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16. *RECOMMENDATION AND APPROVAL OF THE SPECIFICATION / TERMS OF REFERENCE / STATEMENT OF WORK SUBMISSION FOR APPOINTMENT OF A SERVICE PROVIDER FOR THE SUPPLY AND DELIVERY OF RAILS, TURNOUT COMPONENTS, SLEEPERS, FASTENINGS, WELDING MATERIAL, BALLAST AND LUBRICATORS IN THE JHB - DAVEYTON CORRIDOR FOR A PERIOD OF 12 MONTHS ..* **Error! Bookmark not defined.**

1. INTRODUCTION

The works is for supply and delivery of Rails, Turnout components, sleepers, fastenings, welding material, ballast, Track mounted rail and flange lubricators in the Johannesburg – Daveyton Corridor for Gauteng Region.

The Gauteng Region is a network of commuter rail services in Gauteng province in South Africa, servicing the Johannesburg and Tshwane metro areas. It is operated by Metrorail, a division of the Passenger Rail Agency of South Africa (PRASA).

Metrorail routes spread out across the province from three main hubs: Park Station in Johannesburg, Germiston Station on the East Rand, and Pretoria Station. Routes service central Johannesburg, the East Rand, Soweto, the Vaal Triangle, the West Rand, central Pretoria, and suburbs to the north, east and west of Pretoria.

Gauteng Region consists of the following corridors:

- Johannesburg – Leralla / Pretoria: services Johannesburg, Germiston, Kempton Park, Kaalfontein, Tembisa, Oakmoor – Olifantsfontein - Pretoria
- Johannesburg–Daveyton: services Johannesburg, Germiston, Boksburg, Dunswart, Avenue, Northmead and Daveyton.
- Johannesburg–Springs: services Johannesburg, Germiston, Boksburg, Benoni, Brakpan and Springs
- Germiston–Kwesine: services Elsburg, Wadeville, Katlehong, Lindela and Pilot
- Germiston–Kliprivier–Vereeniging: services Germiston, Natal Spruit, Meyerton and Vereeniging
- Germiston–New Canada: services Germiston and the Reef south of central Johannesburg
- Johannesburg–New Canada–Vereeniging: services Johannesburg, Orlando, Lenz, Stretford and Houtheuwel
- Johannesburg–Oberholzer: services Johannesburg, Orlando, Westonaria and Carletonville
- George Goch–Naledi: services Booysens, New Canada, Dube and Naledi
- Johannesburg–Randfontein: services Langlaagte, Westbury, Maraisburg, Florida, Roodepoort, Krugersdorp and Randfontein

- Pretoria–Saulsville: services Pretoria, Pretoria West and Atteridgeville
- Pretoria/Belle Ombre–De Wildt/Mabopane: services Pretoria, Pretoria North, Ga-Rankuwa and Soshanguve
- Pretoria–Pienaarspoort: services Pretoria, Hatfield and Mamelodi
Hercules–Capital Park–Pienaarspoort: services Pretoria North and Mamelodi

2. BACKGROUND INFORMATION

2.1. STATUS QUO

The Perway components has been affected by severe acts of theft and vandalism resulting in a number of lines across the region being closed to the movement of trains. Johannesburg – Daveyton corridor is the most affected in all Gauteng corridors from the acts of theft and vandalism. Perway infrastructure is stripped off rails, turnouts, sleepers, fastenings, rail lubricators coupled with illegal trenching that left ballast excavated from railway track and contaminated.

2.2. PROBLEM STATEMENT

Rails and fastenings form an integral part of the Perway track structure, the main functions include to provide safe passage of trains used to transport passengers/ goods.

Rails are used to provide running surface of the track and cut into 18 or 36-metre lengths. The 48 kg/m, 57 kg/m and 60kg rails are standard for 1065mm track gauge while 60kg/m rails mostly used in main lines.

Closure rails – used where a rail has been broken and where temporary splice joint is removed. Closure rails are shorter than the standard-length rails at least 4.2 m in length.

Rail to sleeper fastenings – use e clips and fist springs, these fastenings or springs offer a constant clamping force to fasten rail to concrete sleepers.

Welding portions are used to join rails and turnout components to improve rail-wheel interaction and to repair broken rails.

Turnouts components form integral part of the Perway major components, the main functions include to provide safe passage of trains used to transport passengers/

goods. Turnout is made up of frogs, guard rails, stock rails, closure rails, stock/switch, stock and point assembly, point blades, crossings, turnout base plates and switch base plates. Figure 1 below shows the typical layout of the turnout.

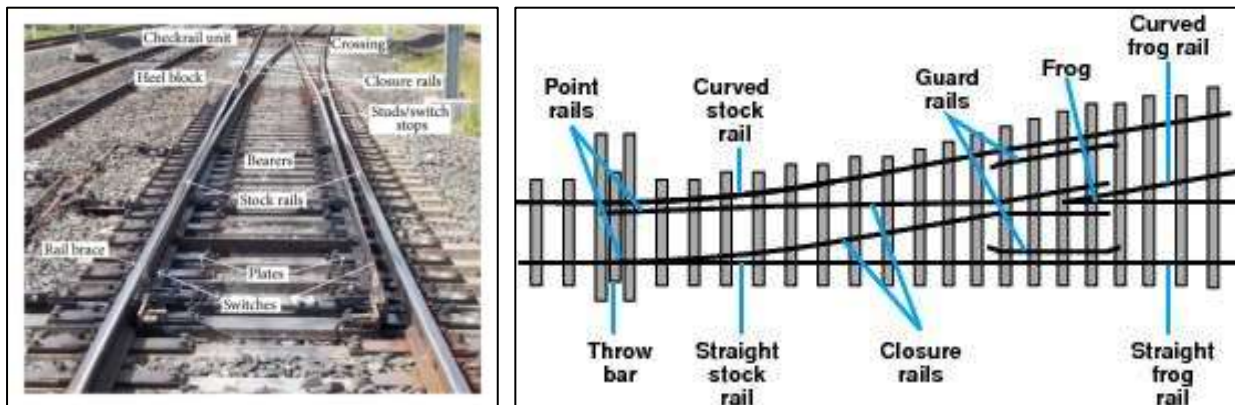


Figure 1: Turnout Layout

Turnout and rails components that have been stolen and vandalised, pose a safety risk to the operation of trains. If not monitored properly they can cause derailments that may lead to loss of life, goods and property. They may also cause performance delays through the introduction of speed restrictions and limiting availability and reliability of the Perway infrastructure.

As can be seen from the above layout, most of the components are made of steel metal (Frogs, guard rails, closure rails, crossings and fastening springs) and become vulnerable to theft and vandalism. This has become evident as a great number of components are stolen for their resale value as scrap steel. There are other smaller components stolen such as lubricants, pads, nuts, screws, washers, checkrails and chairs, which make the turnout whole and functional.

In some areas the theft has left the infrastructure paralysed completely where even the rails have been stolen.



Figure 2: Criminal caught in act of theft and vandalism of rails and fastenings

2.3. PICTORIALS



Fig 2.1: Stolen fastenings and other rail components



Fig 2.2: Stolen turnout components and sleepers



Fig 2.3: Vandalised and stolen rails



Fig 2.4: Stolen rails between Alliance & Daveyton station

3. OBJECTIVES OF THE PROPOSED PROJECT

3.1 DESIRED OUTCOMES FOR CARRYING OUT THE PROPOSED PROJECT

3.1.1. The project aims to restore the Perway infrastructure to enable the resumption of the train service. The strategy will be to appoint a contractor/s for the supply and installation of the Perway system on the identified section. Sections which are critical will be addressed first and the rest will be delivered according to priority.

3.2 PROJECT BENEFITS TO PRASA

3.2.1. The Project will assist the organisation to reinstate lines and corridors that have been closed due to the theft and vandalism of Perway system. This will therefore assist PRASA in achieving its primary mandate of providing a reliable rail transport service to Gauteng commuters and enable the business to collect fare revenue.

3.3 CURRENT MECHANISMS IN PLACE TO ADDRESS THE PROBLEM

3.3.1. In all the sections the in-house teams are busy repairing track gauge by replacing rails and fastenings to enable the region to run the passenger service.

All previous attempts to restore the network by PRASA teams have come to nought as thefts continued unabated, in the most recent incidents even rails have been cut and stolen by the vandals.

4. SCOPE OF WORK AND AREAS OF FOCUS

4.1 SCOPE OF THE DESIRED SOLUTION

The Supply and delivery of:

- 4.1.1 48kg/m, 57kg/m and UIC 60kg/m rails
- 4.1.2 F4, FY, P2, PY concrete sleepers
- 4.1.3 Wooden sleepers on turnouts
- 4.1.4 Fist and e Clip fastenings.
- 4.1.5 Turnout components
- 4.1.6 1:12 turnout sets
- 4.1.7 1:9 turnout sets
- 4.1.8 1:7 double slip 48kg/m and 57kg/m.

- 4.1.9 Single slip 48kg/m and 57kg/m.
- 4.1.10 Diamond crossing 48kg/m and 57kg/m.
- 4.1.11 Scissor crossing 48kg/m and 57kg/m.
- 4.1.12 Welding material
- 4.1.13 Ballast as per S406 specification
- 4.1.14 Track mounted Rail and Flange Lubricators.

4.2 DETAILS ON THE PREFERRED SOLUTION

- 4.2.1. The preferred solution in addressing the corridor recovery challenge is by appointing the service providers to supply material for the rehabilitation of Perway system.

4.3 AREA TARGETED BY THIS PROJECT

- 4.3.1. The supply will cover the delivery of the required material to the below stated depots and sites. The scope of supply for Perway is to cover the two Gauteng regions' designated locations:

- 4.3.1.1. Gauteng North – Infrastructure material stores, Rebecca street Depot, Pretoria west
- 4.3.1.2. Gauteng South – Driehoek material store, corner Branch and Junction road, Germiston
- 4.3.1.3. Rails will be delivered in various lengths of 6,18 to 36 meter between Johannesburg – Daveyton via rail and by road.

4.4 EXTENT AND COVERAGE OF THE PROPOSED PROJECT

- 4.4.1. The project will cover the Johannesburg – Daveyton corridor.

4.5 OTHER RELATED PROJECTS

- 4.5.1. National supply, delivery and handover of 48kg/m and 57 kg/m rails
- 4.5.2. National supply of Turnouts
- 4.5.3. National procurement of a Flash butt on-track welding machine

5. SPECIFICATION OF THE WORK OR PRODUCTS OR SERVICES REQUIRED

5.1 RAILS

5.1.1 RAILS TECHNICAL SPECIFICATION

- 5.1.1.1 Rails shall comply with the Infrastructure Perway Technical Specification for rails components, the Manual for Track Maintenance and EN13674-1 or equivalent specification.
- 5.1.1.2 The Supplier shall provide PRASA with proof that their product meets the EN13674-1 specification when submitting the tender.
- 5.1.1.3 The standard rail sections will be 48 kg/m, 57kg/m, and UIC 60kg/m in accordance with the South Africa Manual for Track Maintenance 2000, European Standard (EN 13674-1) and secondly UIC 860-0 / UIC 861-1, latest editions or equivalent standards.
- 5.1.1.4 The South Africa Manual for Track Maintenance 2000, relevant UIC codes, equivalent EN standards, latest versions, must be applied for the inspection, acceptance, supply, delivery, storage, quality assurance and acceptance.
- 5.1.1.5 Rail Grading.
- 5.1.1.5.1 The standard rail must be manufactured in accordance with South Africa Manual for Track Maintenance 2000, EN 13674-1 or equivalent and to the following grade:

Type	Profile	Trackwork Location	Steel grade	Tensile Strength	Brinell Hardness
48 kg	SAR 48	Cat. B & C Lines	R350LHT,	1175 N/mm ² ,	350 – 390,
57kg	SAR 57	Cat. B & C Lines	350 HT,	1175 N/mm ² ,	350 – 390,
UIC 60	60 E 1	Main Lines	350 HT,	1175 N/mm ² ,	350 – 390,

Figure 3: Rail profiles

- 5.1.1.5.2 The properties and chemical composition of the rail must be in accordance with EN 13674-1, latest edition or equivalent.

5.1.1.6 **Main Dimensions and Tolerances.**

5.1.1.6.1 The nominal dimensions of the section and ends must be within the following tolerances:

	<i>Dimension</i>			<i>Tolerances</i>
	<i>SAR 48</i>	<i>SAR 57</i>	<i>UIC 60 E1</i>	
Height of Rail	150 mm	165 mm	172 mm	± 0.5 mm ± 0.6 mm (UIC60)
Width of Rail Flange	127 mm	140 mm	150 mm	± 1.0 mm
Nominal Width of Rail Head	68 mm	70 mm	72 mm	± 0.5 mm
Asymmetry of Section				± 1.2 mm
Thickness of Web (at point of minimum thickness)				+ 1.0 mm - 0.5 mm
Inclination of fishing surface (on the basis of 14 mm parallel to the inclined theoretical fishing surface)				± 0.5 mm ± 0.6 mm (UIC60)

Figure 3: Rail Dimensions and Tolerances

5.1.1.6.2 The rail ends must be cut to 90 degree of the rail longitudinal axis to permit welding without preparatory cuts.

5.1.1.6.3 The supply of rails to be accompanied by the provision of 3D models and editable drawings.

5.1.1.7 **Rail length.**

5.1.1.7.1 The standard rail length will be as specified but generally 18, 36, 60m undrilled, measured at 15°C.

5.1.1.7.2 Short rails will be permitted ($E < 5\%$) as specified in the respective UIC code. The minimum allowable length is 6m.

5.1.1.8 **Branding and stamping.**

5.1.1.8.1 The rails will be marked in accordance with article 7.4 of EN 13674-1 and article 1.3 of UIC Code 860 or equivalent in such a way as to enable all finished rail steel to be traced to the cast from which it was made.

5.1.1.8.2 Brandings must be provided on one side of the web and must include the following:

5.1.1.8.2.1. The manufacturer's identification

5.1.1.8.2.2. The last two digits of the year of manufacture

5.1.1.8.2.3. The symbol of the steel grade

5.1.1.8.2.4. The symbol of the rail profile

5.1.1.8.3 In addition to the branding requirements each rail shall be identified by a numerical and/or alphabetical code system, at least every 10 m hot stamped on the non-branded side of the rail web.

5.1.2 MANUFACTURE

5.1.2.1 The steel making process must comply with the procedure of the Manufacturer as accepted by major railway companies' worldwide.

5.1.2.2 The Manufacturer is required to substantiate the necessary details for submission. The process must be one of the following: liquid steel melt tapped out of converter (basic oxygen) or electric arc furnace and must comply with article 7 of EN 13674-1 or equivalent.

