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CRN CP 233

Specifications

Engineering Specification Steel Sleepers

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Version 1.3	January 2022	TfNSW template applied.
Version 2.0	30 January 2022	First full UGLRL release.

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1. Scope and application

This specification details requirements for the design, manufacture and type approval of steel sleepers, complete with resilient fastenings and insulators for use on Country Regional Network (CRN) track.

Steel sleepers for special applications, including multi-gauge tracks and turnout bearers, are not covered by this specification.

2. References

2.1. Australian and International Standards

AS 1085.2 – Railway Track Material - Fishplates

AS 1085.17 – Railway Track Material – Steel Sleepers

AS 1085.19 – Railway Track Material – Resilient Fastening Assemblies

Unless otherwise specified, all references relate to the latest standard versions, including amendments and relevant superseding standards.

2.2. CRN documents

CRN CS 200	Track System
CRN CS 210	Track Geometry and Stability
CRN CS 220	Rail and Rail Joints
CRN CS 230	Sleepers and Track Support
CRN CM 203	Track Inspection
CRN CM 211	Track Geometry and Stability
CRN CM 221	Rail Installation & Repair
CRN CM 231	Sleepers & Fastenings
CRN CP 204	Product Approval

2.3. Other documents

Nil

3. Definitions

Refer to AS 1085.17 for definitions

4. Design Requirements

Steel sleepers shall be designed and manufactured in accordance with AS 1085.17 unless otherwise specified in this document.

The design and manufacture of fastening systems for steel sleepers (fastenings, shoulders, spacers and insulators) shall comply with Section 9 of this specification.

Sleepers shall meet the requirements specified in Table 1.

Table 1 – Sleeper design requirements

Criterion	Detail / Description
Sleeper types	Type 1 - for use on Class 1 lines with ≥ 10MGT per year of 25t axle load traffic where no track circuits are or may be provided Type 2 – for use on all other lines where no track circuits are or may be provided
Sleeper types	Type 1C (Insulated) - for use on Class 1 lines with ≥ 10MGT per year of 25t axle load traffic where track circuits are or may be provided. Type 2C (Insulated) – for use on all other lines where track circuits are or may be provided.
Desired Service life	The desired life of the sleeper and fastening system is 50 years. The expected total tonnage for the design life will be as specified in Table 4 for Classes 1, 2 and 3. It is acknowledged that service life will be affected by the type and condition of other components in the track system (rail, joints, fastenings, ballast support etc. As such, and as documented in AS 1085.17, satisfactory compliance by the sleeper fastening assembly with the requirements of AS 1085.17 Sections 2.2.2 to 2.2.8 shall be deemed as meeting the “Desired Service Life” criterion. Where alternative shapes are proposed, appropriate proof of the satisfactory performance of the sleeper in meeting the desired service life criterion shall be provided
Electrical Insulation	Where fitted with insulators, rail/sleeper fastening assemblies and sleepers when tested in accordance with AS 1085.19 Appendix C, shall meet the following requirements: Assembly Insulation Test – Electrical impedance ≥ 1MΩ Wet Electrical Impedance Test – Electrical impedance ≥ 4000Ω

5. Operating environment

5.1. General

Sleepers are expected to be installed in the environment detailed in Table 2, which provides information relating to track and rail operations where the steel sleepers will be used.

It should be specially noted that Type 2 and Type 2C sleepers will be installed in track configurations that vary in rail size, curvature, condition and strength as indicated in the

following tables. These sleeper types shall be designed to suit all these parameters and be suitable for installation and re-use at any location that falls within the ranges indicated.

> Guidance Note: Sleepers will be used in a variety of configurations, each with a specified track structure type and inherent strength and "best" condition. Type 2 sleepers, for example need to be designed to suit a range of applications from heavy fast traffic on good track to lighter, slower traffic on poorer track. The worst combination of these factors will dictate the chosen design output.

Table 2 – Design Information – operating environment

Criterion	Detail / Description
Track gauge	1435mm gauge with installation tolerance ±4 mm (See CRN CS 210 "Track Geometry and Stability").
Rail	
Rail cant	All running rails shall slope towards the track centre-line at 1 in 20.
Maximum Grade	1 in 33.
Curve Radius	Sleepers shall be designed for a minimum radius of 200m.
Signalling	Track circuited signalling – in accordance with CRN Signalling standards.
Climate	Temperate.
Nominal distance between axles	1.8m for 30 tonne axle load 1.7m for 25 tonne axle load 1.6m for 23 tonne axle load
Impact factor	The combines quasit- static and dynamic load factor as per in AS 1085.17
Rail weight	Rail sizes shall be as per the applicable track class as defined in CRN CS 220 "Rail and Rail Joints". Section properties of rail sizes are detailed in CRN CM 211 "Rail Installation and Repair"
Thermal expansion and contraction	Thermal expansion and contraction forces act on continuously welded rails with a rail temperature range from -10°C to 75°C about a neutral rail temperature of 35°C.

Maximum train speeds to be used are specified in CRN CS 200 "Track System" and are detailed in Table 3.

Table 3 – Maximum Train Speed

Axle Load	19TAL	22TAL	23T AL	25TAL	30TAL
Max Super Deficiency	75 mm	75 mm	110 mm	75 mm	N/A
Maximum Speed on Tangent Track	160 km/h	115 km/h	100 km/h	80 km/h	N/A

Track geometry assumptions (curvature, gradient, superelevation, cant deficiency etc.) shall be in accordance with the requirements detailed in CRN CS 210.

Track configuration and operating requirements to be used are specified in CRN CS 200. Track structure data is detailed in Table 4.

