10	Coating	Vitreous Enamel (Preferable coating)		

Note: The charging resistor assembly consists of six charging resistors R1A, R1B, R2A, R2B, R3A and R3B that are on the same mounting bracket on the 20E, 21E. There are two resistor racks on the 22E. There is R1A, R1B, R1C, R2A, R2B and R2C mounted on the same rack, and resistors R3A, 3B and 3C is mounted on the second rack. The below picture shows an example of the existing charging resistors mounted in the locomotive.

Document Name: 20E, 21E, and 22E PCC Charge and Discharge Resistor Specification	Doc. No.: RD_RD_KDS_SPEC_0090
Classification: Restricted – Technical Specification Document	Revision: 2
Date: 06 February 2024	Page 12 of 18



Figure 1: Charging Resistor

6.4. Discharging Resistor technical data

#	Parameter	Resistor characteristics	Unit	Response [Comply/ Not Comply/ Partially Comply]
6.4.1	Resistor rating	30000	Ω	
6.4.2	Power rating	750	W	
6.4.3	Energy requirements	Min. 20	KJ	
6.4.4	Resistance tolerance	± 5	%	
6.4.5	Operating temperature	-40 TO +70	$^{\circ}\text{C}$	
6.4.6	Maximum altitude	2000	m	
6.4.7	Short-term overload (surge)	10 X rated power for 5 s		
6.4.8	Maximum working voltage	5000	V	
6.4.9	Cooling method	Natural cooling		
6.4.10	Coating	Vitreous Enamel (Preferable coating)		

Note: The discharging resistor assembly consists of five discharging resistors (R5a, R5b, R5c, R4a and R4b) that are on the same mounting bracket for the 20E, 21E, and 22E. Below is an example of discharging resistor assembly.

Document Name: 20E, 21E, and 22E PCC Charge and Discharge Resistor Specification	Doc. No.: RD_RD_KDS_SPEC_0090
Classification: Restricted – Technical Specification Document	Revision: 2
Date: 06 February 2024	Page 13 of 18



Figure 2: Discharge Resistor

7. CHARGING/DISCHARGING RESISTOR DIMENSIONS

L	L1	L2	h	b	c	d	f
448 mm	435 mm	336 mm	75 mm	50 mm	7 mm	50 mm	16 mm

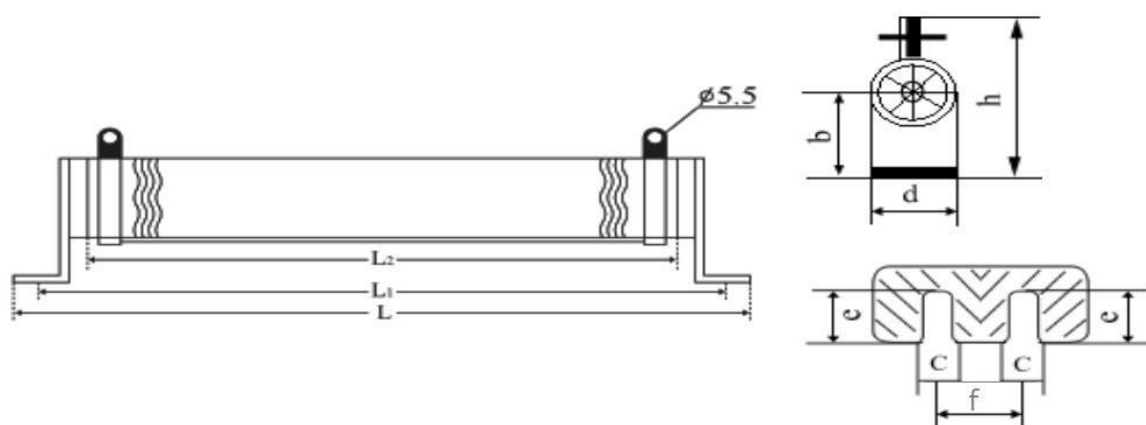


Figure 3: Charging/Discharging Resistor dimensions

Document Name: 20E, 21E, and 22E PCC Charge and Discharge Resistor Specification	Doc. No.: RD_RD_KDS_SPEC_0090
Classification: Restricted – Technical Specification Document	Revision: 2
Date: 06 February 2024	Page 14 of 18

8. CLARIFICATION

- 8.1. The bidder or respondent may contact TE at any time should any void exist in this specification or there be any uncertainty as a result of any contradictory statement within this specification.
- 8.2. All clarification questions directed to TE shall be made in writing through the official channels as detailed in the supporting documents of this technical specification.

9. TYPE TEST

- 9.1. The respondent must provide a list of standards and applicable clauses that they adhere to, for each type of resistor mention in section 4.3, for the type test, and include the list of standards that they adhere to which were not mentioned in the specification.
- 9.2. The successful bidder shall provide Transnet with a list of type test that shall be conducted and the test procedure for approval.
- 9.3. The successful bidder shall conduct and provide a type test report for the supplied resistor for review and approval. An existing type test report may be provided for the resistor if an existing product is available.
- 9.4. In-service evaluation of the resistors shall be conducted only if the type test report is approved.