5.1.2.3 The Manufacturer must describe in detail the process under which the rails are to be produced. The description must include:

5.1.2.3.1. the source of rail steel,

5.1.2.3.2. the steel making process,

5.1.2.3.3. chemical composition of final rails,

5.1.2.3.4. the procedure for straightening rails, and

5.1.2.3.5. the quality control system for manufacture.

5.1.2.4 The manufacturer must provide a certificate of conformance to his specification.

5.1.3 CORROSION PROTECTION COATING FOR RAILS

- 5.1.3.1 If rails are imported, rails destined for the coastal areas will be induced to the highly corrosive costal environment. Therefore, it is required that corrosion resistant coating is applied to rails that are destined to be delivered at the coastal areas. This process will happen as part of the manufacturing process for rails.

5.1.4 PROTECTION DURING TRANSPORT AND STORAGE

- 5.1.4.1 Storage and transport must be arranged such that the rails are not mechanically damaged and not exposed to aggressive chemical influences.
- 5.1.4.2 Rails are not to be stored at port awaiting shipment.
- 5.1.4.3 Suitable commonly used protection methods against environmental damage must be applied.

5.1.5 ACCEPTANCE TESTS

- 5.1.5.1 The manufacturer must supply the necessary gauges of each rolling to be used for spot checks on site.
- 5.1.5.2 Testing must be performed at the manufacturer's plant by independent qualified personnel which must be approved by the PRASA or by an approved testing agency in accordance with SABS 1431.
- 5.1.5.3 All major specification criteria must be tested and inspected to confirm compliance.
- 5.1.5.4 The frequency of testing must follow the respective standards of major railways, adjusted for smaller quantities.
- 5.1.5.5 Test certificates must be delivered with the rails.
- 5.1.5.6 No delivery may take place before acceptance by the Project Manager.
- 5.1.5.7 The testing and acceptance of the quality of the rails must include:
- 5.1.5.7.1. chemical composition,
 - 5.1.5.7.2. tensile tests,
 - 5.1.5.7.3. hardness tests,
 - 5.1.5.7.4. ultrasonic testing for internal defects,
 - 5.1.5.7.5. surface tests, and
 - 5.1.5.7.6. dimension tests

in accordance with the South Africa Manual for Track Maintenance 2000 and article 9 of European Standard Rails (EN 13 674-1) or equivalent.

- 5.1.5.8 The test results, considering both mechanical properties and chemical composition, will form the basis for classifying the steel as to specification.
- 5.1.5.9 A report of the required tests must be submitted to the PRASA RAIL Quality Assurance Inspector prior to delivery. The report of the test results must be traceable to each batch manufactured.
- 5.1.5.10 The manufacturer's quality assurance system has to be at least equivalent to the requirements of ISO 9001(latest edition). Qualifying tests must be carried out according to article 8 of EN 13 674-1. The current certificate must be submitted.

5.1.6 INSPECTION AND DISPATCH

- 5.1.6.1 Representatives of PRASA RAIL will be entitled to witness, at any time, the manufacturing process in all details, including all testing procedures (approval of the gauges of each rolling according Annexure "E" of EN 13674-1 or equivalent).
- 5.1.6.2 The manufacturer must give the inspector at least 15 days written notice of the date of rolling of the rails for this contract.
- 5.1.6.3 The inspector must stamp all rails accepted by him, at least 10% of each rolling out. No rails may be dispatched for use by PRASA RAIL unless 10% of each lot carry his acceptance mark.
- 5.1.6.4 Final inspection will be performed at the delivery point.

5.2 TURNOUTS

5.2.1 General

- 5.2.1.1 The turnouts for the rail types 48/57kg/m and 60E1, to be purchased for the state railway network shall be delivered according to these technical specifications. These technical specifications define the requirements of mechanical turnout parts as well as the functional, material and dimension requirements of sleepers and bearers. The turnouts are:
 - 60-173,6 -1:9 (Single turnout)
 - 60-300-1:12 (Single turnout)

60-904-1:20 (Single turnout)
 60-2x1:9-4.8 (Scissors crossover)
 SAR48/51-178-1:9 (Single turnout)
 SAR48/51-320-1:12 (Single turnout)
 DS48/51-190-1:9 (Double slip)
 SS48/51-190-1:9 (Single slip)
 CR48/51-1:9 (Diamond crossing)
 CR60-2x1:9 (Diamond crossing)
 SCR48/51-2x1:9-4.8 (Scissors crossover)

5.2.1.2 Technical information

5.2.1.2.1. Gauge: 1065 mm

5.2.1.2.2. Radius: as per layout

5.2.1.2.3. Turnout angle: as per layout

5.2.1.2.4. Rail: UIC 60 E1 or SAR 48

5.2.1.2.5. Rail inclination: 1 : 20 or 1 : 1 : ∞

5.2.1.3 Requirements and definitions of European standard EN 13232, part 1 to 7, Track – Switches and crossings-, must be fulfilled.

5.2.1.4 Turnouts having a radius 190 m or sharper ones are called short turnouts. Other turnouts are called long turnouts.

5.2.1.5 All Turnouts have to be designed with tangential geometry.

5.2.1.6 All Turnout parts shall be designed for static axle load of 26 (+10%) tons. Turnout parts shall be designed for highest permitted speeds as follows:

5.2.1.6.1. Straight track of turnouts: 120 km/h (+10 %, fixed frog)

5.2.1.6.2. Straight track of turnouts 160 km/h (+10 %, movable point frog)

5.2.1.6.3. Deviation radius: 174 m, 1:9 30 km/h (+10%)

5.2.1.6.4. Deviation radius: 300 m, 1:12 40 km/h (+10%)

5.2.1.6.5. Deviation radius: 600 m, 1:20 70 km/h (+10%)

5.2.1.6.6. Deviation radius: 900 m, 1:20 80 km/h (+10%)

5.2.1.7 All turnout parts shall be delivered for the temperature range 0°C to +60°C

5.2.1.8 The life-time of turnouts based on gross tons passing along straight track, for SAR48 and 60E1 turnouts, shall be at least 400 MGT (million gross register tons).

5.2.1.9 The geometry, element lengths and bearer distribution of delivered turnouts, as well as the location of point machines and other equipment, are described in the

track design of the turnout. A list of turnout designs is enclosed to these technical specifications.

- 5.2.1.10 The track gauge of turnouts is 1065 mm both on straight and side tracks, except for the bent switches of SYM (symmetric) turnouts and DS/ES (inside double or single slip) sharp turnouts less and equal 190 m radius, which have a gauge of 1070 mm.
- 5.2.1.11 Track gauges must have a manufacturing precision according EN 13 232-1 to EN 13 232-7
- 5.2.1.12 Turnout parts shall work with concrete sleepers / bearers.
- 5.2.1.13 The rails of the turnouts are to be installed either with inclination of 1: 20 or without inclination 1: ∞ throughout the turnouts.
- 5.2.1.14 In case of no inclination at the turnout area, the rail inclination of the adjacent track (1: 20) has to be changed to the rail inclination 1: ∞ at the length of two sleeper spacings. Therefore one turnout bearer has to be equipped with a rail seat presenting an inclination of 1:40.

5.2.2 Layout and Design Process

- 5.2.2.1 The design of turnouts should be in accordance with EN 13 232-9 specification.
- 5.2.2.2 At the end of the detailed component design of the Turnout layout, the contractor shall supply all the following information:
 - 5.2.2.2.1. Assembly documents.
 - 5.2.2.2.2. Detailed component plans.
 - 5.2.2.2.3. Parts list for the layout.
- 5.2.2.3 The content of these documents is described at EN 13232-9, chapter 7.5.
- 5.2.2.4 Furthermore, the contractor shall deliver the following additional information:
 - 5.2.2.4.1. Maintenance documents;
 - 5.2.2.4.2. Handling documents;
 - 5.2.2.4.3. Detailed component plans;
 - 5.2.2.4.4. Part lists for component plans.
- 5.2.2.5 The results and all documents required by the above mentioned EN Standard of each design step will be subject of the engineer's approval.
- 5.2.2.6 The contractor shall submit to the engineer's approval a report indicating the specifications of the materials for use in switch manufacture, technical drawings and manufacturing project details pertaining to the switch designs. The engineer

reserves the right of demanding modifications on the features provided in the said report. In such case, the contractor shall perform the said modifications on the project and resubmit it to the engineer for approval. The Contractor is not entitled to claim whatsoever resulting from such modifications.

5.2.3 Turnout Rails

- 5.2.3.1 Stock rails and points blades used in turnouts shall be of R 350LHT quality in accordance with European standard EN 13 674 -1 and EN 13 674-2 Switch and crossing rails.
- 5.2.3.2 In different parts of the standard normal rails, point blades and stock rails are described. Turnouts shall be manufactured of 60E1 or 48/51kg/m rails in accordance with track diagrams and the drawings appended to these technical specifications. However, the cross-section tolerance of 60E1 rail head is ± 0.5 mm.
- 5.2.3.3 Closure Rails and Rails of the crossing area of 60E1 1:9 turnouts shall be heat treated. The head hardness shall be in the range of 340...390 HB
- 5.2.3.4 Brinell hardness test method for rails is specified in EN ISO 6506-1.
- 5.2.3.5 Closure Rails and Rails of the crossing area of longer 60 E1 turnouts and of 48/51 turnouts are not heat treated.
- 5.2.3.6 60E1A4 rails or alternatively 60E1A1 rails machined to 60E1A4 rails or alternatively 60E1A1 rails machined are used as a blade rail in 60E1 turnouts. 51kg/m rails shall be used as a blade rail in 48/51 turnouts.
- 5.2.3.7 The delivery has to cover the entire rail material of the turnout; closure rails and rails of the crossing area have to be included in the delivery.

5.2.4 Glued Insulated Rail Joints

- 5.2.4.1 Corresponding to the existing and future signalling systems, the client will decide which turnouts have to be delivered with insulation joints.
- 5.2.4.2 Insulated joints are included in the delivery with oblique rail cut of 70° and six-bolt assembly, if they are required.
- 5.2.4.3 The electrical resistance of the insulated joints should be more than 1 MΩ.
- 5.2.4.4 The shortest insulation distance between the rail ends shall be 6 mm. Insulation joints shall be placed at the distance of 3.6 meters from rail joints. Insulated joints shall be suitable for CWR track.

5.2.4.5 Mechanical properties:

Both tests must be passed without failure of the adhesively bond area

5.2.4.6 Tensile Test:

Profile 60 E1 min. 2000 kN

5.2.4.7 Dynamic Fatigue load test:

Maximum load $P_{max} = 200 \text{ kN}$

Minimum load $P_{min} = 15 \text{ kN}$

Baring distance $l = 1000 \text{ mm}$

Frequency $f = 8 \text{ Hz}$

Load changes $L_c = 5 \text{ Mio. Cycles}$

5.2.4.8 Geometrical tolerances:

Vertical tolerances at the running surface: $+0.3 \text{ mm} / - 0.1 \text{ mm}$

Horizontal tolerances at the inner running edge: $+ 0.3 \text{ mm} / 0 \text{ mm}$

5.2.5 Fastenings

5.2.5.1 The rail fastening system must provide support, guidance, resilience and insulation between the turnout rail material and sleeper and must incorporate modern technological developments for all components.

5.2.5.2 The elastic rail fastening system can be either a direct fastening without a base plate or adapted to ribbed base plate.

5.2.5.3 The fastening system should be simple to install, capable of easy visual inspection and of screwed type.

5.2.5.4 The turnout fastening system have to be in accordance to the "TECHNICAL SPECIFICATION FOR ELASTIC RAIL FASTENING SYSTEMS" and the requirements of EN 13 484.

5.2.5.5 Stock rails of switches are fastened on the inside with springs installed inside the slide chairs or by them.

5.2.5.6 The compressive force of a spring shall be 12 -14 kN. The head of the stock rail is allowed to incline outwards by maximum 2.5 mm with the vertical force of 125 kN and the lateral force of 100 kN. The highest portion of the internal fastening shall be a minimum of 10 mm below the bottom surface of the tongue.

5.2.5.7 Stock rails of check rails can be fastened on the inside with springs which are mounted either inside or by the base plates or if there is enough room alternatively

normal spring fastenings suitable for ribbed base plates. The compression force to the rail foot shall be 12 - 14 kN.

5.2.6 Turnout Base Plates and Switch Base Plates

- 5.2.6.1 The delivery shall include all ordinary base plates with fastenings (fastening springs with possible screws, phosphatized nuts, washers, circlips and pads) needed between the front and back joints of a turnout, as well as all special base plates including fastening parts on the turnout area in accordance with the diagram, also in front of the front joint and behind the back joint. If the delivery does not cover the entire turnout, ordinary base plates and their fastenings in the middle rail area are not included in the delivery.
- 5.2.6.2 Special base plates in the closure rail area (including fastening parts) installed towards the switches are always included in switch deliveries. Special base plates (including fastening parts) installed towards the check rails shall always be included in the check rails deliveries.
- 5.2.6.3 Base plates which are mounted under obtuse crossings in double or single slips shall always be included in the delivery of switches.
- 5.2.6.4 Base plates may be roll-formed, forged or cast. The casting material shall be GGG 40.3. Roll-formed plates shall be of grade EN10025-S355J2G3. The diameter of rail screw holes in base plates is 2" 0.5 mm.
- 5.2.6.5 The bottom surface of base plates shall be horizontal. The rail resting surface of base plates may be a maximum of 1.4 mm concave throughout the width of the resting surface. Convexity is not allowed. The upper and under surfaces of sliding plates shall be parallel and straight.
- 5.2.6.6 **Switch base plates** shall by maintenance free sliding chairs of low friction and grease free slide chairs that provided consistent drive forces and longevity.
- 5.2.6.7 Base plates will be delivered installed on sleepers and bearers.
- 5.2.6.8 Sleeper screws shall have a grade of 5.6. They shall be grooved when hot.
- 5.2.6.9 Base plates must be in accordance with the UIV leaflet 864-4V -Technical specification for the supply of baseplates or sections for baseplates made of rolled steel, and well the concerned parts of EN 13484.

5.2.7 Wooden sleepers/ Bearers Screws and Bolts

- 5.2.7.1 Wooden sleepers to be laminated and comply with the Manual for Track Maintenance (2000)
- 5.2.7.2 Wooden turnout sleepers to be supplied as per the specified length.
- 5.2.7.3 Timber sleepers to be 2.1m, 2.4m, 2.7m, 3.0m, 3.4m, 3.8m, 4.2m in length.
- 5.2.7.4 Sleepers must be handled with care so that the outer layer of treated wood is not punctured or damaged.
- 5.2.7.5 Sleeper screws must be in accordance with UIC leaflet 864-1V -Technical specification for the supply of sleeper screws- and 864-2V -Technical specification for the supply of steel track bolts- as well the concerned parts of EN 13484.
- 5.2.7.6 Screw and bolt material shall have a grade of 5.6 and shall be tempered or hot galvanized.

