



TRANSNET ENGINEERING

BRAKE SYSTEM TECHNICAL SPECIFICATION

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LIST OF REVISIONS

Revision	Date	Name	Description of modification
1	13/05/2020	W.A.	Clause 4.1.19: Max. allowable topping distance changed from 1200m to brake performance category R2 (BS EN 16185-1).
2	17/09/2020	W.A.	Distribution list and Clause 3.2.1. removed

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LIST OF SPECIFICATIONS

British Standard for Braking Systems of Multiple Unit Trains: BS EN 16185 (Parts 1 & 2)

Technical Specification for Interoperability: Safety in Railway Tunnels: EN 50553:2012+A1:2016

British Standard for Passenger Alarm System Requirements: BS EN 16334:2014

Transnet Engineering DMU Coupler Specification: PD-PDC-NAT-SPEC-0460

Transnet Engineering DMU bogie Specification: PD-PDC-NAT-SPEC-0441

Transnet Engineering DMU Traction Motors & Wheels Specification: RD_RD_KDS_SPEC_0019

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1.0. INTRODUCTION

1.1. TE BACKGROUND

Transnet Engineering, a Division of Transnet (SOC) Pty Ltd, is an Engineering organization that refurbishes, upgrades, maintains, and builds new locomotives, wagons and passenger coaches for South Africa and the rest of Africa, and beyond the continent.

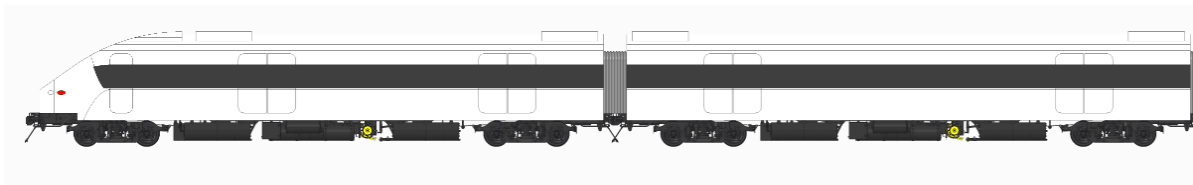
This project is in line with Transnet Engineering's strategy, which is to increase research and development activities, expand technological capabilities and expand current product offerings. Transnet Engineering is embarking on an opportunity to leverage on its existing competency, capability and capacity to evolve into becoming a Diesel Multiple Unit Original Equipment Manufacturer.

The opportunity is to first design and manufacture a proudly Transnet Diesel Multiple Unit (DMU), this will enable the organization to increase its product offering and utilize the DMU as a launch pad toward increasing our footprint in Africa and beyond. This is deemed mission critical for our product development strategy and product range as an organization.

This project is a culmination of extensive market and product research in pursuit of a DMU that will satisfy the needs of railways in Africa as well as other narrow gauge territories given their unique and sometimes harsh operating conditions.

1.2. PRODUCT BACKGROUND

The newly developed DMU will consist of a four-coach module that comprises of two non-motorized coaches situated at the ends of the module, and two motorized coaches positioned between the non-motorized coaches. The module will be semi-permanently coupled via drawbars and with automatic couplers at the ends of the module. It shall be fitted with air suspension bogies and rheostatic braking.



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2.0. SCOPE

The purpose of this document is to define the technical requirements for the supply of a complete brake system for a train capable of electro-dynamic- (primary) and pneumatic (secondary) braking that conforms to British Standard EN 16185-1.

2.1. SCOPE OF SUPPLY

The scope of supply shall include a complete brake system. It is to be accompanied by a comprehensive system diagram that defines the brake system architecture, each component in the system, their functions, and the interactions between them. Detailed drawings indicating component placement shall be required, including 3D .step files of each major component for integration into in-house CAD designs.

