



TRACK TECHNOLOGY MANAGEMENT

SPECIFICATION FOR MONOLITHIC PRE-STRESSED CONCRETE SLEEPERS USED ON 1065 mm GAUGE RAILWAY TRACK

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SPECIFICATION FOR MONOLITHIC PRE-STRESSED CONCRETE SLEEPERS USED ON 1065 mm GAUGE RAILWAY TRACK

1 SCOPE

- 1.1 This specification covers all monolithic pre-stressed concrete sleepers used by Transnet on 1 065 mm gauge railway track. It includes open line as well as sleepers for turnouts and specialized sleepers made from pre-stressed concrete. This specification supersedes all previous versions of the specifications.

2 DEFINITION AND ABBREVIATIONS

- 2.1 **Principal Engineer** - the Principal Engineer, Track Technology Management, Transnet Freight Rail or any other office with authority acting on his behalf.
- 2.2 **TTM** – Track Technology Management, a TFR technical department based in Johannesburg responsible for testing and technical approval, and custodian of track related standards and specifications.
- 2.3 **Bearer** – Sleepers used in turnouts are generally referred to as bearers, although clauses referring to sleepers apply equally.
- 2.4 **Bidder, supplier, Tenderer** – Bidder, supplier, Tenderer all refer to the entity that are doing or plan to do business with Transnet and will be used equally depending on the process.
- 2.5 **SCM** – Supply Chain Management department of Transnet
- 2.6 **Bonded reinforcement** – Reinforcement that is developed by means of adhesion and friction. (Exclude mechanical means)
- 2.7 **LP** – Low profile sleeper
- 2.8 **fci** – Maximum permissible compressive stress in the concrete in MPa due to the prestressing force alone
- 2.9 **UTS** – Ultimate tensile strength of the steel reinforcement
- 2.10 **TESTING** – Testing refers to tests conducted, inspections, evaluations, audits, periodic testing and witnessing of tests at the plant, the laboratory or in the field.
- 2.11 **P1** – The force required to induce the first crack
- 2.12 **P2** – The force required to grow the crack to the first reinforcement

- 2.13 **P3** - The force required to break the sleeper.
- 2.14 **Mcr** – Moment of resistance (M_{Ru} = Rail seat and M_{Ro} Sleeper Centre) specified in kN.m. Mcr are unique to each sleeper type and each sleeper supplier
- 2.15 **Pcr** - Theoretical cracking force.
- 2.16 **Held in reserve** – The confinement of sleepers that may potentially, for any reason, do not comply with the requirements of the specification and that are placed in a contained area that are not part of the stock yard where quality sleepers are placed.

3 ACCEPTABLE DESIGNS AND DESIGN REQUIREMENTS

- 3.1 All specifications refer to the latest versions or revisions that are available, unless specifically stated otherwise.
- 3.2 The reinforcement of the sleeper must be designed by the bidder and the design must be supplied to TTM for final approval.
- 3.3 Each bidder must have their design (reinforcing size, quantity, wire positions and moment of resistance) approved before manufacturing any sleepers.
- 3.4 Sleepers manufactured to the design provided must have been satisfactorily tested and approved by Transnet Freight Rail before any sleepers may be installed in track.
- 3.5 If applicable a minimum of four sleepers must be submitted to the Track Testing Centre at George-Goch for approval and testing.
- 3.6 The design offered must be a pre-stressed design.
- 3.7 The sleeper shall be reinforced to withstand the bending moments as shown in Table 1 without exceeding the maximum permissible stress.
- 3.8 The minimum and maximum strength of the concrete at 28 days must be as indicated in Appendix B
- 3.9 A maximum tensile concrete stress (concrete strength 60 MPa and higher) not exceeding 3.5 MPa will be permitted in the computation of the design bending moments shown in Table 1.
- 3.10 The maximum permissible compressive stress in the concrete due to the stressing force alone (f_{ci}) may not exceed 11.75 MPa except for the LP sleeper where the value may not exceed 13.7 MPa. The nominal compressed

strength of a 150 mm concrete cube at stress transfer must be more than 30 MPa where the (fci) is 11.75 and 35 MPa if the (fci) =13.7 MPa.

- 3.11 TTM will request each bidder for detailed drawings and design calculations proving that the minimum bending moments have been fully provided for. These documents must be supplied for approval timeously and will be required before doing any sleeper testing.
- 3.12 Only designs using bonded reinforcement will be accepted and only reinforcement of a deformed (wire surface are not smooth) design will be approved.
- 3.13 The concrete cover to reinforcement must be minimum 30 mm due to the concrete being exposed to rain and moisture and alternating wet and dry conditions. Suppliers may request for this cover to be reduced provided it can be motivated technically. Suppliers must ask the Principal Engineer in writing to consider the proposal motivating the reason for such a request. Approval is at the sole discretion of the Principal Engineer.
- 3.14 The detail design supplied to Transnet; for design approval; must include the following:
 - Drawings with all relevant information like sleeper dimensions, wire positions, fastening details, cross sections, gauge and tolerances
 - Properties and details of the reinforcement and concrete (E.g. number of wires, UTS, diameter, Youngs modules, Poissons ratio, % relaxation in wire, type of wire)
 - Cross section properties eccentricity and centre of gravity (Area, centre of gravity, moment of inertia, section constants) at the rail seat and sleeper centre
 - Design assumptions, constants, variables and values
 - Details of the design at the top and bottom of each cross section (Rail seat and Sleeper centre) including:
 - Moment of inertia
 - Stresses before losses
 - Average stress in the concrete before losses
 - Details of each loss in pre-stress. Long term and short term as well as the total losses and the pre-stress and force remaining in the tendons
 - Initial and final prestress and % Initial and final pre-stress
 - Stress at transfer
 - Moment of resistance, stresses and forces at 3.5 MPa concrete tensile – Design moment (4 values)

- Moment of resistance, stresses and force at 6.2 MPa concrete tensile – Cracking moment (4 values)

3.15 The initial and final stresses in the reinforcement must conform to the following values:

- Initial stress – not to exceed 75% of characteristic strength.
- Final stress after losses – not less than:
 - 60% of characteristic strength for all open line sleepers except for the LP sleeper that may be 54%
 - 52% of characteristic strength for all turnout bearers
 - 58% for the universal sleeper

3.16 Once Transnet has requested the designs and documentation the bidder has 25 working days to submit their designs. The bidder can, within 5 working days from the request, ask Transnet for an extension of time.

Table 1: Bending moments for sleepers

Sleeper Type	Positive Moment of resistance (Rail seat) kNm	Negative Moment of resistance (Sleeper centre) kNm
P2 (2057)	11.2	10.2
F4 (2057)	11.2	10.2
V2 (2057)	11.2	10.2
PY (2200)	17.2	13.75
Ladder (2200) – Sleeper – Each Beam	17.2 40.0 (Bottom)	13.75 25.00 (Top)
VY (2200)	17.2	13.75
FY (2200)	17.2	13.75
PA (paved)	11.2	10.2
PYW (2200)	17.2	13.75
LP (2100)	11.8	10.9
Turnout bearer with 60E rail profile	27	17

Turnout bearer with 48 kg/m rails	25.8	20.2
Universal Sleeper	20	-12.3

4 ELASTIC FASTENINGS

- 4.1 The design of the sleepers must make provision for elastic fastenings according to specification BBF9273 (latest version). The fastening must be a Transnet approved fastening system and the supplier of the fastening system must be an approved supplier of the particular fastening system.
- 4.2 In designs where a part of the fastenings system is cast into the sleeper, particular attention must be paid to secure these shoulders in position in such a way that they are firmly embedded and will not become loose.
- 4.3 Where ferrous components of the fastening to be cast into the sleeper require corrosion protection, this shall be done prior to casting it into the sleeper with a Transnet approved corrosion protection method. All tolerances specified by the fastening supplier will be post corrosion protection if not specifically mentioned and approved by Transnet Freight Rail.
- 4.4 Components of the fastenings required to be cast into the sleeper must be placed in the sleeper to the dimensions and within the tolerances specified by the manufacturer of the fastenings and as specified in this document. Where there are conflicts between the two the more stringent dimension/ tolerance will apply.
- 4.5 Any components of the fastening that are to be cast into the sleeper are to be supplied by the manufacturer of the sleeper and the price quoted for the sleeper must include these components.

5 SHAPE AND SIZE OF SLEEPER

- 5.1 The sleeper supplier will use the shape, dimensions and tolerances as indicated in the clauses and Table 1 of this specification to compile their own manufacturing drawings. These drawings will become the official drawings for each sleeper type once signed off by the Principal Engineer of TTM. Sign-off will only be done once the product has been approved. The shape and

dimensions may vary slightly from the typical drawing to accommodate each bidders specific manufacturing process.