5.2.8 Pads

5.2.8.1 General requirement

- 5.2.8.1.1 The pads installed between base plates and rails and Base plate and concrete bearers shall ensure that the elasticity of the turnout construction will be close to the elasticity of the track construction.
- 5.2.8.1.2 Therefore, the requirements of the “TECHNICAL SPECIFICATION FOR ELASTIC RAIL FASTENING SYSTEMS” and the requirements of EN 13484, must be considered.
- 5.2.8.1.3 Particularly the static and dynamic stiffness of the employed pads must be in accordance with the above-mentioned technical specification and EN Norm.

5.2.8.2 Pads between base plates and rails

- 5.2.8.2.1 The resilient pads shall be flexible pads between base plates and rails. They shall be used on all sleepers and bearers, but not however under the moving parts of tongues and movable crossings, nor at possible movement stop bolts in 60E1 or 48/51 turnouts. Pads shall be manufactured in accordance with category 1 of UIC leaflet 864-5V, 1.1.1986, appendix 2.
- 5.2.8.2.2 Pads shall have corners that prohibit plates from moving along the length of the turnout.

5.2.8.3 Pads between concrete bearers and base plates

5.2.8.3.1 Insulate pads between concrete bearers and base plates are included in the delivery. Rubber or plastic pads having a thickness of ≤ 4 mm shall be placed between concrete bearers and all steel parts (rails, base plates, end and intermediate reinforcements, fastening plates of point machines and contacts). Pads shall be manufactured in accordance with category 1 of UIC leaflet 864-5V, 1.1.1986, appendix 3.

5.2.9 Switches

5.2.9.1 A switch in a single turnout consists of two blades, two stock rails, their mutual fastening and supporting parts, turnout base plates with rail fastenings under stock rails and blades as well as end and intermediate reinforcements.

5.2.9.2 The design requirements, manufacturing, tolerances and inspection of the switch parts have to be in accordance with EN 13232 and particularly EN 13 235-5 Switches.

5.2.10 Crossings

Crossings shall be designed so that there is as little noise as possible when a wheel passes it.

5.2.10.1 Fixed common crossings

5.2.10.1.1 The design requirements, manufacturing, tolerances and inspection of the switch parts have to be in accordance with EN 13232 and particularly EN 13 235-6 Fixed common and obtuse crossings and EN 13 235-7 Crossings with movable parts.

5.2.10.1.2 Crossings shall be made of cast manganese steel according to UIC leaflet 866-V, 2nd edition, 01.01.1985. Joint rails of quality R 350 LHT shall be bond welded to the end parts (welded legs).

5.2.10.1.3 Geometrical tolerances of the leg welds:

Vertical tolerances at the running surface: $+0.3$ mm / $- 0.1$ mm

Horizontal tolerances at the inner running edge: $+ 0.3$ mm / 0 mm

5.2.10.1.4 The wing rails in short turnouts shall be made elevated in order to optimize wheel movement.

5.2.10.2 Fixed obtuse crossings

5.2.10.2.1 Crossing materials shall be identical to those mentioned in point 7.1. Other rails than end and knee rails of manganese crossings shall be heat treated in areas where wheels pass over. The hardness shall be 360...425 HB. Heat treatment should primarily be fine pearlite treatment. It is possible to use explosion hardening in cast manganese crossings, but it is not a requirement.

5.2.10.2.2 The check rails of crossings shall be elevated 40 mm -1, +/-9 mm.

5.2.10.2.3 All special base plates belonging to the crossing shall be included in the delivery of crossing.

5.2.10.3 Movable crossings

5.2.10.3.1 Crossings shall be made of cast manganese steel according to UIC leaflet 866-V, 2nd edition, dated 01.01.1985.

5.2.10.3.2 Joint rails of quality R 350LHT shall be bond welded to the end parts (welded legs).

5.2.10.3.3 Ends or end parts made of rail profiles or full-profile rails, forged end parts, joint rails welded to their ends that have been machined into rail-form as well as wing rails, are made of R350LHT steel. The movable point crossing can also be made of manganese steel.

5.2.10.3.4 All special base plates belonging to the crossing shall be included in the delivery of crossing.

5.2.10.3.5 The distance between sleepers at point machines is 650 mm.

5.2.11 Check Rails

5.2.11.1 33C1 check rail profile of steel grade R320Cr according to European standard EN 13674-3 "Check Rails" is used as check rails. The upper surface of a check rail shall be 20 mm above the head of the stock rail.

5.2.11.2 Check rail supports shall primarily be forged, but a welded structure is also acceptable.

5.2.12 Point Locking and Contacts

5.2.12.1 The turnouts shall have facilities for the use of clamp locking as well as for locks built into an electrically operated point machine. At the time of procurement will be decided whether clamp locking and their rods are included in the delivery. 60E1 turnouts shall have facilities for the electrical control of the position of tongues and movable crossing, at intervals of approximately 4 meters.

5.2.12.2 Clamp locking

5.2.12.2.1 Clamp locking is placed at the sleeper interval of 650 mm, with a free space of minimum 360 mm, together with two possible control rods to be installed at the tongue end.

5.2.12.2.2 The clamp locking shall lock both an open and a closed tongue simultaneously. The turnout is turned at the end of the operating rod. The setting movement of the operating rod shall be 220-240 mm.

5.2.12.2.3 The lock is to be attached to the stock rail with screws.

5.2.12.2.4 The housing of the clamp locking is fastened to the stock rail. The evenness of the gliding surfaces of the clamp locking shall be Rz 42 (Ra 12.5).

5.2.12.2.5 The gliding surfaces are lubricated with grease, which shall solidify at a lower temperature than -45°C. The gap between the tongue and the stock rail shall be adjustable by 0-5 mm, as well as equipped with a reliable device for locking.

5.2.12.2.6 Asymmetric bushings are used in the tongues of 60E1 turnouts.

5.2.12.2.7 The tongues of 54E1 turnouts have straight bushings, but the joint pin is attached asymmetrically to the tongue. The clamp fastening holes in tongues are Ø 34 H8 mm.

5.2.12.2.8 The lock parts shall be protected so that snow, gravel dust, etc. does not prohibit the lock from functioning. No parts of the lock may protrude lower than 100 mm below the lower surface of the rail.

5.2.12.2.9 The lock shall bear up trailing the switches at 40 km/h in an operating condition.

5.2.12.2.10 The clamp locking shall have an electric insulation so that the operation of rail circuits will not be interfered with.

5.2.13 Concrete Sleepers and Bearers

5.2.13.1 The concrete sleepers for turnouts have to be homologated, manufactures, tested in accordance to the EN 13 230-4 Prestressed bearers for switches and crossings.

5.2.13.2 Sleepers and bearers in each point are installed in right angle direction of the straight track.

5.2.13.3 The basics of design of the concrete bearers are the following:

5.2.13.3.1 Concrete bearers are ordered in lengths matching the track diagram.

5.2.13.3.2 The contractor calculates the locations of screw holes.

5.2.13.3.3 If the turnout requires special geometry, the contractor shall also calculate the lengths of bearers.

5.2.13.3.4 The applied and confirmed fastening system of the turnout.

5.2.13.4 Extent of the required supply of concrete bearers of each turnout if the turnout rail inclination is not continuously 1: 20

5.2.13.5 All bearers of the entire turnout panels

5.2.13.6 Three (3) bearers in front of the turnout with the following rail seat conditions:

5.2.13.6.1 One (1) corresponding with track rail inclination of 1: 20

5.2.13.6.2 One (1) for the transition rail inclination of 1: 40

5.2.13.6.3 One (1) without rail inclination of 1: ∞

5.2.13.7 Three (3) bearers at the end of the straight track of the turnout with the following rail seat conditions:

5.2.13.7.1 One (1) corresponding with track rail inclination of 1: ∞

5.2.13.7.2 One (1) for the transition rail inclination of 1: 40

5.2.13.7.3 One (1) without rail inclination of 1: 20

5.2.13.8 Three (3) bearers at the end of the curved track with the following rail seat conditions:

5.2.13.8.1 One (1) corresponding with track rail inclination of 1:∞

5.2.13.8.2 One (1) for the transition rail inclination of 1: 40

5.2.13.8.3 One (1) without rail inclination of 1: 20

5.2.13.9 All further bearers at the end of the straight and curved track of the turnout, presenting a length less than standard length of the track sleepers.

5.2.13.10 Storing of concrete sleepers and bearers

5.2.13.10.1 When stored concrete bearers shall be supported about 0.5 meters from the end of the bearers or otherwise make sure that bearers won't be bent. Rail screw holes shall be plugged with temporary plastic plugs at the concrete bearer factory.

5.2.13.11 Marking of concrete sleepers

5.2.13.11.1 Factory badge, two last digits of the manufacturing year, manufacturing month and the number of the mold shall be marked on concrete bearers, at the place defined by the drawings. The date of manufacturing shall be stamped or printed at the ends of the bearers. The date marking must be readable for at least two months after delivery.

5.2.13.11.2 The exact installation position of the turnout bearers and sleeper's axis have to be marked by white oil paint at the rail foot of both outer rails.

5.2.14 Protection against Corrosion

5.2.14.1 Machined surfaces, rail resting surfaces of turnout base plates and supporting surfaces of stock rails as well as counter surfaces of rails and tongues shall be protected with a zinc chromate primer.

5.2.14.2 All screws shall be dipped into oil, but not rail screws to be inserted in plastic bushings.

5.2.14.3 Gliding surfaces shall be greased with approved environmentally friendly grease.

5.2.15 Turnout markings

5.2.15.1 Turnouts and their parts shall be numbered so that right-hand turnouts get even numbers and left-hand turnouts odd numbers. Right-hand turnouts are marked with letter O and left-hand turnouts with letter V.

- 5.2.15.2 Plate numbers are stamped on the baseplate ribs. Forged parts are forged with the number of the forgery, the forging month, except for concrete casting which has its own rules in point 10.
- 5.2.15.3 Tongues, end reinforcements, wing rails of crossings and check rails shall have a shield attached to describing the manufacturer=s name, manufacturing year and month, rail profile, crossing relation, turnout number and the receiver. The number, manufacturing year and the name of the manufacturer shall also be stamped on the center part of the end reinforcement, the base of the tongue rail, the upper surface of a wing rail and in the center part of check rails.
- 5.2.15.4 During the pre-assemblage of the turnouts for the inspection at the factory, all positions for the sleepers and fixations shall be marked with paint at the rail foot base.
- 5.2.15.5 The stamped area shall be marked with white paint after priming against corrosion.

5.2.16 Package and Transportation

- 5.2.16.1 The contractor must present the package and loading manual of turnouts and turnout parts prior to the start of the manufacturing process to the design engineer for approval.
- 5.2.16.2 A part switch (Tongue and Stock rail) is loaded and delivered complete if not otherwise agreed. If a switch is delivered without sleepers, it shall be fastened at the factory to temporary wooden transportation beams prohibiting all sort of damage during handling and transportation. At the factory tongues shall be tightly fastened with steel wires to stock rails.
- 5.2.16.3 All loose parts shall be packed at the factory in separate transportation boxes for separate turnouts.

5.2.17 Acceptance of turnout components

- 5.2.17.1 PRASA representative or the inspector authorized by PRASA has always right to do acceptance inspections and must carry out those acceptance tests on the used materials he or she considers necessary.

- 5.2.17.2 PRASA representative or the inspector authorized by PRASA has always right to visit the manufacturing process at any time.
- 5.2.17.3 The contractor has the obligation to place personnel free of charge at inspector's disposal, as well as all tools, devices and material they will need in order to carry out the necessary tests and inspections.
- 5.2.17.4 The tolerances defined in these technical specifications and at the relevant EN 13 232 standards are used at the acceptance of a turnout.
- 5.2.17.5 The contractor shall produce an inspection report on all main parts of a turnout (switches, crossing and check rails) in accordance with the technical specifications and the relevant parts of the EN 13 232 Standards.
- 5.2.17.6 The inspection and testing reports and forms shall prepared be the contractor ad approved by the PRASA representative or the inspector authorized by PRASA.
- 5.2.17.7 The contractor shall prepare an inspection scheme for a whole turnout delivered installed on sleepers, and the scheme shall contain all main dimensions (rail lengths, track gauges, crossing control distances, flange grooves of crossing), and the manufacturing numbers of main parts. Two schemes shall be prepared, one of which is delivered to the PRASA's project manager and the other one to the installation site.
- 5.2.17.8 Turnouts are inspected assembled at the factory. Switches are inspected assembled with possible clamp locking devices fastened in place.
- 5.2.17.9 Crossings are inspected assembled on crossing base plates (except for obtuse crossings in crossing turnouts).
- 5.2.17.10 Check rails are inspected together with stock rails and special base plates with fastenings attached.
- 5.2.17.11 Heat treated parts are always tested for hardness. Crossings (not cast manganese steel) are tested with a penetrating color.
- 5.2.17.12 From the manufacturing batch of clamp parts of clamp locking is taken a 10 % sample, which is tested for example with a penetrating colour. From each manufacturing batch of clamps at least one clamp, or one percent sample, is taken for ultra-sonic testing. The clamp is to be tested at the shaft with a normal probe and a 45E angle probe.
- 5.2.17.13 Acceptance certificates shall be delivered for the used materials such as rails, tongue rails, crossing materials and supporting and intermediate cramps as well as

fastening parts such as base plates, compression plates, springs, pads, screws, etc.

5.2.17.14 The acceptance inspection of mass-produced materials is carried out by applying Wald sampling method or some other statistical acceptance method approved by the purchaser.

5.2.17.15 At the end of the testing and acceptance procedures of each turnout the contractor must produce an inspection certificate according EN 10 204, Type 3.1

5.2.18 Warranty

5.2.18.1 The contractor shall give a guarantee of latent defects on raw materials and work, starting at the beginning of the year following the delivery. Tongue rails and rails shall be guaranteed for five years according to UIC leaflet 860-V, 8th edition 1.7.1986, with amendments of 1.9.1988. Small parts (for example fastening devices) shall be guaranteed for five years.

5.2.18.2 The contractor accepts the obligation to replace defects at own cost without delay for any faults due to raw material, work or manufacturing methods.

5.2.19 Turnout Drawings

5.2.19.1 Drawings to be used

Drawings to be used are presented as appendices extracted from Manual for Track Maintenance (2000) to these technical specifications.

5.2.19.2 Drawings to be delivered

5.2.19.2.1 Before manufacture is started the contractor shall deliver to the purchaser two sets of complete drawings of the turnout parts he has designed, for inspection and approval. Scales: general layout 1:100, details: 1:50, 1:20 and 1:10, see also chapter two (2) of this specification.

