TRANSNET ENGINEERING

SPECIFICATION FOR THE SUPPLY OF PINIONS TO THE ROTATING MACHINES BUSINESS

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Revision – 1.0

SUMMARY OF REVISION

First issue – 15 July 2019. Document No. PD_COMP_NAT_SPEC_1002

Second issue – 13 July 2021. Document No PD_COMP_NAT_SPEC_1002

The following revisions have been made in this version:

CHANGE	DESCRIPTION
Clause 2.4, Table 1	Addition of 19E and 15E pinions
Addition: Clause 3.3	Population of Appendix A is a mandatory requirement
Rephrased: Clause 4.13	The material for each pinion class shall be stipulated in the applicable drawing.
Addition: Clause 5.3.2	Masking of the pinion during carburizing
Rephrased: Clause 5.3.3	The effective case depth shall be specified in the relevant pinion drawing.
Rephrased: Clause 5.3.5	The effective case depth, case hardness and core hardness shall be stipulated in the applicable drawing
Rephrased: Clause 7.6	Surface finish shall be in accordance with drawing, if not provided in accordance with this specification.
Addition: Clause 13.2 sub clauses	Sub-clauses numbered
Addition: Clause 14.1	Material defects which are inherent within a batch will render the entire batch replaceable.

Document Control

Distribution List Distribute to Configuration Offices at the following centers" "Configuration Offices to discuss with the Business Manager, Quality personnel, Lean personnel in the following businesses to distribute the document to all relevant personnel "	National Rotating Machines
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1.0 SCOPE

1.1 This specification covers Transnet Engineering, Product Development's requirements for the manufacture and supply of traction motor pinions within the Rotating Machines Business. The traction motor pinions shall be manufactured in accordance with their respective drawings, in respect of dimensions and other notes contained therein and shall also comply with all requirements of this specification.

2.0 RELEVANT SPECIFICATIONS AND DRAWINGS

2.1 The documents below are incorporated and made part of this specification and should be read in conjunction with this specification.

2.1.1 Applicable pinion drawing
2.1.2 Purchase order text

2.2 All concerned shall ensure that they are in possession of the latest issues of the above requirements.

2.3 The pinion class, drawing and item numbers are shown in Table 1. This specification shall be applicable to all pinions supplied to the Rotating Machines Business even those that are not listed in Table 1.

2.4 The drawing applicable to each particular tender will be quoted in the tender documents and purchase order text.

Table 1: Pinion classes, drawing and item numbers for electrical locomotives

CLASS	PINION ITEM No.	PINION DRG. No.
6E;6E1	69009731 (18 Teeth)	RS A009_001_128
7E;7E2 (S1)	69009439 (20 Teeth)	RS A004_001_128
7E2 (S2)	69009439 (20 Teeth)	RS A004_001_128
7E1;7E3 (S1 & S2)	69000313 (16 Teeth)	RS A003_001_128
10E;10E2	69009488 (19 Teeth)	RS A007_001_128
5M2/5M2A	069004602	RS A006 001 128 REV D
7E2/MG680	069809786	DNR216C000
19E	084813957 (19 Teeth)	PEL05A0236
15E	084809948 (19 Teeth)	PEL_176Z_0301

Table 2: Pinion classes, drawing and item numbers for diesel electric locomotives

CLASS	PINION ITEM NUMBER	DRAWING
G.E.		
31-000 32-000 33-000 33-400 34-000 34-400 34-500 34-900 36-000 36-100	077056220 19 Teeth	RS A010_001_128
G.M.		
34-200 34-600 34-800 36-200 37-000	077141794 14 Teeth	RS A001_001_128

3.0 GENERAL TENDERING REQUIREMENTS

3.1 Tenderers must furnish with at the time of their offer, complete and detailed information as called for in this specification, to enable clear and satisfactory evaluation, comparison and adjudication of their offers.

3.2 Tenderers shall indicate, clause by clause, in Appendix A that their offers comply in every respect with this specification. Any deviations shall be disclosed in Appendix A.

3.3 Appendix A of this document shall be populated and signed in order to be considered for the technical evaluation stage. Failure to populate and sign all fields of Appendix will lead to disqualification

3.4 Deviations from this specification shall not be accepted without written consent from Transnet Engineering, Product Development.

3.5 A broad statement to the effect that the traction motor pinions are in accordance with this specification is not acceptable.

3.6 In addition to this specification tenderers shall fully comply with the purchase order text and pinion drawing of the relevant item number.