- 5.2 Details of each specific bearer in each turnout will be supplied by the manufacturer of the steel hardware for that specific turnout, but must be endorsed by the turnout supplier.
- 5.3 All moulds manufactured must be done in such a manner that the sleeper ends are flat (less than 5 mm un-evenness).
- 5.4 The position of the wires in the universal sleeper will be in 3 vertical columns as shown in the relevant drawing (Annexure D2) to allow for coring between the wires.
- 5.5 The end face of any sleeper when cut by saw will be $90^{\circ} \pm 1^{\circ}$ in both planes.
- 5.6 All universal sleepers must have visible indents on the top of the sleeper indicating where the wire positions are in the sleeper. These indents must have a diameter between 8 and 10 mm diameter with a depth between 2-3 mm and a maximum spacing of 200 mm between each other.
- 5.7 The universal sleeper must be available in the following standard lengths (m) 2.1, 2.4, 2.7, 2.8, 3.0, 3.2, 3.8, 4.2, and 6.
- 5.8 Turnout bearers must be made in lengths as indicated on the relevant turnout supplier's drawing for each specific type.
- 5.9 The maximum length of a turnout bearer is 4.4 m.
- 5.10 The maximum length of a universal sleepers is 6 m.

Table 2: Typical Sleeper Drawings

Sleeper type	Drawing details
P2 and V2	E3303-sheet 1
F4	E3303-sheet 2
PY and VY	E3318-sheet 1
FY	E3318-sheet 2
PA (paved)	E3343-sheet 1
PY wing	Based on E3318 sheet 1

LP (Low profile)	See Appendix D
Turnout Bearer with 57 kg/m and 60 kg/m rails	See Appendix D
Turnout Bearer with 48 kg/m rails	See Appendix D
Universal Sleeper	See Appendix D

6 **TESTING, INSPECTION, PASSING CRITERIA AND AUDITS**

6.1 Tests are required following commissioning of a new plant and/or product line for approval, for periodic re-testing to retain approval, during technical audits and where required for quality assurance processes, or as and when the need arises.

6.2 General

6.2.1 The sleepers must comply with:

- the general and design requirements as set out in this specification.
- pass the tests, inspections and plant audit.
- comply with the material requirements.

6.3 Testing by TTM

6.3.1 The sleepers will be tested by TTM using their standard tests methods and quality assurance processes after randomly selecting the samples.

6.3.2 The sample size for each plant will be calculated based on the number of tests required and as indicated in the TTM quality management system, as per TQM-TRL-PRO5 "Sampling" and TQM-TRL-SPD TQM-TRL-SPD38 "Random sample selection".

6.3.3 The appropriate tests will be fixed by Transnet at the start of the testing and will depend on the type of sleeper offered.

6.3.4 Bending tests:

6.3.4.1 In order to verify the resistance against tension cracks, the accepted sleeper design must pass static and dynamic tests for approval and at periodic re-testing for:

- Positive (not a standard test required for open line sleepers) and negative bending at mid span (TQM-TRL-STM-2 Sleeper centre), and
- Positive bending under the rail seat (TQM-TRL-STM-1 Rail seat test), and
- Two Bond development tests (TQM-TRL-STM-3 Bond development)

6.3.4.2 The design must include a detailed analysis specifying the magnitude of the three resistance moments, computed for a tensile concrete stress of 6.2 MPa. No visible cracking must occur before these bending moment (Referred to as the theoretical cracking moment M_{cr}) values have been reached when doing the static tests.

6.3.4.3 On completion of the dynamic test the cracks (Average size for left and right) induced to determine the cracking moment must be less than 0.1 mm and the sleeper must still be sound. For the test to pass the bond development the sleeper the left and right wire slippage at the bottom row of wires must be less than 0.025 mm at the proof load.

6.3.5 Gauge test:

6.3.5.1 When TTM plan to do gauge tests at the Track laboratory or at the factory TTM will use their standard test method TQM-TRL-STM-4 "Assembly test for gauge on concrete sleepers" to determine the gauge. The supplier must supply two lengths minimum 3 m (± 0.3 m) long of each rail type (48, 57 and 60E1 rail) as well as the fastenings to assemble the section to perform the test (4 Sleepers).

6.3.5.2 Should the result of gauge test indicate that the sleepers do not comply with the gauge requirements the supply of the specific type of sleepers will be stopped and existing sleepers must be held in reserve until such time as the suppliers has demonstrated that they can produce sleepers that comply with the specification. The correct gauge is as indicated in the specification section.

6.3.5.3 When assembled and disassembled 5 times the system must still be within the required tolerances without causing damage or wear on any component.

6.3.6 Sleeper Inspection:

6.3.6.1 TTM may at any time inspect the sleepers for defects using TQM-TRL-STM-5 "Field inspection and hand measurement for concrete sleepers". The sampling will be done as per TQM-TRL-PRO5 "Sampling" and TQM-TRL-SPD38 "Random sample selection". It is the supplier's responsibility to remove the samples selected for testing and stack them in an area where it will be possible to perform the required testing.

6.3.6.2 The sleepers inspected shall be accepted or rejected using one or more of the following techniques or instruments supplied by the plant to determine if there are any defects:

- "GO" and "NO GO" gauges, in conjunction with feeler or wedge type gauges and Vernier callipers.
- Protractor to measure cant
- Specialized jigs

- Visual inspection of sleepers
- New instruments based on newer technologies as they become available.

6.3.6.3 Details of the defects and defect combinations that will be evaluated.

“A” Defects

- A1 Both defects B1 and B5 on the same sleeper
- A2 Both defects B2 and B4 on the same sleeper
- A3 Cast-in components of fastening too low or too high or skew by more than 1 mm (Depending on the fastening type this value may be less to ensure the correct clamping force)
- A4 Excessive rail seat width (± 1 mm)
- A5 Total percentage of defects B4 + B5
- A6 Sleeper too long or too short (± 5 mm)
- A7 Sleeper heights not-correct (End, Centre, Rail seat) (± 5 mm)
- A8 Insufficient distance between shoulders of individual rail seat (± 1 mm)
- A9 Honeycomb
- A10 Cracked sleepers.
- A11 Wire position not-correct as per drawing (Tolerance ± 3 mm)
- A12 Concrete in dowels

% A defects = Sum of defects A1-A12 on sleepers selected for inspection

”B” Defects

- B1 Excessive distance between outside shoulders (As per drawing)
- B2 Insufficient distance between outside shoulders (As per drawing)
- B3 Concrete not sound (E.g. Blow holes)
- B4 Rail seat cant steeper than required. 1: 18 (Open track sleepers)
- B5 Rail seat cant flatter than required. 1:21(Open track sleepers)
- B6 Rail seat area not clean
- B7 Concrete inside the shoulders or cast in component.
- B8 Flashing on sleeper.
- B9 Sleeper bottom too smooth or loose material on the bottom surface
- B10 Rotated shoulders or cast in component (As per drawing)
- % B defects=Sum of defects B1-B10 on sleepers selected for inspection

“C” Defects

- C1 Excessive distance between shoulders of individual rail seat (As per drawing)
- C2 Twist exceeding 30 minutes.
- C3 Rail seat flatness not acceptable (> 0.5 mm) or rail seat damage $>10\%$

- C4 Insufficient rail seat width (As per applicable drawing)
- C5 Appearance
- C6 Chipped edges over a total length of more than 200 mm or deeper than 15 mm.
- C7 Segregation of fines > 5 mm
- C8 Corking not done correctly.
- C9 Cover plates not correctly installed or damaged.
- C10 Sleeper end not-sound (5 mm) with evidence of patching or cup grinding

% C defects=Sum of defects C1-C10 on sleepers selected for inspection

6.3.6.4 The lot shall be rejected on the results of the sample if the percentage of defects at which any individual defect occurs exceeds.

- 6% for “A” defects
- 6% for “B” defects
- 6% for “C” defects
- 6% of the sleepers have defects.
- 0% for defects A3, A6, A7, A9, A10, A12
- 0% of sleepers outside the track gauge specified. (Involves the building of test piece of track)

6.3.6.5 All sleepers identified by Transnet as not complying with the specification; whatever the final %; must be removed from the stock yard.

6.3.6.6 In all cases of rejection, full particulars shall be made available to the Principal Engineer.

6.3.6.7 Under normal circumstances Transnet will plan the inspection, but Transnet reserves the right to inspect the sleepers at the plant without notifying the supplier.

6.3.6.8 The acceptable standard for visual examination must be as outlined in Transnet’s document BBG8734 “Visual criteria of acceptable and unacceptable quality of concrete sleepers” (latest version).

6.3.7 Electrical insulation:

6.3.7.1 Electrical insulation test will be performed using test method TQM-TRL-STM-8 Electrical insulation test with the following passing criteria.