5.2.19.2.2 After the approval the contractor shall deliver the drawings in electronic format (Micro CADAM Release 14/AutoCAD Release 13) and one set of plastic prints for files.

5.3 SLEEPERS AND FASTENINGS

5.3.1 TECHNICAL SPECIFICATION

5.3.1.1 Sleepers to comply with specifications referred to in the schedule of prices. Specification PWM 2/5 and drawings E3303 sheet 1 and 2, E3318 sheet 1 and 2 are attached to this document. Anti-theft (A/T) fastening system to comply with specifications referred to in the schedule of prices.

5.3.1.2 The sleepers and fastening system consist of the following components:

Item No.	Item Images	Item Description	Qty. per sleeper
		e2005 Anti-theft Clip	4
M00067398		e2006 Anti-sabotage Clip	4
M00056144		Sleeve for Anti sabotage clip	4
M00033574		T6 insulator	4
		A11/A17	4
M00020976		P2 HDPE Pad	2

M00015385		F4 Concrete Sleeper	1
M00023208		F4 Fist clip	2
M00075570		Fist Pin	2
M00032610		Base Plate E	2
M00041882		Extraction Tool	1 per 100 sleepers

Figure 5: Sleepers and fastening system

5.3.2 SHAPE AND SIZE OF SLEEPER AND FASTENINGS

5.3.2.1 The sleeper and fastenings shall be of the shape and configuration as indicated on the below table and indicated on Annexure A drawings:

5.3.2.2 The Fist rail fastening system comprises of a spring steel clip, rail pad and insulated retaining pin.

Table 1: "Fist" clip Fastening system

Sleeper	Rail kg/m	Fastening components		
F4	SAR 48	Clip spring	E – Base plate	Fist Pin
	SAR 57	Clip spring	E – Base plate	Fist Pin
FY	UIC60	Clip spring	E – Base plate	Fist Pin

Table 2: "e"- type clip fastening gauge plate combination for different gauges

Sleeper	Rail kg/m	Outer	Inner	Gauge	Inner	Outer
PY	UIC 60	UIC60/06/09	UIC60/06/09	1066	UIC60/06/09	UIC60/06/09
	SAR 57	T14	T11	1065	T11	T14

	SAR 48	T23	T17	1067	T17	T23
P2	SAR 57	T6	T6	1064	T6	T6
	SAR 48	T17	T11	1064	T11	T17
	SAR 57	A11	A17	1064	A11	A17
	SAR 48	A11	A17	1064	A11	A17

Figure 6: Sleepers and fastening system combination

5.3.3 ACCEPTANCE TESTS

- 5.3.3.1 Strength Defects or other defects with classifications on bending tests and concrete quality tests as described in PWM 2/5 shall be measured with respect to PWM 2/5 specification.
- 5.3.3.2 In all cases of rejection, full particulars shall be made available to the Chief Engineer.

5.4 WELDING MATERIAL

5.4.1 EXOTHERMIC WELDING

- 5.4.1.1 This specification is to be used for all consumable items such as alumino - thermic powder, crucibles, moulds etc. used for the alumino – thermic welding of rails on PRASA railway lines.
- 5.4.1.2 The specification is divided into four (4) sections:-
- 5.4.1.2.1. Section A: This section is applicable to all Exothermic welding consumables
- 5.4.1.2.2. Section B and C: These sections are applicable for alumino – thermic welding using the long-life crucible method for rail welding
- 5.4.1.2.3. Section D: This section is applicable for alumino thermic welding kits using the “SINGLE USE” crucible method for rail welding.
- 5.4.1.3 All the test methods and parameters relevant to each section are to be found in Appendix A of this specification.

5.4.2 GENERAL CONDITIONS

- 5.4.2.1 The alumino-thermic welding products and consumables shall be compatible with the following rail profiles normally used on PRASA railway lines:-
- 5.4.2.1.1. UIC 60
- 5.4.2.1.2. S 60
- 5.4.2.1.3. SAR 57
- 5.4.2.1.4. SAR48

5.4.2.1.5. Rail steel chemistries and metallurgies of Head Hardened (350LHT), UIC grade 1100 (Chrome Manganese), and UIC grade 900 (R260).

5.4.2.2 Gap sizes of “Small = 24 – 26 mm”, “Medium = 35 – 40 mm” and “Large = 40 – 50 mm” are to be catered for.

5.4.2.3 All products and processes offered by the Manufacturer in his tender shall be pre-tested by PRASA to ensure compliance with PRASA requirements and this Specification. The tests shall comprise “X-ray” or “Gamma ray” tests, static bending tests, fatigue bending tests, rolling load tests, chemical analysis of weld metal and hardness and metallurgical tests amongst others, as detailed in Appendix A of this Specification.

5.4.3 QUALITY CONTROL

5.4.3.1 The Engineer or his/her deputy will periodically inspect deliveries to ensure strict adherence to this specification. Any items, which are not to the specification, shall be rejected. No payment will be made for any rejected items.

5.4.3.2 All instrumentation and tests described in Appendix A required for Quality Control shall be at the Manufacturer’s expense.

5.4.3.3 Manufacturers shall state their quality assurance control measures that are employed during the manufacturing process of the Alumino–Thermic welding materials offered, as well as inspections and testing procedures.

5.4.3.4 PRASA reserves the right to have access to all documentation and testing equipment pertaining to the quality assurance of all Alumino – Thermic welding materials on prior arrangement.

5.4.3.5 The Manufacturer shall keep relevant proof documents of the tests performed on each batch, and must be able to submit copies to PRASA whenever requested. These documents must be available to PRASA for a minimum period of five years after the date of manufacturing.

5.4.3.6 In the event of material offered which has been approved by the SABS, the permit granted for use of their standardization mark shall be furnished to PRASA.

5.4.4 TECHNICAL REQUIREMENTS AND TESTING

Rails

- 5.4.4.1 The dimensions of the above-mentioned rails shall be as shown on Drawings Z1153 Sheets 1 & 2 and shall be within the normal rolling and straightness tolerances laid down in the EN13674 Specification for new railway rails.
- 5.4.4.2 The rails required to be welded shall be either new, worn or combinations of new to worn. The rails may contain existing fish-bolt holes and the products and process shall accommodate such holes. The Manufacturer shall advise with this tender, for approval by PRASA the maximum differences in rail height that can be accommodated in normal practice with his products and processes. In addition, the welding of rails with crown side wear of up to 26mm shall be satisfactorily accommodated by minor modifications to the alumino-thermic welding processes.
- 5.4.4.3 The Manufacturer shall design all equipment, processes and products to ensure safety of the welding operators and railway track, to prevent movement of or disruption to the joint set-up and to accommodate the temperature and environmental factors experienced by PRASA.
- 5.4.4.4 All products and processes shall be suitable for and compatible with all aspects of alumino – thermic welding work found on PRASA railway lines. Typical although not exhaustive requirements are rail inclinations of 1:20 relative to the sleeper, track super-elevations of up to 100 mm on track gauge of 1065 mm, gradients of up to 1:30 and track radii as sharp as 90 meters or combinations of such instances.
- 5.4.4.5 The crucibles shall be designed and manufactured to avoid splashing of liquid steel and be safe to use.
- As a special, a crucible design for containment or elimination of noxious gases when welding in confined areas such as tunnels shall be supplied with the tender.
- 5.4.4.6 The welding process shall be designed and the kits and products manufactured to produce a complete and satisfactory alumino – thermic weld by one PRASA trained welder and two assistants in a maximum of 45 minutes total track occupation.
- 5.4.4.7 The Manufacturer/Supplier shall supply full details with this tender of all ancillary equipment needed for the safe and correct performance of an alumino – thermic weld using the materials and processes for which he is tendering. The kits shall be as complete as possible for automatically ensuring the satisfactory completion of one alumino – thermic weld and avoid as far as possible the need for ancillary equipment.

5.4.4.8 All process and products shall be compatible with and suitable for the satisfactory and safe welding of the above-mentioned rail profiles with the following rail steel chemistries:-

- (a) UIC grade 1100 (Chrome Manganese)
- (b) UIC grade 900 A
- (c) UIC grade 700

In addition small quantities of head hardened rails of the following types are required to be satisfactorily and safety welded:-

- (a) Voest Alpine manufactured 350 HT
- (b) Thyssen Manufactured 350 HT and 350 LHT
- (c) Sogerrail manufactured 350 LHT and Micro alloy
- (d) Nippon Steel Corporation Micro alloy
- (e) NKK Corporation low and Micro alloy

5.4.4.9 The Manufacturer shall specify in his tender the recommended preheating and post heating processes and equipment for use with his product and processes. The post heating requirements of UIC grade 1100 rail shall be specifically required from the Manufacturer.

5.4.4.10 Specific details of the rise-ring system and process as pertains to the removal of the risers and the application of post heating requirements shall be submitted by the Manufacturer with his tender.

5.4.4.11 welds produced using the Manufacturers products and processes shall not contain any Micro – Shrinkage porosity larger than 0.2 mm. Should any micro shrinkage porosity be present, it's from shall be rounded and uniformly distributed throughout the rail steel. Chains of porosity and sharp forms shall be unacceptable. The tenderer shall advise with his tender the maximum size, concentration and disposition of micro shrinkage porosity expected with the use of his products.

5.4.4.12 The Manufacturer's products and processes shall not create any adverse or deleterious effects in welded track and on the environment.

5.4.5 PERFORMAMNCE REQUIREMENTS

5.4.5.1 Hardness of welds

5.4.5.1.1 The Manufacturer shall submit with his Tender the following details for approval by PRASA:

5.4.5.1.1.1 Details of the harness of the welds in “As Cast” condition without any work hardening

5.4.5.1.1.2 The minimum hardness (Vickers) expected in the spheroidised zones of a typical weld of the type tendered for. Measurement to be made on a smooth ground surface in “as cast” condition.

5.4.5.1.1.3 Explicit details of expected hardness profiles of the spheroidised zones of the weld. Such hardness profiles shall be produced using a Vickers hardness testing machine and shall consist of readings taken longitudinally along the centre line of the running surface of the rail crown at 1 mm intervals. The hardness profiles shall be for “as cast” condition subject to the normal and required post heating for the requisite rail steel type.

5.4.5.1.1.4 The maximum and minimum hardness in the spheroidised zone.

5.4.5.1.1.5 The maximum width of spheroidised zones as seen when etched with Ammonium persulphate solution.

5.4.5.1.2 The following goals should be aimed for by the Manufacturer:-

5.4.5.1.2.1. Maximum width of visible spheroidised zone when revealed by surface etching to be 6 mm.

5.4.5.1.2.2. Minimum harness in the spheroidised zones to be 280 Hardness Vickers for Head Hardened rail welds, 270 Hardness Vickers for UIC grade 1100 rail welds, and 220 Hardness Vickers for UIC grade 900A rail welds.

5.4.1.2.4. No martensite at all shall be permitted in the alumino – thermic weld.

5.4.5.2 **Mechanical and fatigue properties**

5.4.5.2.1 The minimum breaking loads and deflections for static bend tests performed as per Appendix A.

5.4.5.2.2 The alumino – thermic welding products and processes for UIC 60 profile, UIC grade 1100 rail welds shall produce a welded rail joint having the following fatigue capabilities:-

5.4.5.2.2.1. The alumino – thermic weld shall achieve a minimum fatigue life of 10 million cycles without failure when loaded cyclically to 160 MPa tension in the foot followed by 33 MPa tension in the crown when loaded in a cyclical manner at approximately 6 cycles per second.

5.4.6 PACKAGING AND MARKING

- 5.4.6.1 **PACKAGING:** The Manufacturer's disposable, single use crucibles shall be packaged in the same cardboard container with the appropriate, matched and metallurgical compatible, alumino – thermic welding portion for use with that specific crucible type.
- 5.4.6.2 **MARKING:** The packaging shall indicate in a clear, legible and non-coded language, on two of the exterior sides of the cardboard container the following:-
- 5.4.6.2.1. The process requirements applicable to the contents
 - 5.4.6.2.2. The top of the box
 - 5.4.6.2.3. The mass of the contents
 - 5.4.6.2.4. The maximum number of containers that may be stacked one upon the other without damage to the contents
 - 5.4.6.2.5. A clear, specific instruction regarding the mould and crucible requirements for the alumino – thermic portion contained in the cardboard container.
- 5.4.6.3 All packaging shall be colour coded, robust, double walled cardboard boxes in accordance with PRASA specification CP1/1 and special packaging requirements as per each attached specification shall be complied with.

5.5 THE SUPPLY OF ALUMINO-THERMIC WELDING KITS USING “SINGLE USE” CRUCIBLE METHOD FOR RAIL WELDING

5.5.1 INTRODUCTION

- 5.5.1.1 This section supersedes all previous documents and instructions relating to Alumino-thermic welding kits used for Rail Welding with the “SINGLE USE” crucible method by PRASA. The term “SINGLE USE” crucible is not specific to any one manufacturer's brand name or product and is used in this specification to describe a crucible system that can only be used for the casting of one Alumino-Thermic weld.

5.5.2 DEFINITIONS AND REQUIREMENTS

The following specific terms relating to Alumino-Thermic welding kits for the “SINGLE USE” method shall apply:-

5.5.2.1 Alumino-Thermic Welding Kits

- 5.5.2.1.1 A colour coded robust double wall cardboard box in accordance with PRASA's TRACK WELDING MANUAL containing Alumino-Thermic portions, “SINGLE USE” crucible, moulds and all consumables necessary for the satisfactory completion of an Alumino-Thermic weld.
- 5.5.2.1.2 The manufacturer shall specify with his tender all ancillary equipment needed for the safe and correct performance of an Alumino-Thermic weld using this kit.
- 5.5.2.1.3 The kit shall be as complete as possible to avoid the need for ancillary equipment.
- 5.5.2.1.4 The welding process shall be designed and the kits manufactured to produce and complete a satisfactory Alumino-Thermic weld by one PRASA trained welder and two assistants in a maximum of 60 minutes total track occupation.
- 5.5.2.1.5 The Manufacturer shall specify in his tender the recommended preheating and post heating processes.

5.5.2.2 Alumino-Thermic Welding Portion

- 5.5.2.2.1 An individually sealed plastic bag with a minimum thickness of 150 micron containing a quantity of Alumino-Thermic powder mixture used for the welding of rails together under field conditions. The portion shall be chemical, metallurgic and physically compatible with the “SINGLE USE” crucible system.
- 5.5.2.2.2 Each Alumino-Thermic Welding Powder Mix shall be of sufficient quantity to liberate welding metal that will completely fuse into both rails ends, fill collars, risers and leave enough excess metal on the crown for directional solidification purposes, in accordance to the relevant rail section crucible and moulds used.
- 5.5.2.2.3 The determination of individual portion weights for the various rail sections and relevant welding processes shall be the responsibility of the Manufacturer.
- 5.5.2.2.4 Each portion bag must be identified by a computer printed colour label stating:
 - 5.5.2.2.4.1 Batch and sequence number
 - 5.5.2.2.4.2 Portion quality, rail mass and relevant welding process
 - 5.5.2.2.4.3 Date of manufacture
 - 5.5.2.2.4.4 Total weight of the Exothermic Welding Powder Mix.