3.7 Any innovative material or design which deviates from this specification, but will however benefit Transnet Engineering will be considered provided that the tenderer clearly communicates such deviations beforehand. All deviation will have to be assessed and approved by Transnet Engineering, Product Development, prior to implementation.

3.8 Failure to comply with the above requirements may preclude a tenderer from consideration.

4.0 MANUFACTURE

4.1 Steel making process

4.1.1 The steel making and casting process shall be at the option of the manufacturer unless otherwise specified on the enquiry and order. The air or mixed air and oxygen bottom blown basic converter process is not permitted.

4.1.2 The steel material used shall be fully killed and homogenous.

4.1.3 The material grade of the steel for each pinion class shall be stipulated in the relevant drawing applicable to that pinion. All drawings shall be specified in the purchase order text.

4.2 Grain Size

4.2.1 A specimen representing each cast must be taken from the steels for the grain size tests. The grain size must be determined in accordance with specification ASTM E112. The grain structure shall have a grain size of 5 to 8.

4.2.2 The steel when examined in accordance with Method A of ASTM E45 shall show an inclusion content not exceeding severity level 3, well scattered over the field.

4.3 Metal Fabrication

4.3.1 All traction motor pinions shall be manufactured from forged material. No other manufacturing process either than forging shall be accepted.

4.3.2 The semi-product intended for the manufacture of forged blanks to be used for pinion production shall be obtained from adequate cropped ingots free from pipe, segregation and other harmful defects.

4.3.3 The pinion blanks shall be forged with a minimum forging ratio of 4:1 from billet bar to the blank stage. The forging and rolling process shall be performed in such a manner that the central axis coincides with the axle of pinion.

4.3.4 The forged blanks shall be free from any flaws, cracks, folds and other delirious discontinuities. The forged blanks shall be provided with adequate allowance for machining.

4.3.5 Each forged blank shall be stamped when hot with a number to associate it with its relevant cast number which shall be the product of a single ladle, and with a consecutive forged bar number.

4.3.6 All forged blanks shall be ultrasonically tested to ensure freedom from casting and forging defects.

4.3.7 A stress relieving heat treatment should be performed on the forgings in order to relieve residual forging stresses if these exists.

5.0 Heat treatment

5.1 Prior to rough machining the forged blank shall be stabilized by annealing. Adequate machining allowance shall be provisioned for prior to the case hardening process.

5.2 The heat treatment procedure of the surface and core shall be in accordance with the alloy specification for the grade of alloy steel specified in the respective drawing.

5.3 Case hardening

5.3.1 The active tooth surface of the pinion shall be suitably case carburized, hardened and tempered to obtain the specified case depth and hardness as indicated in the relevant drawings. The core hardness should also be in accordance to the relevant drawing.

5.3.2 Masking of the pinion shall be carried out to prevent carburization of the entire pinion,

5.3.3 The effective case depth shall be defined as the distance from the finished tooth surface to a specific subsurface hardness value which is stipulated in the relevant pinion drawings. The effective case depth of the pinions shall comply with their respective drawings. In cases were the case depth is not stipulated in the respective drawing, the effective case depth shall be measured at 550HV.

5.3.4 The case depth shall be checked by providing one test sample per container when box caburizing. In instances where gas caburizing is used, at least two test samples towards the top and bottom of the furnaces shall be provided for case depth measurements.

5.3.5 The test sample shall be of a section which adequately simulates that of the teeth which it represents and shall be placed near but not on the pinion teeth. The test sample shall be composed of the same material of the pinion it represents. Following carburizing, the test sample shall be hardened and tempered with the pinions it represents. Hardness measurements of the case shall be carried out after grinding and polishing. The results shall comply with the requirements of this document and the respective drawing.

5.3.6 The tooth effective case depth, surface, case and core hardness shall comply with the relevant pinion drawing.

5.3.7 Micro-Examination

At least one test sample per caburizing bath shall be microscopically examined for establishing absence of cementite network or free cementite in the carburized case.

6.0 WELDING

6.1 Under no circumstances shall welding or plating be permitted on new pinions.

7.0 MACHINIG OF PINIONS AND TOLERANCES

7.1 All tolerances concerning the dimensions of the pinions shall comply with the requirements of the representative drawing.

7.2 The taper of the pinion bore shall be checked by means of a taper plug gauge and a Go and no-Go plug gauge as necessary.

7.3 The teeth shall be cut and ground on pinion generating machines. Final finishing grinding shall be done after case hardening. The transition between cut area and ground one shall not show too great discontinuity.