- Dry: The minimum electrical resistance shall be 1 M Ω
- Wet: The minimum electrical resistance shall be 4000 Ω

6.3.7.2 These test will only be required if it involves a fastening system or a special pad.

6.3.8 Concrete cube tests

6.3.8.1 If TTM feel the need for doing cube testing,

- the supplier must make their equipment and facility available for the Cube tests or
- TTM may decide to do it at another suitable facility.
- Tests must be done as indicated in Appendix B

6.3.8.2 All cube tests must pass the requirements of this specification.

6.3.9 Witnessing:

6.3.9.1 Witnessing of tests will be done as previously indicated using approved test methods and passing criteria as indicated in this specification.

6.3.10 In-service testing (TQM-TRL-STM-9 In service test) and special testing:

6.3.10.1 These test are typically only done as part of a fastening approval but may be required if it involves a special applications or a unique design not covered under normal testing. These test and their passing criterial would be fixed during the approval stage.

6.3.11 Plant inspection and Audits:

6.3.11.1 Plant inspections and audits will be performed based on the content and passing criteria in this specification. Quality audits will include best practices, the supplier's quality manual, this specification and ISO requirements.

6.4 Test and inspections by the supplier

6.4.1 The supplier is responsible for doing test and inspections on their sleepers, concrete and materials as part of their quality manual on a regular basis. This quality manual must be submitted to Transnet for approval.

6.4.2 The test and inspection section in the quality manual must include the details as outlined in this specification.

6.4.3 Bending tests

6.4.3.1 The bidder/ supplier must submit their proposed quality control static test methods that comply with this specification to Transnet; on request; as this forms part of the approval.

6.4.3.2 The proposed test methods must include the following details: frequency of testing, test rate, tolerances, type of supports, number and points of application of the test loads including the magnitude of the test loads to produce the bending moments specified in Table 1.

- 6.4.3.3 The proposed test method must be approved by the Principal Engineer.
- 6.4.3.4 The bidder/ supplier may request Transnet to allow for a change in the proposed test method to suit their equipment. Suppliers must ask the Principal Engineer in writing to consider a change in the test method motivating the reason for such a request. Approval is at the sole discretion of the Principal Engineer.
- 6.4.4 Pre-tensioned sleepers must be tested by the supplier as specified below:
- 6.4.4.1 The test load shall be applied at a rate of $20^{+0}_{-5} \text{ kN/min}$ until the load (P) required to produce the specified design moment is reached.
- 6.4.4.2 The loading shall then be continued at a rate of $20^{+0}_{-5} \text{ kN/min}$ until the first crack becomes visible. If the ratio of this load P1 (First crack load) to the load (Pcr) , which is the theoretical no crack load at which the tensile stress in the concrete is 6.2 MPa, is less than 1.0 the sleeper has failed. In such cases Transnet's Technology Management must be informed for a decision. The suppliers may request in writing for a concession to stop the test at 1.1P to reduce the number of sleepers that are cracked by 75%. This request must be requested for each type of sleeper. Approval will be given in writing and may be withdrawn by Transnet at any time without justification.
- 6.4.4.3 Should any sleeper fail, Transnet reserves the right to:
- reject all the sleepers cast on the same day as the test sleeper that failed or
 - request additional tests on sleepers from the same day's production of the sleepers concerned. The Principal Engineer will decide how and where it will be tested.
- 6.4.4.4 A minimum of 3 additional sleepers from the day's production shall be tested in the case of (b) above and the final acceptance or rejection of the day's production will be based on the results of these additional tests.
- 6.4.4.5 Each manufacturer is required to have a documented quality control plan. The above test must be part of the manufacturer's quality manual
- 6.4.4.6 If any sample fails that day's production must be separately stacked and held in reserve.
- 6.4.5 Concrete cube tests
- 6.4.5.1 The supplier is required to do cube test as indicated in this specification and their quality manual.
- 6.4.5.2 Any failure must be handled as discussed under Appendix B

6.4.6 Gauge test

6.4.6.1 To obtain and maintain approval a supplier must prove that the supplier can produce sleepers with the correct gauge.

6.4.6.2 It is the responsibility of the supplier to do regular gauge tests as indicated in their quality plan/ manual

6.4.6.3 The Transnet representative may from time to time require the manufacturer to check the cant and gauge. To prove this the manufacturer must assemble a short length of track, comprising of two lengths of new rails of appropriate weight, 3 m (± 0.3 m) long, on 4 sleepers complete with fastenings to check that the gauge is correct.

6.4.6.4 Any failure must be handled as discussed under Non-conformances

6.4.7 Testing of all raw material

6.4.7.1 The supplier is required to do material tests as indicated in this specification and their quality manual. (AAR testing)

6.4.8 Defects and defect combinations

6.4.8.1 The supplier must on a regular basis check the sleepers for the defects and defect combinations as outlined in clause 6.3.6.3

6.4.9 Reporting of results of tests

6.4.9.1 The suppliers must report test results to TTM.

6.4.9.2 The type of results and the frequency must be as indicated in the table 3 below.

Table 3 Type and frequency that results must be supplied.

Data to be supplied	Frequency
Cube result at stress transfer	Monthly
28 day cube results	Monthly
Sleeper/ beam test results	Monthly
Material testing (AAR)	Annually

6.4.9.3 The reports must be done as follow:

- Excel workbook without any locked fields
- Appropriately formatted based on the data type.
- Proper column headings and units

- Individual test result of each test for each sleeper type
- Averaging of the results
- Data must be sequential according to the date.
- Different tab for each of the different test results (Cube test, Sleeper tests, beam tests)

6.4.9.4 In the cases where that the factory did not produce any sleepers the supplier must still submit a spreadsheet and indicate that no sleepers were produced

6.4.9.5 Transnet have the right to request the records of any test conducted by the supplier.

6.4.10 Non-Conformances

6.4.10.1 All non-conformances that affect the final products must be reported to SCM and TTM within 10 working days of the event being known.

6.4.10.2 All other non-conformances indicated in this specification and those agreed on in the quality manual must be reported to SCM and TTM within 10 working days of the event being known.

7 **APPROVAL**

7.1 Approval process (Roadmap and it's phases)

7.1.1 Once a bidder has successfully complied with the tender evaluations processes such bidders would enter into an approval process conducted by TTM for use in Transnet, as detailed in the relevant sections of this specification.

7.1.2 The supply of sleepers for ongoing track maintenance/ construction will only be considered once approval of the system is obtained and a procurement event is issued for the supply of sleepers

7.1.3 The supply of sleepers by rail is required. Access to a siding is a requirement of supply and there must be a valid agreement covering the period of the contract.

7.1.4 Approval will be done in the form of a roadmap that would help all parties to understand the phases and processes leading up to approval, who is responsible for it and where in the process the bidder is as each phase is signed off, once successfully completed. It also helps to control the version of the specification that the bidder's sleeper has approval for.

- 7.1.5 Conditional approval is part of the road to approval. Conditional approval is granted once a product and manufacturing facility is approved, but before the supplier has been able to demonstrate that a specific product can be produced in a continuous process in the intended plant in large enough quantities to allow Transnet to randomly select sleepers for laboratory and field evaluation tests, including testing of the gauge.
- 7.1.6 Transnet will give conditional approval to supplier for a specific product once the following steps have been finalized:
- Pre-approval of design has been successful.
 - Drawings are available and submitted for each design.
 - In the case of suppliers that have not yet been approved for any products, suppliers need to prove to Transnet that the plant that they intend using will be able to produce sleepers of the specified quality. Site visits/technical audits may be required by Transnet of the plant or a similar plant to the one they intend using.
 - Commit to obtaining ISO-9001 accreditation for the manufacturing facility within 24 months from the start of production.
 - The pre-production samples have passed the tests and inspections.
- 7.1.7 At the start of each phase all parties will commit to deadlines covering the various aspects in the phase.
- 7.1.8 As each phase of the process is completed the bidder would be issued with a status indicating the current status (Pass or Fail) on the roadmap to approval.
- 7.1.9 The roadmap to approval includes the following five distinct phases and process owners as follow:

7.1.9.1 Phase 1: Technical due diligence - High level (TTM process)

- 7.1.9.2 The approval steps for phase 1 is as indicated below:
- Agreement on the sleepers and fastenings offered for testing. (Local, imported, laboratory batch, production batch)
 - Technical evaluation of the proposed plant and process
 - Approval off the plant and production process that will be used to manufacture the sleepers including the curing method. Although approval is given Transnet do not take any responsibility for the final product.
 - A high-level technical evaluation of the proposed plant based:
 - on a detailed presentation on the manufacturing process by the bidder on the sleepers offered
 - and/or a visit to a plant similar to the one proposed for the manufacturing of the sleepers

- Agreements and signoff on the changes that will be implemented in the new/ existing plant.