5.5.2.3 “SINGLE USE” Crucible and Preformed Moulds

- 5.5.2.3.1 The kit shall contain a compatible “SINGLE USE” refractory crucible compete with automatic tapping system, preformed refractory moulds, plugs, sealing compound and igniter.
- 5.5.2.3.2 The “SINGLE USE” crucible shall be chemically inert and have no metallurgical effect on the Alumino-Thermic weld.
- 5.5.2.3.3 The “SINGLE USE” crucible shall fit automatically and firmly on the moulds at all times during the preparation, ignition and casting of the Alumino-Thermic weld. The fit and alignment of the moulds on the rails hall be checked closely by the welder, and must be firm and not influenced by the crucible, or the Alumino-Thermic welding process, reaction or casting.
- 5.5.2.3.4 Tapping time of the “SINGLE USE” crucible shall be automatic after the reaction is initiated and shall be between 20-30 seconds. The manufacturer shall state the tapping time in his tender and all material supplied shall comply with this tapping time range. The tapping time shall allow for all metallurgical mixing of the liquid steel and separation of the slag. No deleterious metallurgies shall be permitted.
- 5.5.2.3.5 The preformed Refractory Moulds shall fit onto a specified rail profile or profiles in the case of stepped moulds for worn rail profiles. They shall be strengthened by metal supports and have the ability to withstand temperatures of over 2000°C.
- 5.5.2.3.6 Each set of moulds is to be packed in a single wall cardboard box. The mould cardboard box shall be shrink-wrapped.
- 5.5.2.3.7 For easy identification, colour coded labels must be used on the boxes indicating the date of manufacture, rail size and welding process.
- 5.5.2.3.8 Patterns for the different rail profiles and various welding process used by PRASA are to be provided by the Manufacturer.
- 5.5.2.3.9 The storage life of all the separate component parts of the “SINGLE USE” crucible Alumino-Thermic welding kit when kept under dry conditions, shall be at least three years from the date of manufacture. This shall include for all transport environments including shipping by sea.
- 5.5.2.3.10 The outside texture and appearance of the moulds and plugs must be smooth and bonded in such a manner that disintegration of sand particles will not occur when rubbed by the fingers. The mould and riser design shall be such that no deleterious metallurgies or stress raisers are created at any stage in the Alumino-Thermic welding process. This includes the process of removal of the risers after

casting of the welds. The design shall be such that no adverse metallurgies are created which may have an effect of reducing the fatigue life of the weld.

5.5.2.3.11 The new moulds and “SINGLE USE” crucibles shall be devoid of cracks, cavities, air pockets or any other defects which may lead to loss of exothermic steel.

5.5.2.3.12 Deformed, cracked, broken or disintegrating moulds or “SINGLE USE” crucibles shall not be accepted.

5.5.2.4 **Igniter**

5.5.2.4.1 Igniters are pyrotechnics that initiate the Alumino-Thermic reaction in a charged crucible.

5.5.2.4.2 The flash point for this igniter shall be in excess of 200°C.

5.5.2.4.3 Igniters shall be packed separately from the Alumino-Thermic Weld portions in the welding kits.

5.5.2.5 **Sealing Method**

5.5.2.5.1 The Manufacturer shall state in his tender full details of the proposed method of sealing the moulds against the rails. Sufficient product and applicator for one complete weld including for waste shall be included in the kit. The sealing product shall be sealed separately in a hermetically sealed container inside the kit box. The sealing product shall not allow moisture into the weld and shall not allow any deleterious metallurgies to form inside or on the surface of the weld i.e. porosities, holes, gas bubbles. As prescribe in the Track Welding Manual, clause 11.12.1 – 11.12.10

5.5.2.5.2 The acceptance of different types of sealing methods shall be subject to full agreement between the Engineer and Supplier.

5.5.2.6 **Batch**

5.5.2.6.1 A batch shall consist of a number of portions, not exceeding 1100. Test welds, using Alumino-Thermic welding portions from the production batch shall be performed and documented on each batch.

5.5.2.6.2 These test samples shall be identified by a computer printed colour coded label conforming to the batch under production.

5.5.3 MANUFACTURING PROCESSES

5.5.3.1 The Alumino-Thermic welding portions

The Alumino-Thermic welding portions shall be manufactured from processed iron oxide, atomized aluminium powder and pelletized ferro-alloys.

5.5.3.2 SINGLE USE Crucible

- 5.5.3.2.1 The 'SINGLE USE' crucible shall be manufactured from a high-grade thermal shock resistant material. The material shall be chemically and metallurgical inert and shall have no deleterious effects on the Alumino-Thermic weld.
- 5.5.3.2.2 The "SINGLE USE" crucible shall tap automatically. The automatic tapping components shall also be chemically inert and have no deleterious effects on the Alumino-Thermic weld.
- 5.5.3.2.3 The "SINGLE USE" crucible shall safely contain the Alumino-Thermic portion at all stages of the process prior to tapping.
- 5.5.3.2.4 The minimum life expectancy of the "SINGLE USE" crucible shall be one weld.
- 5.5.3.2.5 The "SINGLE USE" crucible shall be designed and manufactured to ensure the correct process is automatically achieved.
- 5.5.3.2.6 the "SINGLE USE" crucible shall be designed and manufactured to ensure full reaction of the Alumino-Thermic portion, the correct metallurgical mix of alloys and separation of slag, and prevent splashing of the liquid steel or slag.
- 5.5.3.2.7 As a "Special" on demand by PRASA a "SINGLE USE" crucible for use inside tunnels shall be designed manufactured and supplied which will comply with this Specification and shall also contain all noxious gases produced in the Alumino-Thermic welding process. Separate rates for this "Special" shall be included in the tender.

5.5.3.3 Preformed moulds and pouring plug

- 5.5.3.3.1 The moulds and plugs shall be manufactured from a high grade quartz sand, thoroughly mixed with a binder, gassed with carbon dioxide and hardened in an oven.
- 5.5.3.3.2 Raw materials that will have a deleterious effect on the permeability of the moulds or on the Alumino-Thermic steel due to chemical interference will not be permitted.

- 5.5.3.3.3 Additions shall be made to the mould and the plug raw material mix to increase the heat and moisture resistant characteristics.
- 5.5.3.3.4 Moulds shall be supplied in a totally dried condition.
- 5.5.3.3.5 The moulds shall be designed, manufactured to accommodate the following rail profiles; SAR 48; SAR 57; S 60, 60E1 and UIC60.
- 5.5.3.3.6 Stepped moulds to accommodate worn rail profiles shall be designed and manufactured for steps of 3mm, and 6mm vertical crown wear on the above profiles.
- 5.5.3.3.7 Special moulds shall be designed, manufactured and supplied for use on side – worn rails of the above rail profiles. Up to a maximum of 26 mm side wear shall be accommodated. Separate rates for these “Specials” shall be advised in the tender.
- 5.5.3.3.8 Details of the mould design and rise-ring system, the expected fatigue life including “S-N” curves shall be supplied by the Manufacturer with his tender.
- 5.5.3.4 **Igniters**
- 5.5.3.4.1 Igniters shall be manufactured in the form of a pyrotechnic.
- 5.5.3.5 **Sealing compound**
- 5.5.3.5.1 Screened dry sand with bonding agents shall be used. With the addition of 5% moisture, the sealing sand must form a suitable sealing bonding mixture.
- 5.5.3.5.2 Alternative sealing methods may be proposed by the manufacturer and submitted to PRASA for approval. These proposals shall be in addition to the tenderer's prices based on the 5% water/sand sealing method.

5.5.4 PACKAGING AND DISPATCH

- 5.5.4.1 Each Alumino-Thermic portion shall be packed according to clause D3.2 in order to prevent spilling, ingress of foreign matter or contamination by water.
- 5.5.4.2 Each bag of sealing sand shall be packed according to clause D3.6.3.
- 5.5.4.3 Igniters shall be packed according to clause D3.5.3
- 5.5.4.4 All the above items shall be packed separately into a master robust cardboard container which complies to PRASA's TRACK WELDING MANUAL with the following markings printed onto the boxes. As prescribe in Manual for Track Welding, Clause 11.1.5 and 11.1.6.

The Tenderer shall design all packaging to accommodate the stacking requirement. Alternatively, the Tenderer shall make recommendations in his tender as to the stacking requirements and mark his boxes accordingly.

5.6 BALLAST

5.6.1 SCOPE OF WORK REQUIRED

5.6.1.1 This contract and specifications cover the provision of BALLAST STONE to PRASA Rail Gauteng province. The ballast to be loaded onto AY rail wagons at the supplier's local siding by the supplier, the delivery and offloading of ballast transported by rail to be done by PRASA. In some instances of derailments and emergencies, ballast to be delivered by road to PRASA stockpile siding. Prices tendered shall be the ex-works, loaded onto road trucks and transport cost will be borne by the supplier. Ballast will be ordered on an "as-and-when" required basis with a one-month notification period

5.6.2 GENERAL

5.6.2.1 Ballast stone shall comply with SABS 1083:2013 Edition 2.3. In addition, the ballast stone shall comply with the requirements specified hereinafter. Acceptance of the stone shall also depend on a full petrographic analysis to identify any micro fissuring, weakness and/or the presence of undesirable minerals that could lead to early degradation.

5.6.3 LOADING OF STONE

5.6.3.1 The Contractor will be responsible for the loading of stone within their area of operations and the offloading of stone from the trucks in the area indicated by PRASA Rail Gauteng.

5.6.3.2 The Contractor to ensure that all road trucks are loaded to the correct allowable carrying capacity. Any penalties for the overloading of vehicles will be for the contractor's own costs.

5.6.4 STANDARD OF WORKMANSHIP

If the ballast delivered does not comply with specifications as mentioned in this document, it will not be paid for.

5.6.5 TECHNICAL SPECIFICATIONS FOR BALLAST

- 5.6.5.1 The standard ballast type must be in accordance with European Standard (EN 932, EN 933, EN 1097, EN 1367, EN 1483, EN 13 450-1, EN ISO/IEC 17 025, EN 27 888), latest editions or equivalent standards.
- 5.6.5.2 The relevant UIC codes, equivalent EN or ASTM E standards, latest versions, must be applied for the inspection, acceptance, supply, delivery, and storage and quality assurance.
- 5.6.5.3 Ballast stone shall be in accordance with specification for stone S406 and Appendix A, B, C attached.

5.6.6 TECHNICAL REQUIREMENTS

- 5.6.6.1 The ballast must be from hard, durable machine crushed stone (i.e. granite) extracted from a quarry from none-friable weathered rock, free from organic impurities and inorganic residue.
- 5.6.6.2 The ballast should, as far as possible, be cubical in shape.
- 5.6.6.3 The grain shape has to be irregular sharp broken. Individual pieces should not be flaky and should generally have flat faces with not more than two rounded/sub rounded faces.
- 5.6.6.4 The ballast must also be permeable to both air and water drainage.
- 5.6.6.5 The Aggregate Abrasion Value must not exceed 30%.
- 5.6.6.6 The Aggregate Impact Value and Crushing Value must not exceed 14 % (Los Angeles coefficient).

5.6.7 GRANULOMERTY

- 5.6.7.1 The grading must be between 31.5 mm to 63 mm to enable proper and long-lasting mechanical tamping of the track.

5.6.7.2 The critical values or limits of the different granulometry of the ballast stones must be indicated in "...V.-%".

5.6.8 SIZE AND GRADATION

5.6.8.1 The ballast must satisfy the following size and gradation in accordance to EN 13450:

5.6.8.1.1 63mm sq. mesh sieve: retaining limit 97% to 100%

5.6.8.1.2 50mm sq. mesh sieve: retaining limit 65% to 100%

5.6.8.2 Limited amounts of under sized grains of less than 22.4mm are allowed:

5.6.8.2.1 Up to 3.0 V.-% in the quarry

5.6.8.2.2 Up to 5.0 V.-% on the track

Figure for grain size distribution of ballast

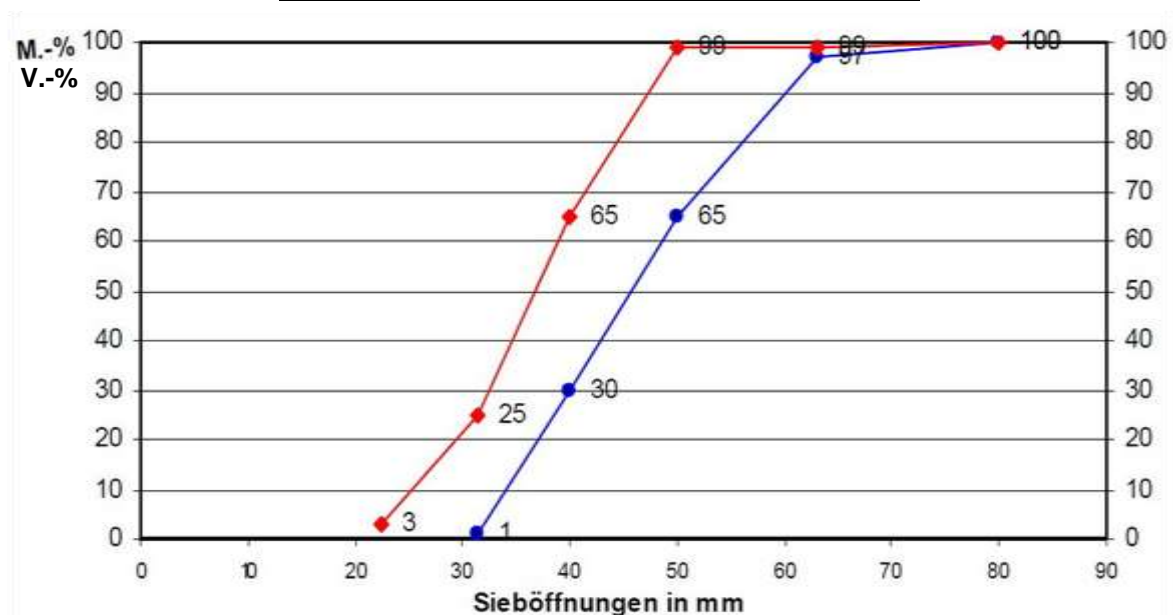


Figure 7: Grain size distribution of ballast

5.6.9 TEST EQUIPMENT ACCORDING TO EN 933-2:

5.6.9.1 **Square mesh sieves:** 22.4mm, 31.5mm, 40mm, 50mm, 63mm, 80mm

5.6.9.2 **Size of sieves:** 500mm x 500mm or diameter of 400mm

5.6.9.3 **Wire mesh sieves:** 0.5mm and 0.063mm

- 5.6.9.4 Balance with scale of 1gram
- 5.6.9.5 Balance with scale of 0.1gram: Measurement of water-absorbing capacity (according EN 1097-6)
- 5.6.9.6 Test volumes: for all tests more than 100Kg, minimum 50 Kg of ballast.
- 5.6.9.7 **Fines** - less than 0.5mm: maximum **1.0 V.-%**;
- 5.6.9.8 **Fines** - less than 0.063mm: maximum **1.0 V.-%**; in tunnels: **0.5 V.-%**

5.6.10 FORM OF GRAIN:

- 5.6.10.1 Volume of grains with length/thickness equal to or greater than 1/3 must be between **5.0 - 30.0 V.-%**
- 5.6.10.2 **Grain shape:** irregular, sharp, mechanically broken rocks.
- 5.6.10.3 **Grain length greater than 100mm:** less than **6.0 V.-%** per **40** kg sample, according to EN 13 450, chapter 6.7, table 6.