7.4 All sharp edges on the pinion teeth shall be rounded of. The chamfered radius shall be in accordance with the relevant drawing.

7.5 The tooth surface shall be free from any discontinuities which may be caused by metal defective forging, grinding or any other manufacturing process. Any repair is prohibited.

7.6 The surface finish of the teeth shall be stipulated in the relevant drawing. If not specified in the drawing the surface finish of the tooth flank profile shall be Ra 0.8 μm or better.

8.0 SHOT PEENING

8.1 The sequence of finishing the pinions shall always be shot-peening of the roots of the pinions to impart compressive stresses. Atleast 98% coverage of the tooth root fillet shall be achieved and verified by visual inspection. All other tooth surfaces should be protected against peening. After pinion tooth finish machining operations are complete, the manufacturer shall verify that all evidence of the shot peening operation has been removed from the active tooth surfaces.

8.2 During shot peening a S330 shot with an intensity of 0.4 – 0.5 mm shall be used.

9.0 TESTS ON FINISHED PINIONS

9.1 Hardness

The hardened teeth of all pinions, following heat treatment, shall be tested for surface hardness. The hardness shall be measured at four equidistance points in the proximity of the root circle of the teeth. The average value of the four measurement readings shall conform to the requirements of the relevant drawings. The variation between the maximum and minimum values shall not exceed 20 points HV.

9.2 Crack detection

Following heat treatment all pinions shall be crack tested using a magnetic particle inspection.

It shall be the responsibility of the tenderer to ensure that only qualified non-destructive testing (NDT) personnel conduct defect detection tests.

10.0 MARKINGS

10.1 All pinions shall have traceability markings on the areas shown in the relevant drawings, the markings shall be as follows:

10.1.1 Identification symbol of manufacturer
10.1.2 Drawing number
10.1.3 Serial number of manufacturer
10.1.4 The date of manufacturer (No. of the month and two digits of the years)

11.0 CORROSION PROTECTION

11.1 The pinions shall be suitably protected against oxidation and corrosion with an approved anti-rust compound capable of being removed easily by white spirit.

11.2 The pinions shall be protected by an appropriate packaging against impact or friction which may cause deterioration of their surface.

12.0 INSPECTION

12.2 Transnet Engineering, Product Development reserves the right to undertake inspection anytime during manufacturing of the pinions.

12.3 Prior to any approval of a supplier for the supply of pinions, Transnet Engineering, Product Development together with Corporate Quality reserves the right to conduct a technical audit at the premises/facilities of the pinion manufacturer.

12.4 Transnet Engineering, Supply Management shall inform Product Development of all potential suppliers in order for technical audits to be scheduled.

13.0 APPROVALS AND DOCUMENTAIONS

13.1 Prior to any approval of a supplier for the supply of pinions, a prototype pinion together with a test piece sample which is composed of the same material and underwent the same heat treatment process as the pinion shall be supplied. The prototype pinion should be included in the request for quotation (RFQ).

13.2 The prototype pinion and its test sample shall be accompanied by:

13.2.1 Material test certificate stating the chemical composition, mechanical properties (ultimate tensile strength, yield strength, %elongation, impact strength @20 °C), grain size and ultrasonic test of the forged billet in the annealed condition.
13.2.2 Heat treatment certificate
13.2.3 Case depth measurement certificate
13.2.4 3D dimensional measurement report of the pinion including the reference point during measurements.
13.2.5 Magnetic particle inspection report

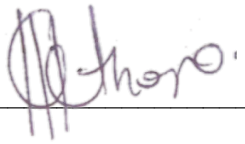
14.0 GUARANTEE

14.1 The contractor shall guarantee the pinions for an in-service period of twelve months from the date of commissioning, against any defect imputable to manufacture and not revealed during acceptance at the works. In such instances the supplier's liability shall be restricted to the replacement of the defective pinions. In instances where the entire batch is affected by the defective material, the entire batch shall be replaced.

15.0 CALIBRATION

15.1 All measuring instruments shall be calibrated annually in accordance with nationally recognized standards.

DOCUMENT AUTHORITIES

COMPILER	**Emma Molobi (Pr.Eng)**
DESIGNATION	**Snr Engineer (Metallurgy & Materials)**
SIGNATURE	
APPROVED BY	**Edgar Mothapo**
DESIGNATION	**Acting Principal Engineer**
SIGNATURE	

APPENDIX A

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Tenderer Signature Date