7.1.9.3 Phase 2: Design approval of each product offered including approval of the drawing. (TTM process)

7.1.9.4 Bidders may only propose one design per sleeper type for testing and approval.

7.1.9.5 The approval steps for phase 2 is as indicated below:

- Must have passed phase 1.
- Agree on dates for the supply of the necessary technical documentation and designs for technical approval prior to the start of the testing.
- Supply of the necessary technical documentation and designs for technical approval.
- Evaluation and approval of designs and drawings. (Typically, 30 days)

Note:

Approval of the design and drawings do not mean that Transnet take responsibility for the final product nor for the correct dimensions and gauge.

7.1.9.6 Phase 3 Laboratory testing (TTM process)

7.1.9.7 The approval steps for phase 3 is as indicated below:

- Must have passed phase 2.
- Confirm what tests will be performed, as per this specification.
- Check if any special tests would be required.
- Supply of documentation by the bidder indicating sample compliance, handling, stacking, storing and transportation requirements
- Agree on dates for the supply of samples by the bidder for testing. Once requested, a supplier has 75 working days to deliver samples. The bidder can, within 20 working days from the request, ask Transnet for an extension of time.
- Supply of samples by the bidder for testing
- Laboratory testing of the sleepers (Typically 30 days for a sleeper type)
- Inspection and evaluation of sleepers
- Conditional approval if the above phases are completed which would allow for the manufacturing of a batch of sleepers.
- Supply of the supplier's quality manual for approval by TTM.

7.1.9.8 Phase 4 Plant audit, in track and field evaluation of sleepers at the plant

7.1.9.9 Once the plant has manufactured sleepers and the supplier is convinced that the sleepers are of the correct quality and correct gauge, they must approach TTM to carry on with the next phase of testing once the first batch of sleepers

has been manufactured from the plant it intends supplying from.

7.1.9.10 These sleepers will be subjected to laboratory tests as well as to a field evaluation and a gauge test. In some cases where special sleepers are developed a one-year in track test may also be required. Special sleepers refer to sleepers that have special methods of fastening and/or do not fit the size or shape as mentioned in this specification.

7.1.9.11 The manufacturer must demonstrate from its own documents and records that it can produce sleepers with the correct quality that comply with this specification. The supplier must include their own test results as part of the request to indicate that the batch complies with Transnet requirements.

7.1.9.12 The approval steps for phase 4 is as indicated below:

- Phase 4A Audit of the plant for compliance (TTM process)
- Evaluation of gauge results done by the factory
- Sample selection for static test at the plant and subsequent witnessing of the tests
- Audit of plant
- Phase 4B Field evaluation of batch of sleepers produced at the plant (TTM process)
- The plant must be producing sleepers on a continuous basis so that random sampling is possible.
- All sleeper moulds must be checked for the correct gauge by the supplier and be submitted to the Principal Engineer for approval.
- Sample selection (Laboratory testing, field evaluation and testing)
- Field Evaluation of the sleepers at the factory
- Gauge test on the selected samples by TTM
- The results of the testing and inspection of the random samples all gave compliant results.
- Static and dynamic testing of the sleepers manufactured (Locally in a batch)
- Access to a siding for the loading of sleeper

7.1.9.13 Phase 5 Compliance of system (TTM process)

7.1.9.14 Transnet will give approval to supplier for a specific product once the following steps have been finalized:

- Must have passed phase 4.
- Technical assessment of the system against this specification (based on information provided by the bidder)
- A TTM report indicating compliance or non-compliance with the specification and providing an indication of the shortcomings.

7.1.9.15 Approval will be granted before the ISO-9001 accreditation is achieved, provided the supplier has committed to obtaining the required accreditation as indicated in their plan. If the required accreditation is not provided within 24-months after manufacturing started, the supplier may apply in writing six months before the accreditation is due with the reasons for the delay for consideration by the Principal Engineer for a one-off extension of six months. If the accreditation is not obtained within the agreed period, the unconditional approval will be revoked.

7.1.9.16 The most recent road map status issued by Transnet supersedes any previous road map status. If a product has failed at a specific phase, then the process would stop for that product and the bidder will not be further considered for approval on the current process. Depending on the reason for the non-compliance it may affect other products. Bidders will have to wait for the next opportunity and depending on the non-compliance the phase where approval continuous may range between 1 and 5.

7.2 Opportunities for re-submission

7.2.1 Each product offered for approval can only be tested once during a specific tendering event or during a testing cycle. Should the product fail to meet the specified criteria, the shortcomings should be rectified and a new submission made for approval at the next applicable opportunity or similar.

7.3 Samples and supporting information for testing

7.3.1 Samples will be selected at random in accordance with the TTM Quality Management System procedure for Sampling (TQM-TRL-PRO-5).

7.3.2 During the approval phase the supplier shall on request supply and deliver the following elements to TTM in Johannesburg free of charge for all the laboratory tests required

- Designs
- Samples
- Jigs
- Material
- Training
- Specialised equipment if applicable
- Documentation: certificates, quality assurance tests, technical information, drawings and other relevant documentation to facilitate testing and evaluation.

7.4 New systems

- 7.4.1 Approval is on a per design basis. New designs are subject to confirmation of compliance to this specification through the approval process outlined in this specification.

7.5 Currently approved systems

- 7.5.1 Systems that have previously been tested and technically approved by TTM will be deemed as complying with this specification, subject to the following conditions:

- The scope of previous applications is appropriate for the current intended use cases as outlined in this document.
- Comply with all the necessary test and inspections as outlined in this specification.
- Continued compliance is maintained.
- Suppliers have been informed of a change in specification affecting their approval and the deadline for such approval have not passed resulting in approval being revoked or not granted.

- 7.5.2 A system will be deemed technically approved if:

- The status of the roadmap to approval indicating approval to the latest specification
- Approved for a previous version of the specification and the one-year grace period to get approval has not yet lapsed.
- Approval has not been revoked.

7.6 Continued compliance and approval

- 7.6.1 Approval is obtained indefinitely, as long as the requirements of this specification are complied with (including periodic re-testing and inspections). Transnet may from time to time revise this specification and inform suppliers of the new requirements that may affect their approval status.
- 7.6.2 Approved suppliers must make sure that their plant, and products produced in the plant, continue to comply with any new requirements of this specification.
- 7.6.3 Suppliers have one year from the date of issue of a revised specification to make sure they comply with the new requirements of the specification (Unless specifically mentioned in the specification that approved suppliers are exempted or when an extension has been granted by TTM).
- 7.6.4 Depending on the nature of the change re-approval may not be required. Once an approval is revoked suppliers will have to go through the approval process again.

- 7.6.5 To ensure continued compliance Transnet will inform approved suppliers with approved products and suppliers that are currently in the process of being tested of revisions to the specification, if implemented between tenders, and will indicate the nature of the change and by when they need to be aligned.
- 7.6.6 When a newer specification becomes available, suppliers that are currently in the approval process on an older specification will be given the opportunity to allow their products to be tested based on the latest specification. If they choose to do so and the product fail it would result in them not getting approval and they will have to wait for the next available opportunity for testing.

7.7 Periodic testing by TTM

- 7.7.1 After approval Transnet require suppliers to pass periodic testing to maintain approval.
- 7.7.2 Transnet will request samples for testing to ensure continued compliance, unless compelling reasons justify waiving such tests for a period, at the discretion of TTM. Such testing shall be planned at a rate of:
- 1 set of four sleepers every 6 months if the plant produces a specific type of sleeper.
 - Annual auditing of the plant
 - Annual field evaluation of sleepers at the plant or in the field
 - Annual checking of the gauge
 - When deemed necessary, as prompted by a relevant event or circumstance.
 - As indicated in the TTM quality management system, as per TQM-TRL-PRO5 "Sampling"

Note:

The discretion on which rate will rest solely with TTM . Transnet reserves the right to automatically extend approval for a further 6 months without conducting this periodic re-testing

- 7.7.3 The randomly Transnet selected sleepers must be sent to the Transnet testing facility at Track Technology Management within a month of the selection.
- 7.7.4 These sleepers (and any other additional sleepers sent if the initial submission failed) will be supplied and delivered to Transnet at no cost to Transnet as part of the quality assurance (QA) testing/periodic re-testing required by Transnet to retain approval. These test sleepers shall also be removed by the manufacturer on completion of the tests.

7.8 Periodic Testing and inspections by bidder

- 7.8.1.1 See section TESTING, INSPECTION, PASSING CRITERIA AND AUDITS for details.

7.9 Further Testing

- 7.9.1 TTM reserves the right to arrange further testing of any sleeper at the Track Testing Laboratory or at the plant should a particular event or circumstance warrant this.