5.6.11 PHYSICAL REQUIREMENTS

The Resistance against Cracking has to be approved in the following 3 types of tests below:

5.6.11.1 Crack and Abrasion Resistance (Los-Angeles-Test)

The Los-Angeles-Test must be realized according to EN 13 450 Chapter 7.2, table 7, Category LA_{RB20}.

5.6.11.2 Resistance against Cracking

The test must be realized according to EN 13 450 Chapter 7.2, table 8, Category LA_{RB18}

5.6.11.3 Particle Shape and Flakiness index

- 5.6.11.3.1 The shape of ballast shall be determined in terms of Flakiness index as specified in EN 933-3. The Flakiness index must be declared in accordance with EN 13 450, chapter 6.6.1, table 4 with the relevant Category FI₁₅.
- 5.6.11.3.2 The maximum value of the Shape index of the ballast, determined according to EN 933-4 has to be in accordance with EN 13 450, chapter 6.6.2, table 5 with the relevant Category SI₁₀ max SI₂₀.

5.6.12 DURABILITY

5.6.12.1 Compactness

The compactness must be determined according to EN 1097-6 (basket test grains 31.5/40mm). The dumping compactness is half of the compacted ballast.

5.6.12.2 Weathering Resistance

5.6.12.2.1 In order to judge the weathering resistance, the water absorption of the ballast has to be determined according to EN 1097-6 (minimum of 10 grains of different varieties with a minimum of 5 pieces for each variety)

5.6.12.2.2 If the water absorption is more than 0.5V.-% of one grain, a crystalline test has to be done (magnesium sulfate-resistance (MgSO_4) test) for the grading of 31.5/50mm according EN 1367-2.

5.6.12.2.3 The spalls passing the square mesh sieve of 22,4mm must be less than 3.0V.-% after the crystalline test (magnesium sulfate-value (MgSO_4))

5.6.12.3 Sun damage, volume stability

5.6.12.3.1 During testing of basalt stone ballast against sun damage, no star type staining with hair line cracks must occur. If this should occur, a quality test must be done according to EN 1367-3.

5.6.12.3.2 After the heating test, a shock test has to be done. The shock-cracking-value SZ_{RB} has to be taken before and after cooking of the ballast stones. The difference of the shock-cracking-value SZ_{RB} before and after cooking must be less than 5.0V.-%

5.6.12.4 Property and State (Condition) of Ballast

5.6.12.4.1 The ballast must be free from organic impurities and inorganic residue.

5.6.12.4.2 No components of clay or marl must be in the grains.

5.6.12.4.3 The Ballast must be free of weak rocks like:

- a) Brown, weathered and discomposed grains

- b) Grains with cracks and/or ferro-manganese-oxide-, limonite- or hematite fissures
- c) Schist pieces of ballast

5.6.12.4.4 Weak rock grains are only allowed as part of the ballast up to a **maximum of 1.0V.-%**

5.6.13 QUALIFICATION OF SUPPLIERS

- 5.6.13.1 Before the first supply of ballast to PRASA RAIL or their contractors, the supplier has to prove his qualification and competence to produce ballast, especially when opening new quarries or long periods between ballast productions.
- 5.6.13.2 A precondition for the first supply of ballast from a supplier is a scientific certification/expertise carried out by an independent expert or a quality assurance company nominated by PRASA RAIL.
- 5.6.13.3 Suppliers without a certificate will not be allowed to deliver ballast to PRASA RAIL or their contractors.

5.6.14 QUALITY ASSURANCE OF THE BALLAST

- 5.6.14.1 Tests of the ballast will be executed according to EN 932-1 and/or requirements of PRASA RAIL and the supplier's quality control plan.
- 5.6.14.2 The petrographic analyses have to be executed according to EN 932-3.
- 5.6.14.3 These tests must be done for the purpose of monitoring quality during supply. In cases where the test results are not as per the described specification and/or ENs, further supplies must be suspended until suitable corrective action is taken and supplies ensured as per specifications/EN.
- 5.6.14.4 A report of the required tests must be submitted to PRASA RAIL Quality Assurance Inspector prior to delivery. The report of the test results must be traceable to each lot produced.
- 5.6.14.5 The above tests may also be carried out in the laboratory of PRASA RAIL or TRANSNET.

5.6.15 INSPECTION AND DESPATCH

- 5.6.15.1 Representatives of PRASA RAIL will be entitled to observe, at any time, the method of ballast production and all testing procedures of the supplier in detail in

accordance to European or equivalent Standards (EN 932, EN 933, EN 1097, EN 1367, EN 1483, EN 13 450-1, EN ISO/IEC 17 025, EN 27 888, latest editions)

5.6.15.2 PRASA RAIL will also be entitled to carry out quality assurance tests at as and when required.

5.6.15.3 The supplier must give the inspector of PRASARAIL at least 15 days written notice of the date of testing the production.

The inspector will stamp all results of testing accepted by him. No portion of ballast may be despatched for use by PRASA RAIL unless the documents carry his acceptance mark.

5.6.15.4 The final inspection will be performed at the point of delivery.

5.7 RAIL LUBRICATORS

5.7.1 SCOPE OF WORK REQUIRED

Wayside Rail lubrication systems used at PRASA must lubricate the gauge face on curved tracks at identified sections/curves along railway track. The system should be mounted of the outside high-leg rail on curves. The wayside lubricating system should have the following characteristics;

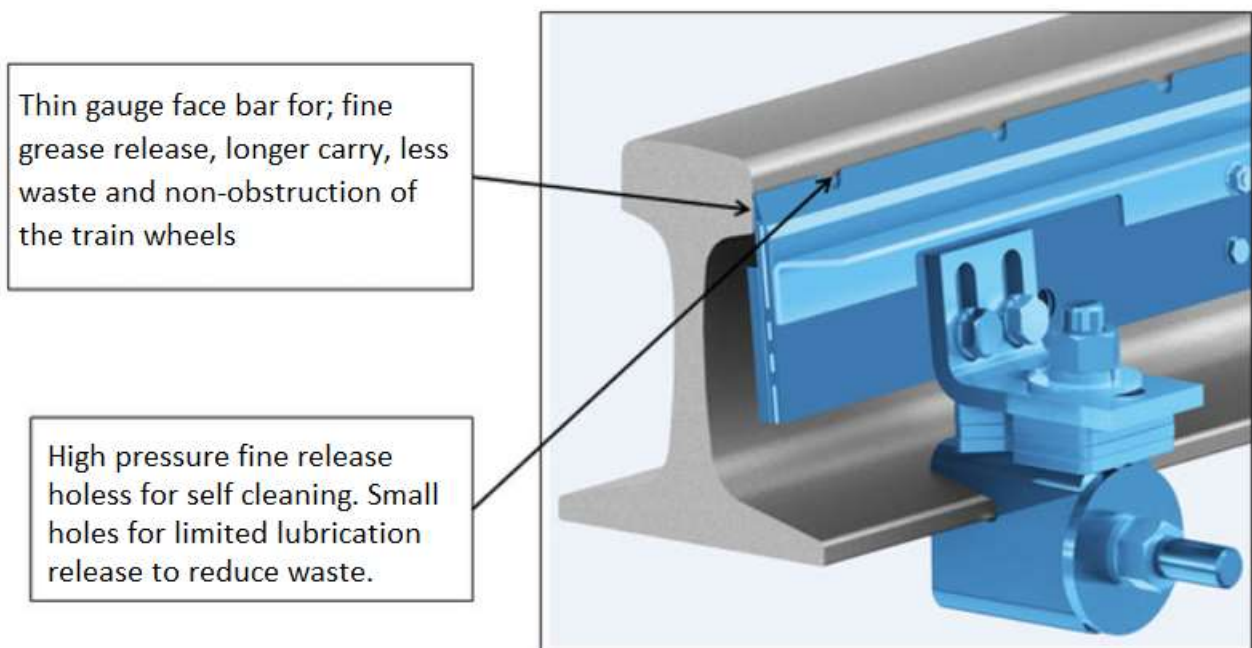
5.7.1.1 Wheel/train sensing system

The system should be able to sense the arrival on a train of a wheel for the lubrication system to be dispensed. It is preferred that this is a mechanical system and nothing else. PRASA has reviewed other electrical wheel/train sensing systems, however to reduce the added maintenance that comes with it a mechanical system was adopted. Therefore, this mechanical system will detect the arrival of the train/wheel before applying the lubrication onto the rail gauge face. The applied lubrication will be carried by the wheels along the length of the curve.

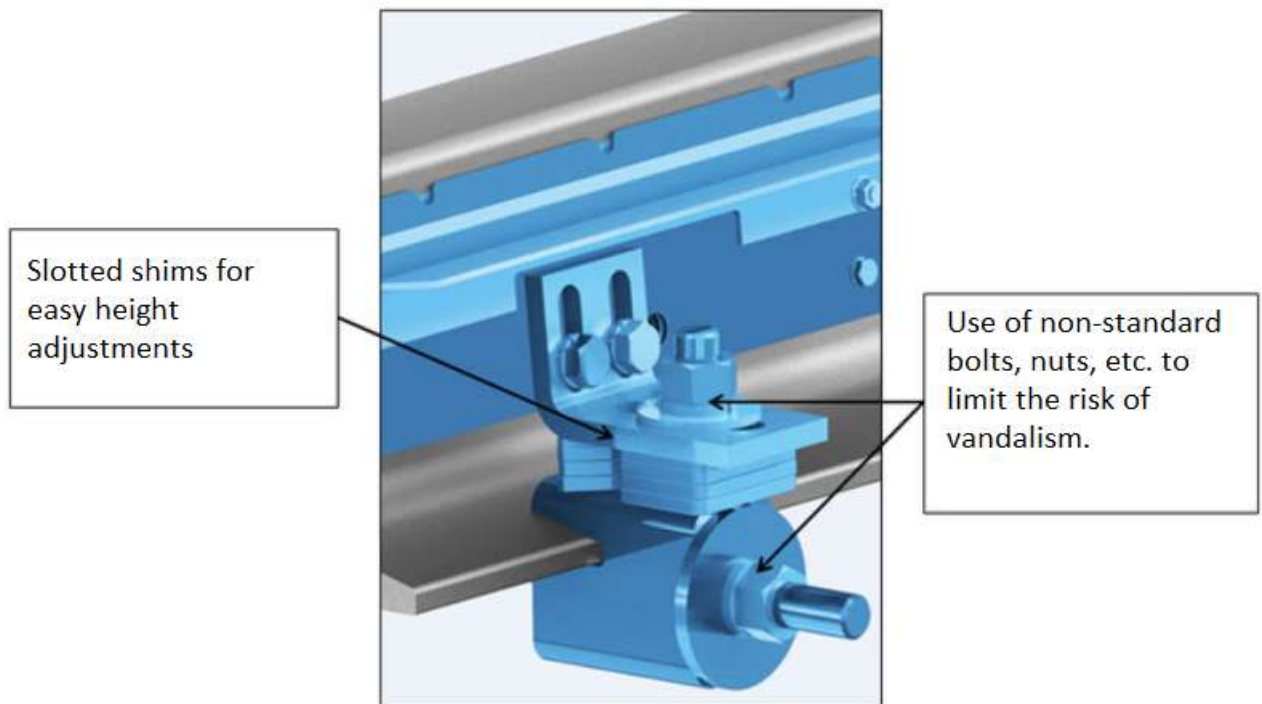
5.7.1.2 Grease lubrication system/mechanism

5.7.1.2.1 Upon activation of the wheel/train sensing system, the lubrication should be pumped out of its storage reservoir into the inner rail gauge face to lubricate the rail and be carried along the curve of the outer high-leg rail. The lubrication should be slightly squirted on the gauge face as illustrated on the image below. PRASA

requires the ability to control the amount of grease/lubrication released onto the gauge face. Therefore, the gauge face bar needs to be adjustable in such a way that the amount of grease released may be controlled by PRASA. The gauge face bar should be mountable using a clamping system on the rail, without the requirement of welding.



5.7.1.2.2 The application mechanism should be height adjustable so that the gauge face bar may be place as high as desired. This can be used to increase the carrying on longer curves. PRASA requires the use of non-standard bolts, nuts socket, etc. to limit the risk of vandalism. An example of such a system is illustrated below.



5.7.1.2.3 Suppliers are welcome to use propose their designs, however they need to comply or surpass to the elements/requirements stated above.