The supplied brake system components shall comprise (amongst others):

- Driver's brake valve
- Dedicated brake system driver's display unit
- Air pipe reticulation
- Main air compressor
- Air reservoirs
- Air pipe fittings, couplings and brackets, including
- Air pipe connections required to interface with the coupler
- Check valves
- Safety valves
- Water traps
- Stop cocks
- Brake pipe pressure regulation device
- Test points
- Brake calipers
- Distribution valves

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- Emergency brake valves
- Electronic air brake signaling system
- Electro-mechanical valves
- Park brake indicators
- Braking indicators
- Brake resistor grid
- Wiring harnesses
- Driver vigilance system
- Derailment detection system
- Wheel slide protection system

Additional requirements:

- Warranty period
- Maintenance schedule for all major components
- Comprehensive spare parts catalogue

The above items are to be quantified based on a four-coach module.

3.0. RESPONSE TO TECHNICAL SPECIFICATION

3.1. GENERAL

The Respondent must adhere to all the requirements included in this document. Failure to adhere to these requirements may result in disqualification. Transnet reserves the right to disqualify any Respondent should their submission not adhere to all the requirements specified in this document.

3.2. RESPONDANT'S TECHNICAL RESPONSE

3.2.1. Responses should contain a clause-by-clause response for each clause in this document, containing at least one of the following answers:

- ☐ Noted and Agreed: Response used when responding to informational clauses.
- ☐ Full Compliance: When the current solution complies already.
- ☐ Future Compliance: To state that the solution does not exist currently, but will be offered as part of their offer. Respondents to state the development time needed to attain compliance.
- ☐ Partial Compliance: To state that the current solution only provides partial compliance to the clause. In such a case, Respondents to specify discrepancy, the possibility of attaining full compliance plus cost and development time needed to attain compliance.
- ☐ Non Compliance: To state that the clause is not met currently and not an option at all.

3.2.2. Respondents shall provide drawings, diagrams and additional literature to clearly describe the operation of the proposed system and highlight any noteworthy aspects thereof.

4.0. DESIGN PARAMETERS

- 4.1. The proposed brake system shall conform to the following design parameters in line with the British Standard for Braking Systems of Multiple Unit Trains, BS EN 16185-1:
- 4.1.1. The proposed brake system by Respondents shall be compatible with a four-coach module that comprises two non-motorized coaches and two motorized coaches.
- 4.1.2. The module shall be configured with one non-motorized coach at each end, and two motorized coaches situated between.
- 4.1.3. The non-motorized coaches will be identical in design. Equally, the motorized coaches will be identical in design.
- 4.1.4. The module shall be coupled by means of a semi-permanent drawbar between each coach. The leading/trailing ends of the non-motorized coaches shall each have an automatic coupler capable of transferring pneumatic, electric and electronic signals to interoperable modules for the purpose of communicating brake demand throughout the train. For further information, refer to coupler specification PD-PDC-NAT-SPEC-0460.
- 4.1.5. The module will be approximately 80m in length, with a maximum of three modules within a train (i.e. 240m). The functionality and performance of the brake system shall be maintained throughout this length.
- 4.1.6. The approximate coach masses are as stated below:
- Non-motorized coach: 37.2 Ton
 - Motorized coach: 51.7 Ton
- 4.1.7. The motorized coaches shall provide traction, and thus, provide electro-dynamic braking (i.e. eight axles) in the form of rheostatic braking, thus requiring suitably performing brake resistors.
- 4.1.8. All wheels shall be fitted with pneumatic brakes in the form of wheel-mounted disc brakes – fitted to both the inside and outside of each wheel – and calipers.
- 4.1.9. The proposed brakes system shall allow for redundancy in brake functionality across the module.