10. IN-SERVICE EVALUATION

- 10.1. The successful bidder shall arrange with Transnet for the installation of the charging and discharging resistors for in-service evaluation.
- 10.2. Immediately after installation of the resistors, a "stress tests" shall be conducted over 15 cycles (x 15 times), whereby the resistors will undergo the charging and discharging process over a time period that will be determined during the testing phase.
 - 10.2.1. Both the start and end temperatures of the environment together with the newly installed resistors must be recorded.
 - 10.2.2. The line current must also be recorded for the duration of the test.
 - 10.2.3. The resistors shall thereafter be visually inspected to examine their condition following the stress test.
- 10.3. The in-service evaluation testing period, of the installed resistors, shall be three (3) to six (6) months. TE will monitor the performance of the installed resistors during this period, and follow-up on any possible failures.
- 10.4. The in-service testing period may be shortened or negated if the Transnet Engineering's Chief Maintenance Engineer or Fleet Maintenance Owner accepts the product at an earlier stage for operational or other reasons.
- 10.5. The resistors shall only be granted approval or fit for purpose once the in-service evaluation testing is successful.

Document Name: 20E, 21E, and 22E PCC Charge and Discharge Resistor Specification	Doc. No.: RD_RD_KDS_SPEC_0090
Classification: Restricted – Technical Specification Document	Revision: 2
Date: 06 February 2024	Page 15 of 18

11. PROJECT TIMELINES

- 11.1. 11.1. The Respondent shall include the dates which the Respondent will be able to deliver (for both prototype and pre-production), together with the activities (and accommodating dates).
- 11.2. The following table shall be responded to in the right hand most column, with a YES or NO, with respect to compliance of the requirement.

Note: Scope of Delivery Period for the prototype is mandatory. A respondent will be disqualified if the table is not completed (i.e., blank), indicating the possible delivery date of the prototype. The respondent with the shortest delivery period will receive a higher evaluation score.

#	Prototype Delivery	Response [YES/NO]
D.1	1 Months	
D.2	<3 Months	
D.3	<6 Months	
D.4	Other: _____ (Supplier to stipulate the delivery period of the prototype, please provide reasons of not meeting <6 months delivery date)	

- 11.3. The Respondent is made aware that failure to reach the stated delivery date in 11.2 above may result in disqualification of this tender.

12. QUALITY ASSURANCE

The Supplier shall provide certificate of compliance of quality assurance.

13. Data Pack and training

- 13.1. The successful bidder shall provide the maintenance pack for the resistor(s). The maintenance pack will include the following: datasheet of the resistor(s), maintenance manuals, installation manuals, replacements parts and/or maintenance schedule.
- 13.2. The successful bidder shall provide training on how to install and maintain the resistor(s).

14. Maintenance Support

- 14.1. The successful bidder shall provide maintenance support and spare parts for at minimum period of 10 years.
- 14.2. In the event of repetitive similar failures, the successful supplier shall investigate and support with an updated solution.

15. Warranty

The following table shall be responded to in the right hand most column, with a YES or NO, with respect to compliance with the requirement.

Document Name: 20E, 21E, and 22E PCC Charge and Discharge Resistor Specification	Doc. No.: RD_RD_KDS_SPEC_0090
Classification: Restricted – Technical Specification Document	Revision: 2
Date: 06 February 2024	Page 16 of 18

Note: Scope of Warranty Period is mandatory. A respondent will be disqualified if the answer “Not Compliant” (i.e. response No/blank) to any of the points in the table below. The respondent with a longer warranty period will receive a higher evaluation score.

#	Warranty Period	Response [YES/NO]
W.1	3 Months	
W.2	6 Months	
W.3	12 Months	
W.4	Other: _____ (Supplier to stipulate the warranty period they will provide)	

16. STANDARDS ADHERENCE

S1	SANS Standards	COMPLY [YES/NO]
S1.1	SANS 10111 (Latest) Engineering Drawing	
S1.2	SANS 60529:2013 Degrees of protection provided by enclosures (IP Code)	
S2	EN Standards	COMPLY [YES/NO]
S2.1	EN 60322: Electric equipment for rolling stock - Rules for power resistors of open construction.	
S2.3	EN 61373:2010 Railway applications – Rolling stock equipment – Shock and vibration tests.	
S3	IEC Standards	COMPLY [YES/NO]
S3.1	IEC 60068-1:2013 Environmental testing - Part 1: General and guidance	
S3.2	IEC 60068-2-1:2007 Environmental testing - Part 2-1: Tests - Test A: Cold	
S3.3	IEC 60068-2-2:2007 Environmental testing - Part 2-2: Tests - Test B: Dry heat	
S3.4	IEC 61373:2010 Railway applications - Rolling stock equipment - Shock and vibration tests	
S4	ISO Standards	COMPLY [YES/NO]
S4.1	ISO 9001:2015 Quality management systems — Requirements	

DOCUMENT AUTHORITIES

COMPLIED BY

Document Name: 20E, 21E, and 22E PCC Charge and Discharge Resistor Specification	Doc. No.: RD_RD_KDS_SPEC_0090
Classification: Restricted – Technical Specification Document	Revision: 2
Date: 06 February 2024	Page 17 of 18

Nhlanhla Mackenzie	Signed: 
Designation: Engineer TE: System Integration, Assurance and Support	Date: 10/05/2024

REVIEWED & APPROVED BY	
Wing Lau	Signed: 
Designation: Engineer TE: System Integration, Assurance and Support	Date: 10/05/2024

APPROVED BY	
Mankoko Mabusela	Signed: 
Designation: Principal Engineer TE: System Integration, Assurance and Support	Date: 13/05/2024

Document Name: 20E, 21E, and 22E PCC Charge and Discharge Resistor Specification	Doc. No.: RD_RD_KDS_SPEC_0090
Classification: Restricted – Technical Specification Document	Revision: 2
Date: 06 February 2024	Page 18 of 18