5.7.1.3 **Grease storage**

5.7.1.3.1 The grease/lubrication storage reservoir should have enough capacity to lubricate a curve without needing replenishment for a period of two to three months. The reservoir should have the following properties:

- a) Allow for easy level assessment to check if the lubrication is running empty and at what level
- b) Quick coupling connections for easy replenishment of the lubricating fluid
- c) Equipped with non-return valve to limit contamination of the lubricating fluid
- d) Should not be attached to the rail
- e) Can easily be buried under the ballast as a vandal deterrent
- f) Painted grey to blend in with the railway environment (the surrounding ballast). No bright colours will be accepted.
- g) Use non-standard bolts and nuts
- h) Maintain the thermal stability to ensure consistent viscosity of the lubricating grease

- i) Brackets, hoses, fasteners, couplers used should be resilient to extended exposure to sunlight, materials used should not deteriorate the longer they are in the sun

5.7.1.4 Pumping and application mechanism

5.7.1.4.1 The pumping mechanism should be activated by the mechanical sensing system outlined in section 5.7.1.1. The amount of lubricating grease pumped out should be adjustable. The pump should have some of the following characteristics:

- a) Ensure a constant grease output per activation
- b) Adjustable to ensure the desired pressure
- c) Ability to bleed air locks from the system
- d) Equipped with non-return valves
- e) low chemical corrosiveness
- f) high anti-wear characteristics
- g) low tendency to cavitate
- h) total water rejection
- i) constant viscosity, regardless of temperature,
- j) hydrolytic and thermal stability to ensure constant viscosity

5.7.1.5 Lubricating Grease properties

5.7.1.5.1 The lubricating grease should have the following properties:

- a) >90% biodegradable
- b) Form vertical beads on the gauge face for easy pick up by wheel flange
- c) Forms a protective lubrication coat for the rail gauge face and the wheel flange
- d) Not spill on the top of rails, thereby limiting wheel braking friction
- e) Ability to operate between -20 to 70 degrees Celsius
- f) Maintain consistent viscosity
- g) Lubrication carry distance required is greater than 3km
- h) Grease colour must be visible
- i) The working penetration at 25 degrees Celsius must be 310-340
- j) Structure of the grease must be smooth

5.7.1.6 Leakage free

The system should be free of splatter and scatter of lubricating grease. The only lubricating grease allows to spill on the ground is the lubrication that is carried along the rail by the wheel flange. PRASA expects the proposed system to have effective sealing systems to prevent contamination of the lubricating grease and to prevent waste and loss due to a leaking system.

5.7.1.7 Vandal Proofing

Vandalism is a reality for PRASA. Therefore, any proposed system has to take that into consideration. PRASA seeks to procure systems that will remain in tack to improve the performance of its track and for the safety of its commuters. Therefore, in proposing the suitable rail lubrication system for PRASA. Vandal proofing solutions for such systems also need to be proposed.

5.7.1.8 First line maintenance

5.7.1.8.1 First line maintenance must be provided to 4-6 regional personnel on the following:

- a) Operation of the system
- b) Installation of the system
- c) Maintenance of the system
- d) Fault finding and list of spare parts

5.7.2 QUALITY

5.7.2.1 The Contractor is to ensure that the quality of the rail lubricators and components must comply with these specifications.

5.7.2.2 The contractor must together with their document submit a letter of certification either from PRASA or Transnet Freight Rail for the approval of their product within the rail industry

5.7.3 COMPLIANCE TO TECHNICAL SPECIFICATION REQUIREMENTS

5.7.3.1 Suppliers are required to respond with supporting documents and proposal of their rail lubrication system. All drawings, data sheets and lab test results must be submitted for evaluation. This will assist PRASA representatives in selecting the best proposal for PRASA's rail lubricating system. Failure to submit the relevant documents will be considered non-responsive. All test results provided must come from a SANAS accredited lab.

5.7.3.2 PRASA reserves the right to request the lubricating grease for testing and approval. This will be the case for lubricating greases that have never been used in the railway industry.

5.7.3.3 For the end user to evaluate your system the following needs to be provided:

- a) Detailed datasheets of the biodegradable grease
- b) Lab test results of the grease indicating the impact on the environment & how it degrades
- c) Detailed mechanism of the wayside lubricating system. As stated in the scope of work, the system must be fully mechanical.
- d) Details of how vandalism will be addressed
- e) Details on test results of how long the grease carries

5.7.3.4 All that is stated in the scope of work should have the relevant documentation that makes it clear that the bidding suppliers meet the set requirements for the correct product. Supplier responses that do not have the required data sheets will be considered non-responsive.

5.8 PRICES

Prices quoted must be in South African currency and fixed for the duration of the contract inclusive of transport to the point of delivery at PRASA Gauteng Region Driehoek material store, Rebecca Material store and PRASA sites between Johannesburg and Daveyton corridor. inclusive of loading and off -loading.

DISTRIBUTION

Prices tendered shall be the ex-works, loaded onto road trucks and Rail wagons. Transport cost will be borne by the supplier. In a case where rails are transported by rail, PRASA will assist to transport the rails from the contractor's siding to the point of delivery.

5.9 NEGOTIATION

PRASA reserves the right to negotiate prices and commercial aspects after the closing date of the tender.

5.10 INCREASE OR DECREASE IN COSTS

5.10.1 This is an as and when required basis contract, and no contract price adjustment will be applied to allow for all increases or decreases in production costs of a product, from any cause whatsoever, which may occur after the closing date of the submission of tenders and before the date of completion.

5.10.2 Price shall be firm for the duration of contract.

5.11 EXCHANGE RATE

The contract price payable to the Contractor will not be adjusted for increases and decreases in costs of imported materials, machines and spare parts, due to fluctuations in foreign currency exchange rates after the conclusion of the Contract and for the duration thereof.

5.12 PLACING OF ORDERS AND DELIVERY OF GOODS

5.12.1 The Parties shall meet monthly for the purposes of-

5.12.1.1 Planning

5.12.1.2 Placing of orders and delivery of goods.

5.12.1.3 Amending, revising, updating and finalising the twelve-month forward delivery schedule.

5.12.1.4 To re-plan previous plans where there have been mismatches or discrepancies.

5.12.2 The Supplier shall, on a monthly basis, furnish the Project Manager with a written report on the production of the Goods to be supplied.

5.12.3 PRASA will provide the Supplier, in advance, over the duration of the contract period, with a written document regarding requested deliveries for each product, taking the necessary lead-time into consideration. Such document must be accepted and signed by the Supplier who thereby binds himself to the delivery times therein stated.

5.12.4 Orders for each month will be placed at one instance. Any extraordinary factors surrounding the required goods, lead time, expected delivery date, price in relation to forward cover influences, place of delivery and production capacity, which may influence price or performance are to be brought to the attention of the Project Manager immediately upon receipt of an order by the Supplier.

5.12.5 Orders shall be placed as follows:

5.12.5.1 Orders will be placed at the Supplier.

5.12.5.2 The Supplier will check the required goods, based on projections, the lead times, expected delivery date and place of delivery and adjust, if necessary and notify the Project Manager of the adjustment.

5.12.5.3 The Supplier shall confirm the order with the Project Manager.

5.12.5.4 The Supplier shall issue an order confirmation, to be handed to the Project Manager, which order confirmation shall be fixed.

5.13 DISPATCHING OF MATERIAL

The Supplier shall do all necessary to acquire transportation for the goods, in the form of "road or rail transport", in order to dispatch such goods to the various places of delivery. Transport of the material will be to the supplier's account. Transportation rates to be included on the tender.

5.14 ACCEPTANCE OF GOODS

5.14.1 Final acceptance of goods is the Project Manager's responsibility (with support from the relevant technical expert) and shall be in the form of a Quality Assurance Final Release Certificate to be issued by the Supplier to the Project Manager on presentation of the goods.

5.14.2 The Project Manager shall inform the Supplier in writing within a reasonable period from date of receipt of the goods if the goods are found to be defective or not strictly in accordance with specifications.

5.14.3 The Supplier shall upon handing over the goods to a cartage agent to transport the goods to the PRASA's sites or transport the good themselves (based on the applicable incoterms), issue a certificate confirming that quantities correspond to the accompanying waybills.

5.15 QUALITY ASSURANCE

5.15.1 The manufacturer/supplier shall be ISO9001 accredited and shall make available its quality plan for the manufacture of all components. These quality plans will be audited by PRASA/Metrorail every six months.

5.15.2 The Supplier shall keep quality assurance records for a period of at least 36 (thirty-six) months from the date of final delivery of the goods in a safe place. These records must be made available to the Project Manager for inspection on his request.

5.16 SUPPLIER'S WARRANTY FOR GOODS

5.16.1 The Supplier hereby warrants that the Goods he or she shall provide to the PRASA in terms of this Agreement are suitable for the purpose for which they are intended, the prices are fair and market related and that it shall adhere to the delivery times as stipulated in the specifications.

5.16.2 If within 18 (eighteen) months after delivery of the goods, or 12 (twelve) months after being placed into service, whichever expires first, any defects, whether patent or latent, are found in the goods due to improper workmanship or defective material, excluding fair wear and tear, rough handling or improper use, such defects will be rectified by the Supplier at no extra cost, upon receiving written notification from the Project Manager of such defects within a reasonable time.

5.17 PERFORMANCE LEVELS

5.17.1 The Supplier shall perform strictly in accordance with the levels required by this Agreement and any other specifications emanating there from and accept the penalties which will be instituted for non - performance.

5.17.2 When goods are delivered late, early delivered, but not in accordance with specification it will be regarded as non-performance. Delivery is deemed to be early if it arrives at the destination more than 4 (four) weeks prior to the expected delivery date, and it is considered late if it arrives at the destination after the delivery date stipulated in the order.

5.17.2.1 The delivery lead time key milestones for this project are outlined in figure below.

Item No.	Description	Anticipated delivery lead time
----------	-------------	--------------------------------

1	Rails	6 months
2	Turnout components	4 months
3	Sleepers	3 months
4	Fastenings	1 month
5	Welding material	1 month
6	Ballast	1 month
7	Lubricators	3 months

Figure 8: Planned project delivery lead time

5.17.3 Should there be non-performance, the Supplier shall inform the Project manager immediately of such an event, stating the reasons and remedial action the Supplier intends taking.

5.18 OTHER SPECIFIC PERFORMANCE REQUIREMENTS

5.18.1 The Supplier shall, provide the Goods in the quantity, on or before the due date determined in accordance with the technical specification, tender specification and written Purchase order issued by PRASA,

5.18.2 All Goods shall be packaged in accordance with the provisions of the technical specification. Where no provisions are made in the technical specification for packaging, the Goods shall be properly packed for long term storage suitable to protect the contents against damage through rough handling and over-storage in transit or whilst in store.

5.18.3 Unless otherwise stated, all containers (including packing cases, boxes, pallets, tins drums and wrappings) supplied by the Supplier shall be considered as non-returnable, and their cost having been included in the price of the Goods.

5.18.4 The Supplier shall clearly mark the outside of each consignment or package with the Supplier's name and full details of the destination in accordance with the PRASA's order and include a packing note stating the contents thereof.

5.18.5 On despatch of each consignment, send to PRASA at the address for delivery of the Goods, an advice note specifying the means of transport, weight, number or volume as appropriate, the point and date of despatch.

- 5.18.6 Send to PRASA a detailed priced invoice as soon as is reasonably practical after despatch of the Goods, and state on all communications in the relevant order number and code number (if any).
- 5.18.7 Goods shall be delivered on working days, between working hours of 08:00 am to 15:00 pm to Driehoek material store, corner, Branch and Junction road, Germiston via road; between Johannesburg and Daveyton via rail.
- 5.18.8 Should the Supplier have reason to suspect delays in delivery, the Supplier shall advise the Project Manager upon receipt of the purchase order (PO) in writing of any anticipated delays citing reasons therefore and put forward a new anticipated delivery date. PRASA may then extend the delivery date if and as it seems fit. Unless and until the Supplier receives a notification of the new, extended delivery date, there shall be no extension to delivery dates. Should delivery delays lead to cost implications, the supplier will be held liable for the cost incurred.
- 5.18.9 All Goods supplied shall comply with the requirements of the Scope of Work or shall conform in all respects to the technical and tender specification in Annexure A and B, respectively.
- 5.18.10 All Goods supplied shall be the subject of the Project Manager's inspection and test at all times before, during or after manufacturing. The Supplier shall furnish without extra charge all reasonable facilities and assistance for the safe and convenient inspection or test required by appointed inspectors. Such inspections may be carried out on the Supplier's premises or at another place as deemed appropriate by inspectors.
- 5.18.11 If the Supplier fails to supply Goods, materials, workmanship or services in accordance with the provisions of the Contract, the Project Manager may reject any part of the Goods by giving written notice to the Supplier specifying the reason for rejection and whether replacement Goods are required and within what time.
- 5.18.12 The Supplier warrants that the goods will remain free from defects for a period of three years (unless otherwise stated in the Contract Data) from acceptance of the Goods by the Project Manager.

5.19 BOND AND GUARANTEES

5.19.1 Surety in the amount equal to ten percent (10%) of the contract price, as elected by the Contractor, shall be provided by the Contractor for the due and faithful performance by him in terms of the Contract. Such security shall be in the form of:-

5.19.2 Government or approved Municipal stocks in negotiable form, or

5.19.2.1 A deed of suretyship furnished by an approved bank, insurance or guarantee corporation in such form as may be prescribed by PRASA, provided however that the Project Manager may, upon written application by the Contractor, return to the Contractor the whole or part of such security held by PRASA

5.20 PAYMENT CERTIFICATE

5.20.1 On or after the assessment date, the Supervisor and the Supplier will together assess the quantities of the progress on each item in the Bill of Quantities and complete the Progress Assessment Detail form, where after the Progress Assessment Certificate will be issued.

5.20.2 The Supplier shall then submit a VAT invoice and attach the above Progress Certificate for payment by the Employer.

5.20.3 Supplier to provide the Employer with the necessary details regarding banking details to enable the Employer to make electronic payments.

5.21 PRICING OF THE WORKS

5.21.1 The contractor is required to provide firm prices/ rates for material and labor for the duration of the contract.

5.21.2 The contractor shall make provision for the costs (direct or otherwise) associated with works on, over or adjacent to railway lines. The Contractor is advised to study the requirements of the SPK 7/1 and ensure that all works can be completed in accordance with these requirements.

5.22 PENALTIES

5.22.1 If the Contractor fails to complete the Services within the time a stipulated in this Contract for completion of Services or a part or portion of Services, the Contractor

shall be liable to the Employer for an amount calculated at 0.5% of the Contract Price per delayed Day per order, which shall be paid for every day which shall elapse between the time for due completion and completion of the relevant Services. However, the total amount due under this sub-clause shall not exceed the maximum of 10% of the Contract Price.