- 7.9.2 Examples of the testing are:

- Turnout testing.
- Under sleeper pads.
- Testing off sleepers with fastenings that function fundamentally differently and/or where a new test method will be more suitable for the testing.

- 7.9.3 A reasonable number of samples must be supplied to TFR at the manufacturer's expense.

7.10 Product improvement

- 7.10.1 Once a supplier and a specific sleeper is approved suppliers can approach Transnet to test and approve improvements to their sleeper without affecting the approval already obtained.

- 7.10.2 The approval will follow all the applicable approval stages

7.11 Technology plan

- 7.11.1 Transnet have a Technology Plan that indicate the sleepers they intend using. Once a sleeper is approved it will be considered for inclusion in the plan. The reasons for inclusion or exclusion are beyond the scope of this specification.

7.12 Non-Compliance

- 7.12.1 Transnet reserves the right to do one or more of the following based on the results of the audit, testing and inspections or the inability to do the forementioned work due to a supplier fault:
- Put the procurement of all or a specific component on hold pending the results of further investigations that may include testing, inspections, audits.

- Request the supplier to hold in reserve all or a specific component based on batches or period pending the result of further investigations that may include testing, inspections, audits.
- Revoking approval if continued non compliances are witnessed.

7.12.2 Should any test or quality inspection (e.g., Bending test, material test, quality tests on the final product) fail to achieve the required results, that day's production must be held in reserve pending the outcome of further tests by TTM. SCM and TTM must be informed of all such cases. To perform the tests TTM will use their standard test methods, depending on the nature of the non-conformance. (e.g., Sleeper strength problem use TQM-TRL-STM-1 Rail seat test, TQM-TRL-STM-2 Sleeper centre and TQM-TRL-STM-3 Bond development.)

8 QUALITY OF GROUTING MORTAR

- 8.1 All openings in the end faces of sleepers – used for stressing and anchoring purposes – must be carefully plugged to prevent the ingress of moisture with grout having a minimum compressive strength of 28 MPa after 28 days. Also see section Manufacturing of Sleepers for more details
- 8.2 Patching will be restricted to occasional damage to sleepers and not to fix manufacturing or mould design problems.
- 8.3 The water absorption of the grout/mortar must be less than the water absorption of the concrete that the sleepers are made off. The grout/mortar used for the repairs must be approved by Transnet.
- 8.4 Based on field test by Transnet permission may be granted to the supplier not to plug such holes but may be revoked at any time during the contract period.
- 8.5 Plugging/ Corking must be done to the full depth of the hole and rammed in which will result in a dense grout without air voids.

9 TOLERANCES

- 9.1 The generic drawings in Table 4 give the typical dimensions and tolerances. As part of the approval of designs and drawings each bidder/ supplier must submit drawings with tolerances of all their products for approval by the Principal Engineer.
- 9.2 The approved drawings will be the drawing to which sleepers will be made.

- 9.3 Although Transnet approve the drawing the supplier is responsible and must make sure that the dimensions supplied or calculated by the supplier will produce sleepers that will comply with the correct gauge.
- 9.4 Any changes in these dimensions shall require Transnet's written approval.

Table 4: Typical generic Sleeper Drawings

Sleeper type	Drawing
P2	E3303 sheet 1
F4	E3303 sheet 2
PY	E3318 sheet 1
FY	E3318 sheet 2
PA	E3343 sheet 1
PY wing	Based on E3318 Sheet 1
LP (Low profile)	See Appendix D
Turnout bearer	See Appendix D
Universal Sleeper	See Appendix D
VY Sleeper	Same profile as per drawing E3318 sheet 1
V2 Sleeper	Same profile as per drawing E3303 sheet 1

- 9.5 A tolerance of ± 5 mm shall apply to the length, width and depth of the concrete sleeper unless otherwise shown on the drawings.
- 9.6 The rail seat on the sleeper must be true and flat to within 0.5 mm
- 9.7 The placement of the reinforcement must be within ± 3 mm of the design and drawing positioning.
- 9.8 The cant of the rail seat shall be not less than 1:21 and not more than 1:18 for the open track sleepers and for sleepers without a rail seat cant. ~~†~~—The difference in rail seat cant measured over a distance of 100 mm may not be more than 1 mm.

- 9.9 An adverse combination of the tolerance described in clause 9.4 and other tolerances affecting gauge will not be permissible. Therefore, when portions of the appropriate mass of rail together with the necessary fastenings (all correct to nominal size) are mounted on a sleeper or sleepers, the track gauge is to be correct within a tolerance of ± 1.5 mm
- 9.10 Notwithstanding the clause above, the track gauge referred to above shall be the following for the assembled open track sleepers:
- a) 1064 mm ± 1.5 mm for 48 kg/m rails on P2 sleepers
 - b) 1065 mm ± 1.5 mm for 48 kg/m rails on F4 sleepers
 - c) 1065 mm ± 1.5 mm for 57 kg/m rails on F4 sleepers
 - d) 1066 mm ± 1.5 mm for 60 kg/m rails on PY sleepers
 - e) 1067 mm ± 1.5 mm for 60 kg/m rails on FY sleepers
 - f) 1065 mm ± 1.5 mm for 48 kg/m rails on PA (paved) sleepers
 - g) 1066 mm ± 1.5 mm for 60 kg/m rails on PY wing sleepers
 - h) 1065mm ± 1.5 mm for 48kg/m rails on LP sleepers
 - i) 1066 mm ± 1.5 mm for 60 kg/m rails on VY sleepers
 - j) 1065 mm ± 1.5 mm for 48 kg/m rails on V2 sleepers
- 9.11 Each of the individual turnout bearers must be as per the Transnet approved manufacturers drawings.
- 9.12 New products (new product or design from existing supplier or new products from new suppliers) must pass the gauge test to the standard test method TQM-TRL-STM-4 "Assembly test for gauge on concrete sleepers" in order for the supplier to be approved for that product.
- 9.13 Before supplying any sleepers made in new or repaired moulds and when gauge issues are picked up or when new sleepers are made for the first time the supplier must prove that the supplier can produce sleepers with the correct gauge. To prove it the manufacturer must assemble a short length of track, comprising two lengths of new rails of appropriate weight, 3 m (± 0.3 m) long, on 4 sleepers complete with fastenings to check that the gauge is correct. (See 9.5 for the correct gauge).

9.14 The manufacturer will be required to maintain and use appropriate measuring apparatus to ensure continued compliance to the dimensional requirements, as part of the quality control plan/ manual. See appendix C for examples of typical measuring apparatus.

9.15 The maximum sleeper tolerances are as:

- indicated in the drawings mentioned in Table 2
- summarized in Table 5
- indicated in this specification. (Amongst others clause 9.10)
- indicated in the supplier approved drawings.

9.16 In the cases where the specification does not give a specific tolerance mutual agreement will be reached between Transnet Freight Rail and the supplier before implementing such a tolerance. Such an agreement will be in writing and would typically be reflected in the updated signed drawings.

9.17 If there are a conflict in tolerances between drawings mention in Table 2 and any other clause or table in the specification the more stringent tolerance would apply

Table 5: Summary of sleeper tolerances and visual standards.

Dimension description and defect number	Tolerance
Length	± 5 mm
Depth at cross section's	± 5 mm
Width	± 5 mm
Rail seat area flatness	True and flat to within 0.5 mm
Placement of reinforcement	± 3 mm measured from the top
Sleepers with a rail seat cant.	Not less than 1:21 and not more than 1:18
Sleepers without a rail seat cant.	Difference in rail seat cant measured over a distance of 100 mm may not be more than 1 mm.
The relative twist between the two rail seats	Not to exceed an angle of 30 minutes.
A3-Fastening too low or too high	Fastenings cast in more than 1 mm too high or too low
Rail seat width	± 1 mm
Fastening rotated (If applicable)	± 1 mm
Visual defects	1. Honeycomb (A9)

	2. Sleeper cracking (A10) 3. Concrete in dowels (A12) 4. Concrete soundness (B3) 5. Rail seat area not clean (B6) 6. Concrete inside the cast in component (B7) 7. Flashing (B8) 8. Sleeper bottom too smooth or loose material (B9) 9. Sleeper surface finish (not in section 6.3.6.3) 10. Segregation of fines > 5 mm (C7) 11. Corking not done correctly (C8) 12. Cover plates not correctly installed or damaged (C9) 13. Evidence of patching or cup grinding (C10) 14. Blowholes (B3) As defined in the specification and Transnet document BBG8734
Outer shoulder to outer shoulder (If applicable)	± 1.5 mm from drawing
Relative Twist on rail seat	Maximum 30 minutes
Rail seat damage	Damaged area > than 10% of the rail seat area
Chipped edges	The cumulative damaged length is longer than 200 mm where it is deeper than 15 mm
Sleeper ends	Flatness > 5 mm un-evenness
End face of any sleeper when cut by saw	$90^\circ \pm 1^\circ$ in both planes.
Concrete cover	Minimum 30 mm

10 **MARKING**

10.1 All sleepers are to be marked with the following:

- Transnet Logo
- Year of manufacture
- Manufacturer's identification mark
- Open track sleeper type and fastening identification mark (e.g. P2, PY, F4, FY, LP etc.)
- Place of manufacture
- In the case of turnouts: a turnout type, unique number and orientation as indicated on the turnout manufacturer's drawing.