- 4.1.10. This redundancy shall be achieved by having two individual brake systems per module, configured such that a brake system shall service a non-motorized coach and motorized coach.
- 4.1.11. Each brake system shall possess full brake functionality to the performance requirements described throughout this document. Thus, each brake system shall have its brake components distributed between a non-motorized coach and motorized coach.
- 4.1.12. These two brake systems shall be identical in all respects and interoperable to allow for full brake functionality across the module.
- 4.1.13. The train will be designed to operate on a track gauge of 1065mm.
- 4.1.14. The bogies to be fitted shall be defined within specification PD-PDC-NAT-SPEC-0441
- 4.1.15. The traction motors and wheels to be fitted shall be defined within specification RD_RD_KDS_SPEC_0019.
- 4.1.16. The bogie shall feature helical compression spring primary suspension and air cushion secondary suspension.
- 4.1.17. To allow for hauling of a damaged train or module, the leading/trailing ends of each non-motorized coach shall provide an alternate means of pneumatic coupling by means of an adapter between itself and the rescue vehicle, i.e. locomotive.
- 4.1.18. The operating speed of the train shall be 80 km/h, with a maximum speed limited to 120 km/h.
- 4.1.19. The maximum allowable stopping distance shall adhere to brake performance category R2 (UIC) as defined in Annex A of BS EN 16185-1 for the speeds defined in 4.1.18., despite the influence of topography, track- and environmental conditions.
- 4.1.20. All brake equipment shall possess adequate ingress protection.
- 4.1.21. The proposed brake system equipment shall be capable of providing digital outputs to the driver's display unit for the purpose of condition monitoring and the display of warnings to the driver. The driver's display unit shall, at a minimum, display the following critical system parameters and warnings:
 - Brake pipe pressure
 - Brake pipe leak detection

- Warning resulting from an unintentional loss of (total) brake pressure
- Traction motor status
- Resistor grid status
- Holding-, immobilization- and park brake status
- Passenger alarm system status
- Activation of the derailment detection system – warning to sound/flash to prompt the driver to reduce speed
- Wheel slip detection and the presence of a locked wheel as detected by the wheel slide protection system

The proposed driver's display unit dimensions shall be provided for integration into the driver's desk.

5.0. SERVICE CONDITIONS

- 5.1. The proposed brake system shall suitably function in the service conditions described below, without detriment to performance.
- 5.2. The proposed brake system shall conform to the following design parameters in line with the British Standard for Braking Systems of Multiple Unit Trains, BS EN 16185-1:
 - 5.2.1. The train shall experience such topographical conditions as expressed below:
 - Gradients not exceeding 2%.
 - Altitudes between 0m and 2095m above sea level whilst operation between coastal and inland centers.
 - 5.2.2. The train is intended for operating within the Africa continent, thus the brake system shall withstand the effects of such environmental conditions as state below without undue deterioration to equipment or impact on its performance:
 - Ambient temperatures ranging between -10° C and 50° C may be expected. However, considerably higher temperatures may be experienced whilst operating in tunnels due to heat expenditure from dynamic braking.
 - Average humidity exceeding 80%, with 100% humidity not being uncommon.

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- Adverse weather conditions, such as sandstorms, gale force winds, and torrential rain.
- 5.2.3. The proposed brake system shall comply with the Technical Specification for Interoperability: Safety in Railway Tunnels (TSI SRT) with respect to operating in very long tunnels, as outlined in EN 50553:2012+A1:2016. Furthermore, compliance to Transnet Freight Rail specifications that specify the operational requirements of rolling stock in tunnels shall also be adhered to. The train shall successfully negotiate a tunnel of at least 13 500m.

6.0. TECHNICAL REQUIREMENTS

- 6.1. The brake system proposed by Respondents shall comply with British Standard EN 16185-1 in its entirety, with specific compliance to the Standard in the below manners:

6.2. ELECTRO-DYNAMIC BRAKE SYSTEM

- 6.2.1. The train shall be capable of electro-dynamic braking (i.e. rheostatic braking).
- 6.2.2. Brake resistors required to perform this function shall have sufficient thermal capacity to perform emergency brake applications even after the most demanding service brake application has been performed. An emergency brake application shall be performed without time restriction (100% duty cycle). Should this not be possible, the brake resistors shall at least perform two consecutive emergency brake applications at the rate of 100% electro-dynamic power.
- 6.2.3. Automatic protection of the brake resistors against thermal overload shall be incorporated.

6.3. PNEUMATIC BRAKE SYSTEM

- 6.3.1. A pneumatic brake system with wheel-mounted disc brakes and calipers shall be used. The disc brakes shall be fitted to the inside and outside of the wheel.