5.22.2 The imposition of such penalty shall not relieve the Contractor from its obligation to complete Services or from any of the obligations and liabilities under the Contract,

5.22.3 PRASA may set off or deduct from the fees due to the Contractor any penalty amounts due and owing by the Contractor in terms of clause 5.22.1

5.23 LIST OF SPECIFICATIONS THAT FORMS PART OF SCOPE OF WORK

The documents forming the contract are to be taken as complimentary to each other. In case of any discrepancy or inconsistency between contract documents, the order of precedence will be:

SANS 3000-1 to 2,	Railway Safety Management
SABS 1200NB	Railway Sidings (Track work)
EN13674-1	Specification for new Railway Rails or the latest equivalent standard
UIC 860-0, UIC 8610-1	UIC Codes or the latest equivalent standard
EN13848	Railway applications – Track geometry quality standard
EN 13481- Part 1	Performance requirements for fastening systems
EN 13146	Test methods for fastening systems
EN 10089	Hot rolled steels for quenched and tempered springs
EN ISO 6506-1	Brinell hardness test method for rails
CCE 1/57/2	Specification for concrete sleepers to standard dimensions 1065mm gauge track
PWM 2/5	Specification for prestressed concrete sleepers used on 1065mm gauge Railway track
E3303 sheet 1	P2 Concrete sleepers drawing
E3303 sheet 2	F4 Concrete sleepers drawing
E3318 sheet 1	PY Concrete sleepers drawing
E3318 sheet 2	FY Concrete sleepers drawing
Z1153 Sheets 1 & 2	Drawing for normal rolling and straightness tolerances laid down in

	the EN13674 Specification for new railway rails
ASTM	American (USA) standards
SABS 1083:2013	Ballast specification (latest revision for Railway lines)
S406 (1998)	Transnet specification for supply of ballast stone
EN13674	Specification for new Railway Rails
CP1/1	Exothermic welding portions packaging specification
SABS 1431	Grade 300wa for weldable structural steel
E10	General Specifications for Railway Track work (1996)
Track Manual	Manual for Track Maintenance (2000)
Track Manual	Manual for Track Welding (2007)

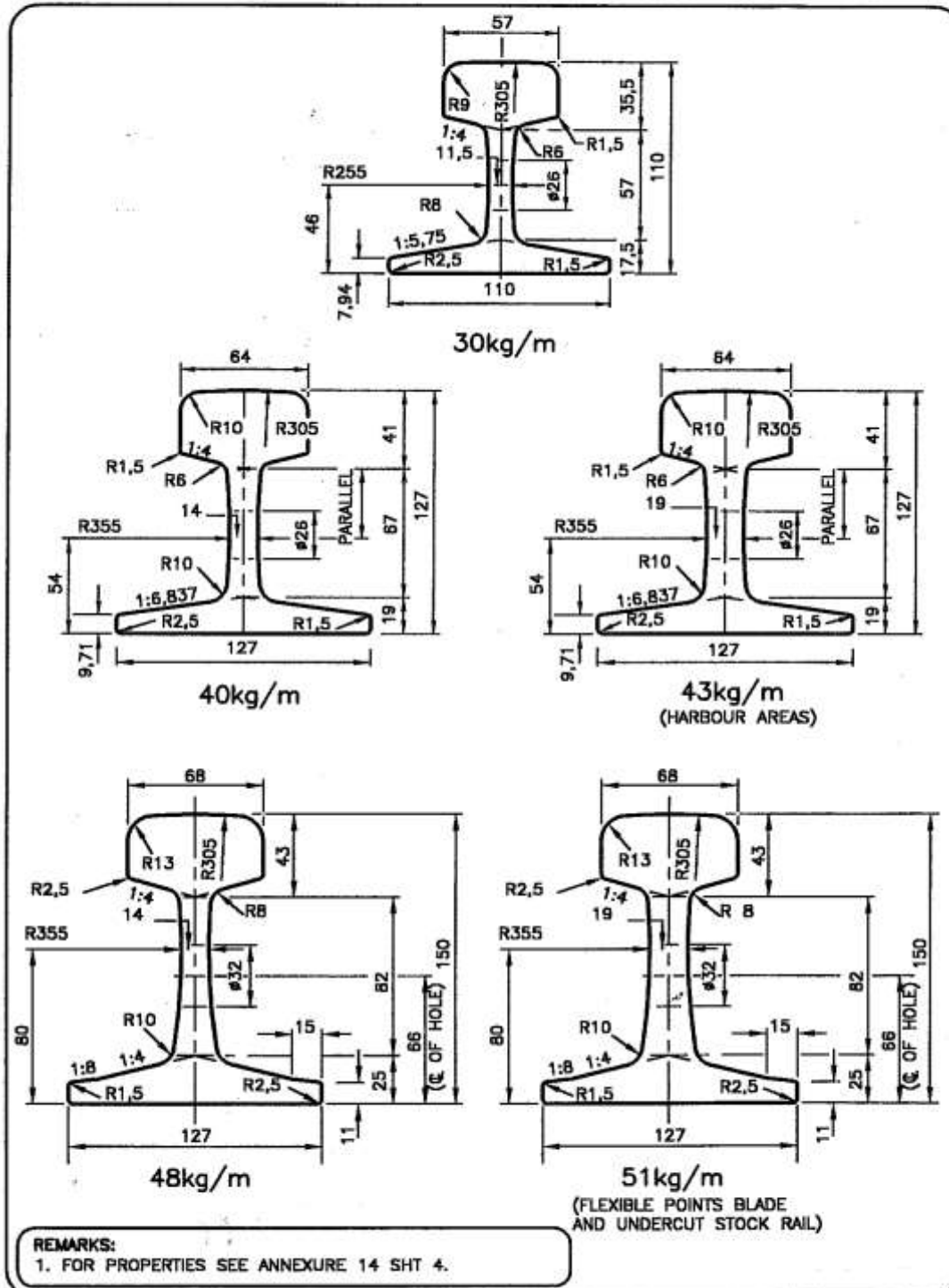
5.24 LIST OF ANNEXURES/SHEETS AND APPENDIX

Annexure/Appendix	Document Name Reference
Rail profiles	Manual for Track Maintenance (2000)
Turnout drawings	Manual for Track Maintenance (2000)
E3303 sheet 1 & 2	PWM 2/5 specification for prestressed concrete sleepers
E3318 sheet 1 & 2	PWM 2/5 specification for prestressed concrete sleepers
Concrete sleepers Annexure A drawing	PWM 2/5 specification for prestressed concrete sleepers
Alumino -Thermic Welding Tests Appendix A	Manual for Track Welding (2007)
Drawings Z1153 Sheets 1 & 2	Manual for Track Welding (2007)
Test for soundness of stone Appendix A	Transnet S406 (1998)
Durability Test for Ballast stone Appendix B	Transnet S406 (1998)
Mill Abrasion Test Appendix C	Transnet S406 (1998)

5.25 EXTRACT FROM MANUAL FOR TRACK MAINTENANCE 2000

ANNEXURE 14
SHEET 1 of 4
AMENDMENT

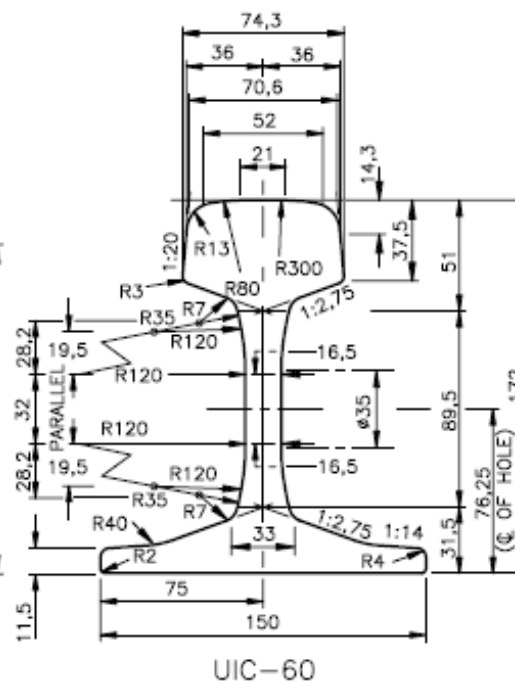
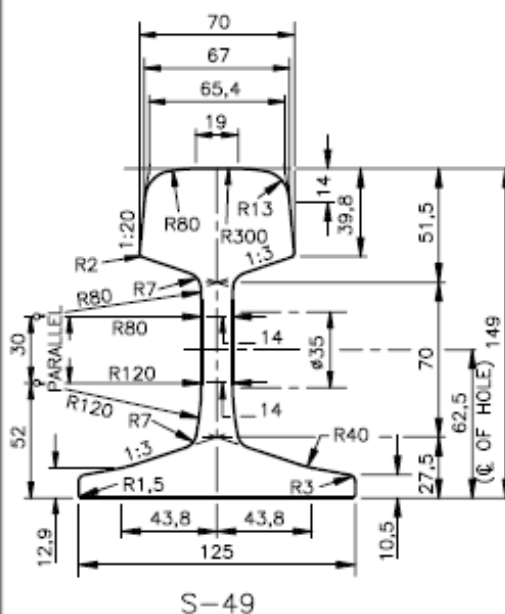
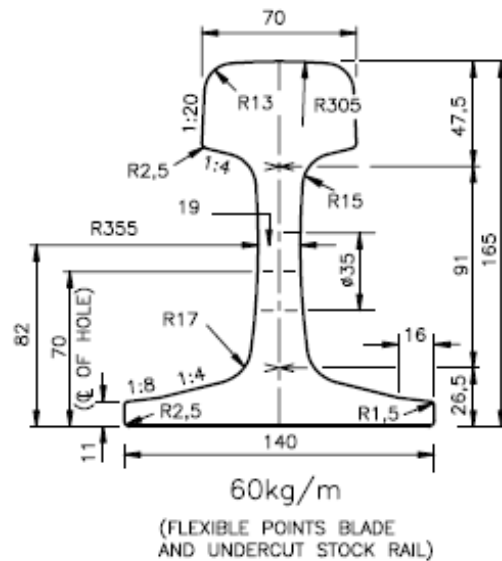
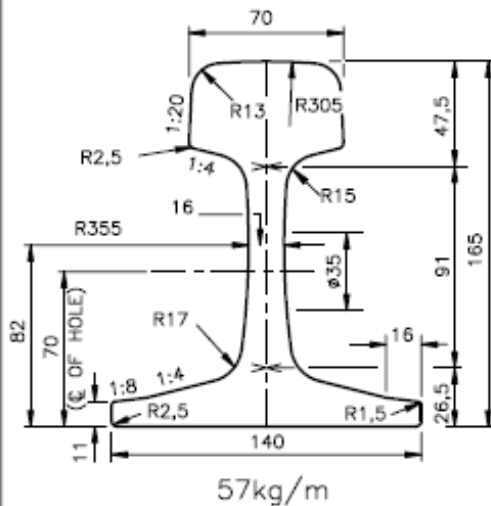
RAIL PROFILES



BE 97-14 Sht 1 of 4 DATE : JUNE 2000

ANNEXURE 14
SHEET 2 of 4
AMENDMENT

RAIL PROFILES



REMARKS:

1. FOR PROPERTIES SEE ANNEXURE 14 SHT 4.

6. Is this a CIDB related Project? (Yes / No)

No

If YES, what is the applicable Class of Work & Grade?

Class of Work: _____ N/A _____

Minimum Grade: _____ N/A _____

7. PROJECT SPECIFIC TERMS AND CONDITION

7.1 INCREASE OR DECREASE IN COSTS

7.1.1 This is as and when required basis contract, and no contract price adjustment will be applied to allow for all increases or decreases in production costs of a product, from any cause whatsoever, which may occur after the closing date of the submission of tenders and before the date of completion.

7.1.2 Price shall be firm for the duration of contract.

7.2 EXCHANGE RATE

The contract price payable to the Contractor will not be adjusted for increases and decreases in costs of imported materials, machines and spare parts, due to fluctuations in foreign currency exchange rates after the conclusion of the Contract and for the duration thereof.

7.3 ACCEPTANCE OF GOODS

7.3.1 Final acceptance of goods is the Project Manager's responsibility (with support from the relevant technical expert) and shall be in the form of a Quality Assurance Final Release Certificate to be issued by the Supplier to the Project Manager on presentation of the goods.

7.3.2 The Project Manager shall inform the Supplier in writing within a reasonable period from date of receipt of the goods if the goods are found to be defective or not strictly in accordance with specifications.

7.3.3 The Supplier shall upon handing over the goods to a cartage agent to transport the goods to the PRASA's sites or transport the good themselves (based on the applicable incoterms), issue a certificate confirming that quantities correspond to the accompanying waybills.

7.4 QUALITY ASSURANCE

7.4.1 The manufacturer/supplier shall be ISO9001 accredited and shall make available its quality plan for the manufacture of all components. These quality plans will be audited by PRASA/Metrorail every six months.

7.4.2 The Supplier shall keep quality assurance records for a period of at least 36 (thirty-six) months from the date of final delivery of the goods in a safe place. These records must be made available to the Project Manager for inspection on his request.

7.5 SUPPLIER'S WARRANTY FOR GOODS

7.5.1 The Supplier hereby warrants that the Goods he or she shall provide to the PRASA in terms of this Agreement are suitable for the purpose for which they are intended, the prices are fair and market related and that it shall adhere to the delivery times as stipulated in the specifications.

7.5.2 If within 18 (eighteen) months after delivery of the goods, or 12 (twelve) months after being placed into service, whichever expires first, any defects, whether patent or latent, are found in the goods due to improper workmanship or defective material, excluding fair wear and tear, rough handling or improper use, such defects will be rectified by the Supplier at no extra cost, upon receiving written notification from the Project Manager of such defects within a reasonable time.

7.6 PERFORMANCE LEVELS

7.6.1 The Supplier shall perform strictly in accordance with the levels required by this Agreement and any other specifications emanating there from and accept the penalties which will be instituted for non - performance.

7.6.2 When goods are delivered late, early delivered, but not in accordance with specification it will be regarded as non-performance. Delivery is deemed to be early if it arrives at

the destination more than 4 (four) weeks prior to the expected delivery date, and it is considered late if it arrives at the destination after the delivery date stipulated in the order.

7.6.2.1 The delivery lead time key milestones for this project are outlined in figure below.

Item No.	Description	Anticipated delivery lead time
1	Rails	6 months
2	Turnout components	4 months
3	Sleepers	3 months
4	Fastenings	1 month
5	Welding material	1 month
6	Ballast	1 month
7	Lubricators	3 months

7.6.3 Should there be non-performance, the Supplier shall inform the Project manager immediately of such an event, stating the reasons and remedial action the Supplier intends taking.

8. PROJECT SPECIFIC SAFETY RELATED REGULATIONS

11.1 The contractor shall comply with requirements of safety legislations and regulations in all respects.

8.1.1 It is the requirement of this contract that the contractor should provide PRASA with a detailed safety plan prior to being issued with a site access certificate, in accordance with the latest version of the Occupational Safety Act, 1993 (Act No: 85 of 1993) and the SPK7, E4E and National Environmental Management Act 107 of 1997

11.2 All drivers shall be in possession of valid driver's licenses and Public Drivers Permits (PDP) where applicable. Crane operators will be required to have a valid Crane Operator's certificate. All vehicles shall be road worthy.

- 11.3 The contractor shall be responsible for all protective clothing and equipment for his employees. All employees required to climb structures shall be issued with suitable harnesses.
- 11.4 All work shall at all times comply with the E7/1 Specification attached hereto.
- 11.5 Normal protection measures in accordance with the Protection Manual shall apply.
- 11.6 An effective safety procedure to be followed by all personnel on any work site in the case of approaching rail traffic shall be compiled by the Contractor and implemented before any work commences. This procedure shall be updated whenever the need arises and any changes shall be communicated to all employees on a works site before work proceeds.