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10.2 Such marking must be indented.

10.3 A temporary date DDMMYY that is visible for 6 month or until it is installed in track. must be visible when it is in the stack.

11 MANUFACTURING OF SLEEPERS

11.1 Particular care must be taken that the rail seats are smooth and even and within the tolerances laid down in this document.

11.2 Transnet will not accept sleepers where the cover to reinforcing steel is insufficient or where there are signs that the concrete is cracked. The protrusion of any reinforcement beyond the concrete level shall be limited to a maximum of 1 mm.

11.3 Full details of the curing method to be adopted must be submitted for approval during the final approval process and this curing method once accepted by Transnet will then be the method that must be implemented at the plant. This curing method must comply with the requirements of clause 11.4

11.4 Where vapour or other curing techniques is used the following shall apply:

- For at least two hours after casting the sleepers shall not be subjected to steam.
- The temperature shall be raised by not more than 15°C during the first hour of steaming.
- After the first hour of steaming the rate of increase in temperature shall not exceed 10°C per hour.
- When a temperature of 60°C has been reached it shall be maintained until a concrete strength of 30 MPa is reached. This temperature must not maintain for more than 6 hours.
- On no account shall the temperature exceed 60°C.

11.5 The above temperature and time requirements still apply even if another source of heating is used.

11.6 Suppliers must implement a method and inspection schedule in their quality manual that will allow them to confirm that they comply with clause 11.4

11.7 Each of the production lines or chambers must have a temperature system that will measure the temperature at various locations. These strategic locations must be such that it will prevent sleepers from being over or under cured. Curing records must be kept for a minimum period of two years. If the temperature measurement is a hand system then:

- the thermometers must be calibrated/verified daily to confirm that they are in working order.
- measurements must be taken at least every 30 minutes.
- the supplier must also have a system in place that will confirm that the readings taken is correct by doing random check by a quality representative.

11.8 Reinforcement placed in pre-formed ducts is to be grouted by means of cement grout under pressure.

11.9 If applicable the recesses formed in the end faces of the sleeper for the purpose of tensioning the reinforcement are to be plugged with cement mortar in such a manner as to achieve a satisfactory seal to protect the internal steel components against corrosion.

11.10 The sleeper must be free of defects and sound and the bottom surface must be suitably rough.

11.11 The manufacturer must comply with ISO 9001 and must be ISO 9001 certified once they have been in operation for 24 months since the supply of the first production sleepers to Transnet.

11.12 The supplier must have a clearly marked stock yard where sleepers that comply with the specification will be stacked ready for dispatch or inspection. This stock yard must be appropriate for the volume and type of sleepers they intend supplying and must be able to accommodate at least 28 days stock. TTM and Supply Chain Management must be informed and supplied with the layout, stock yard sizes for the different sleeper types and of any changes in the layout of the demarcated stock yard.

11.13 No sleeper may be supplied to Transnet during the 28 day curing period.

11.14 Refer to appendix A for the method of making and curing 150 mm concrete test cubes. In the event that the supplier wants to use an alternative method it must be submitted to the Principal Engineer for approval before manufacturing any sleepers against a contract.

11.15 All equipment used in the production and checking of the quality must be calibrated and verified as indicated in the quality manual

12 CONTROLLING OF ALKALI-SILICA-REACTION (ASR)

- 12.1 The alkali reactivity of aggregates used at the different manufacturing plants must be determined by an approved institution unless it is known from previous history or field performance that the aggregate is innocuous. If applicable the supplier must supply proof that the aggregate is innocuous.
- 12.2 A copy of results (from each supplier) tested must be forward to Transnet. These tests must be repeated if the supplier changes quarries and at least every 2 years. The supplier must submit a copy of these reports within a month of receiving it to Supply Chain Management and Technology Management for each of the relevant products used.
- 12.3 Transnet reserves the right to draw a sample of aggregate on the manufacturing plant and test it for the alkali-reactivity
- 12.4 For alkali-reactive aggregate the total content in kilogram Na₂O equivalent per cubic metre should not exceed the limits given in table 6 below for aggregates from the different lithostratigraphic units
- 12.5 To minimise the risk of ASR the following extenders can be used:
- Ground Granulated Blast Furnace Slag (GGBS) at least 40% by mass.
 - Fly Ash (FA) at least 20% by mass.

The limit of alkali content per cubic metre of concrete for South African aggregates from different lithostratigraphic units are as follows (Fulton's Concrete Technology):

Table 6: Limit of Alkali Content

Rock Type	Total Na ₂ O
• Witwatersrand Super group quartzite, shale	2.0
• Dolomite Group chert	2.8
• Malmesbury Group metasediments	2.1
• Table Mountain Group orthoquartzite	2.8
• Bokkeveld Group Quartzite, sandstone	2.8
• Natal Group Quartzite, sandstone	2.8
• Dwyka Formation tillite	2.8
• Enon Formation quartzite pebbles	2.8
• Quaternary	4.0

13 INFORMATION TO BE SUBMITTED BY BIDDERS DURING THE BID/ TENDER PROCESS

13.1 Approved suppliers with approved products (including conditionally approved) must supply the following information during the initial bid process:

- 13.1.1 The place of manufacture of the concrete sleepers.
- 13.1.2 The type of sleepers they have approval for
- 13.1.3 The type of sleepers they have approval/ conditional approval for
- 13.1.4 New sleepers they intend offering
- 13.1.5 ISO 9001 certification status and certificate if in operation for more than 24 months since the supply of the first production sleepers to Transnet.
- 13.1.6 Site layout of where the stock yard will be located and the number and type of sleeper that it can accommodate. The stock yard may only include sleepers that comply with this specification but may include sleepers that are not 28 days old.
- 13.1.7 The latest roadmap to approval and if applicable the signed notification of a change in specification.
 - Note:
 - Transnet will confirm approval information provided against internal records to confirm the approvals.

13.2 Non-approved suppliers without approved products must supply the following information during the initial bid process

- 13.2.1 the new sleepers they intend offering for approval and supply

14 DOCUMENTS REQUIRED BY TTM DURING THE APPROVAL, TESTING, AUDITS, QUALITY INSPECTIONS AND CONTINUED COMPLIANCE ASSESSMENTS

14.1 The following is a summary of documentation required during the various stages, phases of approval, audits, inspection and continued compliance:

- 14.1.1 Phase 1 of approval
 - Documented agreement and signoff on the sleepers and fastening offered for testing. (Local, imported, laboratory batch, production batch)

- Detailed presentation on the manufacturing process by the bidder on the sleepers offered and/or a report on the plant; similar to the one proposed for the manufacturing of the sleepers.
- Documented agreement and signoff on the changes that will be implemented in the new/ existing plant and approval off the production process including curing that will be used to manufacture the sleepers.

14.1.2 Phase 2 of approval

- Signed roadmap to approval phase 1.
- Documented dates for the supply of the necessary technical documentation, designs and drawings
- Technical documentation, proposed drawings and detailed designs for technical approval.
- Approval of corrosion protection.
- Letter indicating approval for a reduced concrete cover (If applicable)
- Mutual agreement between TTM and the supplier on tolerance not mentioned in the specification.
- Approved designs, tolerances and drawings.

Note:

Approval of the design and drawings do not mean that Transnet take responsibility for the final product nor for the correct dimensions and gauge.

14.1.3 Phase 3 of approval

- Signed roadmap to approval phase 2.
- Documented dates for the supply of the necessary technical documentation (sample compliance, handling, stacking, storing and transportation requirements) and sleepers for testing.
- Documented quality manual (Evaluation, approval, signed off)
- The quality control static test methods (Evaluation, approval, signed off) and if applicable the request for deviation from test method with the technical motivation.

14.1.4 Phase 4 of approval

- Access to a siding for the loading of sleeper.
- Site layout of where the stock yard will be located and the number and type of sleeper that it can accommodate. The stock yard may only include sleepers that comply with this specification but may include sleepers that are not 28 days old.
- Signed roadmap to approval phase 3.
- Documents and records that prove to Transnet that the plant is producing the correct quality sleepers and requesting an inspection and audit.