- 6.3.2. The pneumatic brake system shall be capable of performing an emergency brake application from maximum speed in the event of electro-dynamic brake failure or malfunction. In this event, the pneumatic brake system shall attain the same allowable stopping distance as defined for electro-dynamic braking under the prescribed service conditions.
- 6.3.3. Exclusive application of the pneumatic brake shall be employed under low speeds only (limited to 30km/h), for precise and smooth positioning of the train.
- 6.3.4. A brake system architecture that define the brake demand levels, distribution of the brake demand, and the force generated in response to the brake demand shall be supplied.
- 6.3.5. Only components and sub-assemblies of proven design and high availability shall be considered.
- 6.3.6. The pneumatic brake shall operate on the basis of energize-to-apply (during service brake applications).
- 6.3.7. Service brake control demand shall be electronically communicated to remaining coaches within the train by means of a hard wired circuit following a safety loop design.
- 6.3.8. Brake pipe pressure shall be automatically adjusted to mitigate over-/undercharging.

6.4. MECHANICAL COMPONENTS

- 6.4.1. All mechanical components to comply with EN 16185-1.

6.5. BRAKE DEMAND

- 6.5.1. A combined acceleration and brake lever shall be fitted.
- 6.5.2. Service and emergency brake applications by the driver shall be made possible from the same device, with the emergency brake position on the lever located at the furthest position beyond the full service application position.
- 6.5.3. The advance in brake application intensity will be made by drawing the brake level towards the driver.
- 6.5.4. The lever with have a smooth operation (no notches).

- 6.5.5. The passenger alarm system shall automatically initiate a brake application and disable propulsion when activated, as in accordance with BS EN 16334:2014.
- 6.5.6. The driver's vigilance system shall automatically initiate a brake application and disable propulsion.
- 6.5.7. The derailment detection system shall automatically initiate a partial brake application to reduce speed to a safe level. (In such an event, a warning indicator is to prompt the driver to reduce speed)
- 6.5.8. The wheel slide protection system shall be equipped to avoid wheel slide, and thus wheel flat spots, and to optimize the available adhesion whilst under braking. This system shall also monitor for the presence of locked wheels.
- 6.5.9. Train separation, caused by a forced division or unintentional coupler release, shall automatically initiate a brake application on all parts of the train. The loss of brake pipe pressure shall be communicated to the driver.

6.6. SERVICE BRAKE APPLICATIONS

- 6.6.1. A brake management system shall manage brake blending, prioritizing electro-dynamic braking over pneumatic braking (i.e. brake preference modes).
- 6.6.2. In the event of electro-dynamic brake system failure, train-wide blending should be used to compensate for the loss by using the remaining dynamic brakes up to their performance limit before application of the pneumatic brake.
- 6.6.3. During coupling and uncoupling, brakes applied to keep the train at a standstill shall not be allowed to release.
- 6.6.4. Under service braking, the brake system shall automatically apply brakes when the propulsion system fails or malfunctions.

6.7. EMERGENCY BRAKE APPLICATIONS

- 6.7.1. The emergency brake shall be designed to function on the basis of energize-to-release.

6.7.2. The propulsion system shall be cut off automatically in the event of emergency brake application. The propulsion system may only be reactivated through deliberate action by the driver once the brake demand has been eliminated completely.

6.8. BRAKE FUNCTIONS TO KEEP THE TRAIN STATIONARY

6.8.1. The brake system shall incorporate a holding-, immobilizing- and park brake.

6.9. DRIVER'S BRAKE TEST

6.9.1. It shall be possible to perform a regular basic brake test and full brake test when required to do so in order to test for brake system component functionality as specified in EN 16185-1.

6.10. MAINTENANCE

6.10.1. The brake system shall be provided with a diagnostic interface with a suitable connection for a mobile test computer to indicate failures in the brake system, and related equipment, as detailed in 4.1.21.

6.10.2. The respondent shall propose, to the best of their ability, a brake system for which they will offer support in terms of after-sale service, spares and maintenance for no less than 30 years.

6.11. BRAKING PERFORMANCE

6.11.1. Service braking minimum braking performance shall provide a deceleration no less than $0,1\text{m/s}^2$, excluding the effects of rolling resistance.

6.11.2. Maximum service braking shall provide at least 75% of the emergency brake.

7.0. TESTING AND COMMISSIONING

- 7.1. The brake system shall undergo a comprehensive testing and commissioning program to ensure that all equipment, systems, etc. are in compliance with BS EN 16185-1 prior to placement of the train into service. The OEM shall provide the testing and commission program.