14.1.5 Phase 5 of approval

- Signed roadmap to approval phase 4.

14.1.6 Final approval, Audits, continuous improvement, quality test and inspection and continued compliance assessments.

- signed roadmap to approval phase 5.
- ISO 9001 certificate or plan for accreditation (Within 24 months from start of operations) or approval of extension was requested, motivated and granted (Extension were granted <30 months from start of operations)
- Signed letter indicating a change in specification. (Roadmap specification approval do not match latest specification)
- ASR results for last 5 year from each supplier. (if the supplier changes quarries and at least every 2 years) and proof that records were sent to TTM within a month of receiving it.
- Monthly quality sheets and proof that it was sent.
- TTM and SCM were informed of Non-conformances of the final product as indicated in the quality manual and proof that it was sent.

14.2 General

- The information above is a summary of the documentation mentioned in this specification and therefore some clauses may have been omitted or lack the detail because of the summarization. Please refer to the specification for the detail and clauses that may have been omitted.
- Some documents are listed as part of a specific approval processes and it is assumed that these documents will be available for all subsequent phases of approval, quality requirements and audits.
- Transnet reserves the right to ask the supplier for any other documentation relevant to this specification before giving final approval. Once information or documents are requested the bidder has 25 working days to comply. The bidder can within 5 working days from the request ask Transnet for an extension of time.

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15 **DELIVERY AND PACKAGING**

15.1 The sleepers shall be supplied loaded in rail wagons in the following manner:

- a) The sleepers are to be loaded rail seats uppermost transversely in layers: each layer being placed as nearly as possible in the middle of the truck.
- b) Each layer of sleepers including the bottom layer, is to rest on two strips of timber packing, each strip having a cross-section of not less than 38 mm x 38 mm. In the case of fastenings with a higher height the size must be increased. The timber strips may not be placed on the rail seat.

c) Under no circumstances may any layer of sleepers touch another layer of sleepers.

15.2 The number of sleepers to be loaded in each wagon shall be based on the permissible load of the wagon but rounded down to the nearest multiple of 10.

15.3 No loose concrete must be present on top of the sleepers when loaded on the wagons.

16 WARRANTY AND GUARANTEE

16.1 The supplier will be required to warranty the sleepers against all defects attributable to faulty manufacture, workmanship and quality of materials for a period of 3 years after the sleepers have been placed in the track.

16.2 Sleepers that fail or do not comply with the requirements of the specification while in service before the expiration of the warranty period shall be replaced free of charge at the site where sleepers were offloaded or installed when not offloaded

16.3 If any department within Transnet or third-party appointed by Transnet have any cause to suspect that a batch of sleepers delivered at site do not comply with the requirements, TTM and Supply Chain Management will be informed and they in turn will then inform the supplier. Once it has been established through inspection or testing that a stack contains sleepers that do not comply it will be up to the supplier to rework the stack to Transnet's satisfaction and to remove all affected sleepers and to replace them with the same quantity of new sleepers at the point of delivery.

16.4 Suppliers should be able to offer a guarantee that the sleepers will perform adequately for a reasonable period under the operating conditions specified, and provide reasonable assistance should under-performance be identified and reported.

17 QUALITY AND INSPECTION

17.1 To ensure that the sleepers manufactured are consistently of the specified quality the plant must have a Transnet approved quality manual that includes the following minimum details:

a) Details of the quality management system and ISO-9001 accreditation

- b) Competencies, roles and responsibilities of individuals
- c) Approved manufacturing process including the curing method
- d) Type of testing and evaluation that will be performed on each day's production
- e) Standard test methods for all tests, inspections, monitoring and evaluations and where applicable the Transnet signoff
- f) The frequency of the test, inspection, monitoring and evaluations
- g) Work instructions or Standard Operating Procedures for all test methods, tools, gauges, templates and equipment
- h) List of calibrated tools, gauges, templates, components and other equipment that will be used and available for use by Transnet during inspections
- i) Specification, tolerances and drawing for all tools, gauges, templates and other equipment
- j) Method of calibration of tools, gauges, templates and other equipment
- k) Details and frequency of calibration and verification of tools, gauges, templates and other equipment
- l) Standard templates for all tests, inspections, evaluations and monitoring including details of passing criteria and applicable signoffs
- m) Process for the handling of non-conformances
- n) Details and frequency of quality checks that will be performed on material, equipment and components received
- o) Stock yard layout with type of sleepers and maximum quantity
- p) Area where non-conforming or sleepers hold in reserve will be placed
- q) Standardized method of how non-conforming sleepers will be marked that are visible when it is in a stack
- r) ASR result not older than two years for aggregate
- s) Approvals, test method and specification for use of special grouts and epoxies when used on sleepers
- t) Concessions by TTM for all sleepers transported which are not 28 days old
- u) Record retention period for tests, inspections, monitoring, evaluations, calibrations and verifications
- v) List of all test results that must be send to TTM on a monthly basis

- w) List of all non-conformance that must be send to Supply Chain Management and TTM
- x) Transnet approved fastening systems details
- y) A test and inspection section
- z) Increase in test frequency if non-conformances are witnessed
- aa) Supplier specific installation procedures, drawings and tolerances
- bb) Transnet approved corrosion protection details
- cc) Transnet approved drawings
- dd) Method of temperature curing and monitoring
- ee) All the tests and inspections as outlined in the specification with specific reference to clause 6
- ff) Inspection of components that wear and that will affect the quality of the final product (e.g. gauge checking)
- gg) Information required on all equipment used in the test, evaluation, monitoring and inspection process (The serial number, calibration date, next calibration date and who did the calibration/ verification)
- hh) Details of how the sleepers will be checked for defects and defect combinations as outlined in clause 6.4.8
- ii) Process to be followed before:
 - Design or dimensional changes are made.
 - Materials or material suppliers are changed.
 - Changing the curing method
 - Using new or repaired moulds
 - Producing sleepers in a new year

17.2 General

- 17.2.1 The plant must supply TTM within 10 working days of a new month the previous month's individual quality records in a spreadsheet format with the following quality control test results for all sleeper types manufactured in that month for:
- Static Bend tests (Sleeper centre negative and Rail seat positive)
 - Cube test at release and at 28 days
 - Results of reinforcement properties
- 17.2.2 The plant must supply TTM and SCM within 10 working days of a non-conformance that affect the quality of the final product the details of the non-conformance and if the sleepers are held in reserve for inspection by Transnet.

- 17.2.3 Transnet require the supplier to grant inspectors access to the manufacturing facility, on request, to conduct technical audits and/or inspections of the manufacturing facility and testing to ensure compliance to the specification.
- 17.2.4 The top and side surfaces of the sleepers shall present a smooth, uniform appearance. A random scattering of surface voids will not be a cause for rejection. Heavy concentrations of surface voids or evidence of improper mixing, vibrating or curing will be a cause of rejection.
- 17.2.5 Because of wear and tear and repairs to moulds it is the responsibility of suppliers to put a quality plan in place that will ensure sleepers produced consistently provide the correct gauge.
- 17.2.6 Suppliers are required to supply, without charge to Transnet, calibrated tools, gauges, templates and other equipment required for checking the quality of the final product. TTM may require the supplier to prove that their equipment can measure correctly and to the required accuracy and precision.
- 17.2.7 The tools, gauges, templates and equipment must be verified and calibrated as per the supplier's quality manual. See appendix C for examples of some of the typical measuring apparatus.
- 17.2.8 Records must be kept of all tests, inspections, monitoring, evaluations, calibrations and verification for a minimum period of 5 years

APPENDIX A

METHOD OF MAKING AND CURING 150 mm CONCRETE TEST CUBES

The method below must be used if an alternative standard method is not used or if the plants method is not approved by Transnet.

1.1 Moulds

-
- Mould shall conform to current SABS specifications.
-

1.2 Vibrating Machine

- The vibrating machine shall be capable of
 - (a) Holding the mould firmly attached to the machine during vibration,
 - (b) Exercising vibration adequate to expel all trapped air within 5 minutes so that no more air bubbles emerge.

1.3 Method of Manufacture

Approximately 20 kg of concrete to be taken where the mixed concrete reaches the sleeper mould. This concrete must be spooned into the cube mould during vibration and the surface worked level, within 5 minutes. Vibrate for another minute.

1.4 Duration of Manufacture

Vibration of test cubes shall be completed within 45 minutes from the moment the dry cement enters the mixer.

1.5 After Manufacture

After vibration the filled mould shall be covered and transferred back to the sleeper production line for overnight curing. The mould to be removed between 8 and 24 hours after completion of vibration and the cube marked for identification and stored in water until time of testing, unless otherwise agreed.

APPENDIX B

QUALITY OF CONCRETE

- 2.1 The crushing strength of the individual 150-mm cubes of the concrete from which sleepers are made shall be at least 60 MPa and the maximum average 28 days cube results must be less than 90 MPa in all cases. The contractors must strive to find ways to reduce their 28-day concrete strength as the maximum cube strength may be reduced to less than 90 MPa in future specifications.
- 2.2 At least one set of three cubes shall be cast for every three hundred sleepers or part thereof from different batches of concrete at different intervals throughout each day.
- 2.3 The Contractor shall ensure that the testing machine is at all times in correct adjustment and properly calibrated. The Engineer shall have the right to check the calibration by crushing his own cubes on the Contractor's machine and on the Principal Engineer's testing machine and if there is any material discrepancy, the Engineer's calibration shall be accepted.
- 2.4 A test result shall be regarded as the average result for a set of 3 cubes. If the difference between the highest and lowest result for the 3 cubes exceeds 15% of the average, the test shall be rejected and the standard of testing shall be deemed inadequate if more than 10% of the tests have to be rejected.

Test results shall be recorded. From each day's group of cubes, the average strength shall exceed the strength specified in Annexure B1 section 2.1 by an amount not less than the standard deviation computed from the last 20 recorded averages, failing which the day's production must be separately stacked and held in reserve. In such cases the matter must be reported to the Principal Engineer who will decide whether the sleepers may be accepted. For that purpose, additional testing on the sleepers themselves shall be required. A minimum of 3 sleepers manufactured during the day concerned shall be tested in accordance with section 6 of this specification.

- 2.5 100 mm Cubes may be used in place of 150 mm cubes so long as the largest aggregate particles do not exceed 10 mm.

APPENDIX C

APPARATUS FOR MEASURING TOLERANCES

This section describes typical equipment that may be used to measure tolerances.

C1 **Twist and Rail Seat Cant**

The relative twist between the rail seats and the rail seat cant shall be measured by means of an apparatus similar to the one illustrated in sketch A.

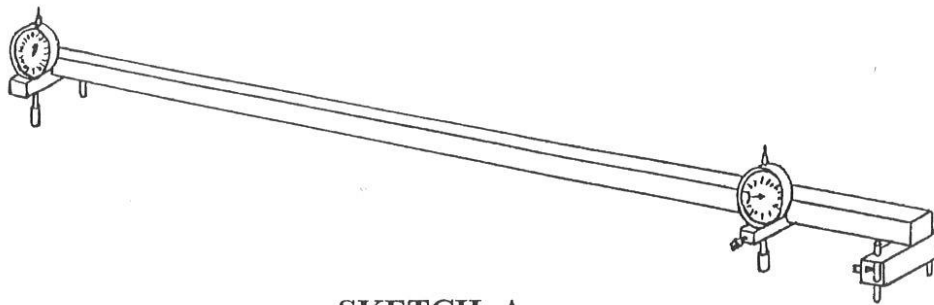
C2 **Rail Seat Width**

Rail seat width shall be measured by means of an apparatus similar to the one illustrated in sketch B.

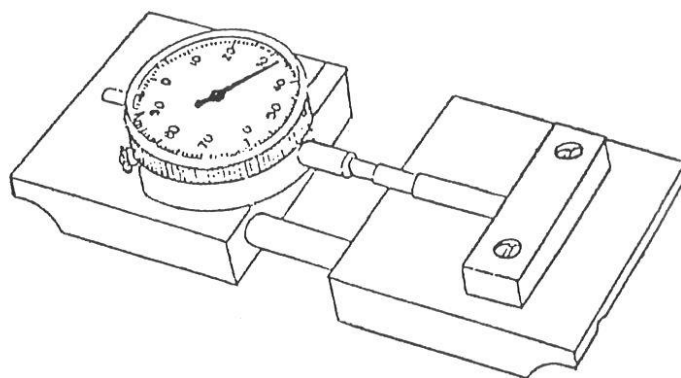
C3 **Flatness of Rail Seat**

The flatness of the rail seat shall be measured by means of an apparatus similar to the one illustrated in sketch C.

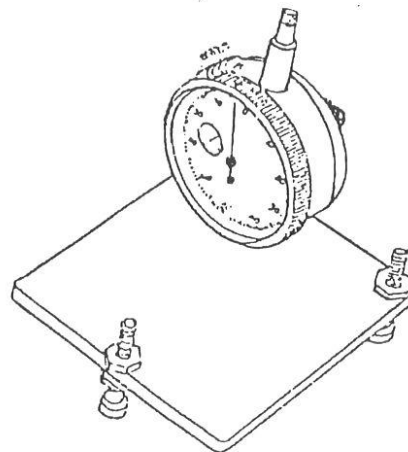
C4 For each of the forgoing measurement as well as for all the measurements in section 10 the manufacturer shall make available apparatus at his factory for the use by the Transnet Freight Rail's inspectors.



SKETCH A

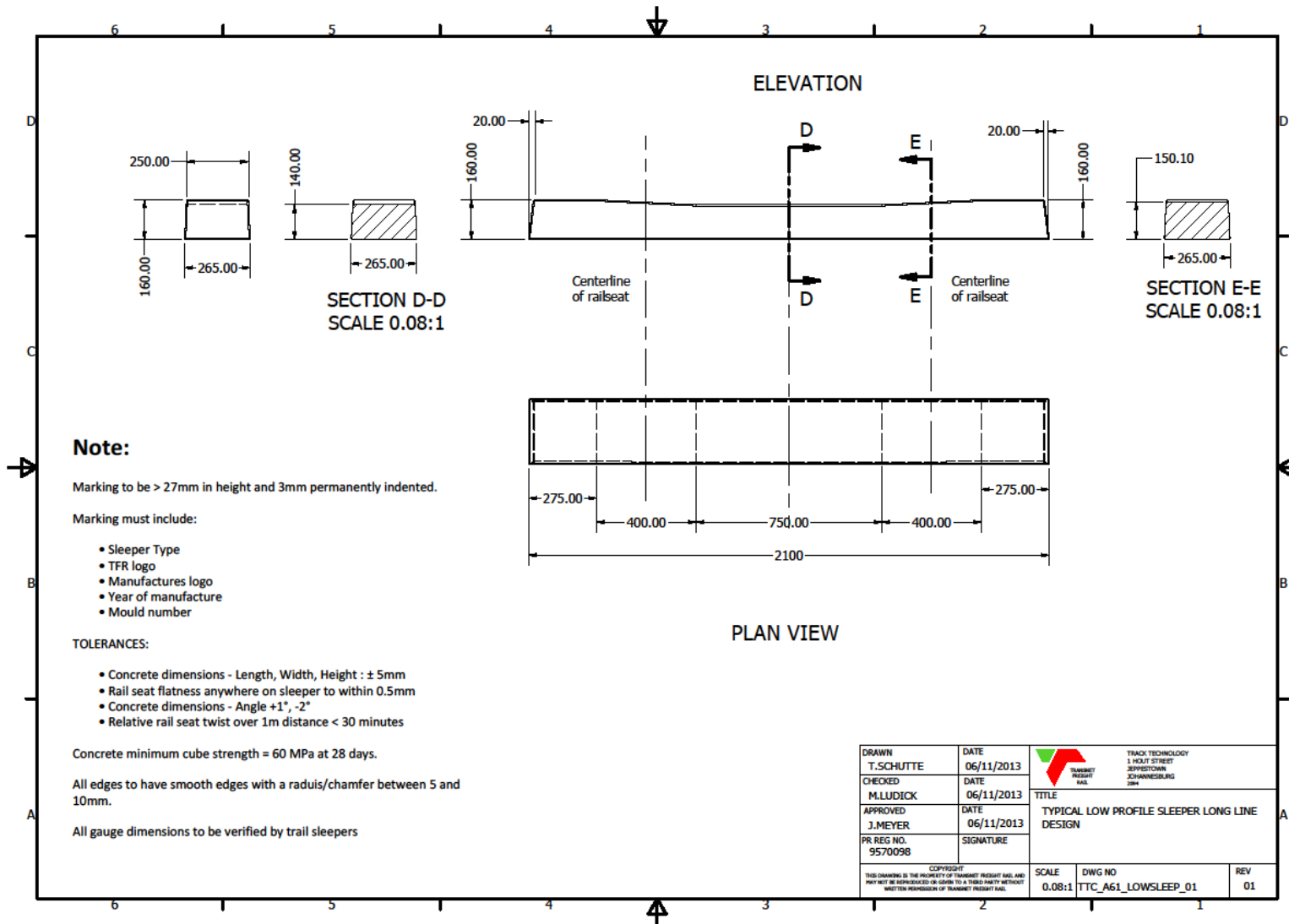


SKETCH B



SKETCH C

APPENDIX D



Appendix D1