Table 4 – Design information - track structure data

Criterion	Class 1	Class 2	Class 3
Nominal Ballast Depth	250 to 300 mm	200 to 250 mm	150 to 200 mm
Nominal Track Modulus	25 MPa	20 MPa	15 MPa
Nominal Track Condition	TCI = 40 to 45	TCI = 45 to 50	TCI = 50 to 60
Eisenmann Track Condition Factor	0.225	0.275	0.35
Sleeper Centres	600 mm	600 mm	623 mm
Desired Service Life	500 MGT	200 MGT	200 MGT

As detailed in CRN CS 200 the CRN network includes a number of Class 5 lines in which steel sleepers may be installed. Steel sleepers installed on these lines shall meet the design requirements specified for Class 3 lines.

5.2. Sleeper dimensions (nominal)

The sleepers shall be designed to conform to the dimensions detailed in CRN Engineering Standard CRN CS 230 “Sleepers and Track Support “as shown in Table 5.

Table 5 – Nominal sleeper dimensions

Parameter	Dimension (mm)
Length	2380 to 2520
Width (at base)	250 to 260
Width (at seat)	150 to 200
Depth	95 to 100

Note:

The envelope of sleeper dimensions is based on the following considerations:

- Sleepers may be used in existing track infrastructure
- Sleepers may be interspersed with existing timber sleepers
- Sleeper length is restricted by existing embankment width, ballast shoulder width, clearance to structures, and need to accommodate rail fastenings
- Sleeper width at the base is restricted by sleeper spacing and the requirement to be able to tamp between sleepers

- Sleeper depth is restricted by need to maintain ballast depth for load distribution and for consistent tamping depth
- Sleeper height above rail base is restricted by consistency requirements for ballast regulating, clearance to rolling stock, ability to adjust, remove and inspect rail components

6. Lateral stability requirements

When tested in accordance with the Lateral Stability Test in AS 1085.17 the steel sleepers shall achieve at least equivalent loading to a reference panel of timber sleepers, at

- a lateral deflection of 10mm, and
- maximum load

The following requirements are specified for the test

- The reference panel of timber sleepers shall be constructed of components meeting the condition and geometry requirements of CRN Engineering manual CRN CM 203 “Track Inspection” for “Normal” operation
- Ballast consolidation shall be achieved by application of a cyclic load up to 30 tonnes for 250,000 cycles
- Ballast shoulder width shall be 400mm
- Tests to be repeated three (3) times for both the steel sleeper and timber sleeper with ballast beds to be re-built and re-consolidated between each test to limit the loss of ballast angularity

7. Design guidance notes

7.1. Treatment of changes in track configuration, condition and usage

UGLRL acknowledges that the condition of track into which steel sleepers will be installed will sometimes vary from the design conditions stated in Section 5. In managing the track assets UGLRL considers condition and usage in determining appropriate levels of maintenance and renewal.

Accordingly, steel sleepers shall be designed to meet the configuration, condition and usage requirements of this specification. Future changes in condition, configuration and/or usage shall not be a consideration for design or design acceptance.

8. Application of sleeper fastening system

Sleepers may be designed to accommodate different rail sizes as listed in Table 6. They shall be designed as single fastening sleepers.

Where multiple rail sizes are used, spacers shall be supplied for smaller rails in the same sleeper shoulder size (e.g. from 146 mm to 127 mm or 108/102 mm).

Insulators may be used in conjunction with single fastening insulated sleepers. Where multiple rail sizes are used, the insulator used with the smaller rails shall, preferably, operate as both a spacer and insulator.

Table 6 – Compatibility with rail type

Criterion	Type 1	Type 2	Type 2
Punched for foot size	146mm	146mm	127mm
Used without spacers for	53, 60kg and equivalents	53, 60kg and equivalents	50, 47, 41kg and equivalents
Used with spacers for	47kg and equivalents	50, 47, 41, 30kg and equivalents	30kg and equivalents

9. Fastenings

The method of fastening the rails to the sleeper shall be a resilient fastening system.

All replaceable components (fastenings, shoulders, spacers and insulators) shall be removable for ease of installation in existing track when performing track maintenance.

All replaceable components shall be designed and manufactured to provide a desired service life of 10 years in the operating environment in Section 5.

The design and manufacture of the fastening system including clips, shoulders, insulators and spacers shall meet the requirements of AS 1085.19 and other relevant Australian Standards.

The fastenings system shall meet the requirements specified in Table 7.

Fastenings may be proven products, for which track performance data shall be supplied. Data may contain axle load, total gross tonnage, train speed and track details with relevant site information. For new designs, design data and laboratory test results shall be submitted. Laboratory tests must simulate in-track situations.

The insulation components supplied shall ensure sufficient insulation between the rail and the sleeper in accordance with the requirements of Table 2.

The fastening system design shall make special provision at fishplated joints (including bonded insulated joints) to ensure effective fastening of the rail to the sleeper. Refer to AS 1085.2.

Table 7 – Fastening design requirements

Criterion	Class 1 Track	Class 2 & 3 Track
Min. Rail Clamping Force	20 kN (at each Rail Seat)	18 kN (at each Rail Seat)
Min. Longitudinal Restraint	10 kN (at each Rail Seat)	9 kN (at each Rail Seat)

10. Handling and maintenance performance

10.1. Stacking of sleepers

The finished sleepers shall be handled and stacked in such a manner that there shall be no damage to the sleepers. Stacked sleepers shall be nestable and able to be easily separated.

10.2. Surface finish

Sleepers shall be free of burrs that could cause injury when handled or that could prevent efficient stacking and installation.

10.3. Maintainability

Sleepers must be suitable for installation by conventional track laying equipment of a type used for partial resleepering.

Trackwork fitted with these steel sleepers must be suitable for maintenance with conventional track maintenance equipment. Such equipment may include tamping machines, track adjustment jacks, track lining machines and fastening insertion/removal equipment.

10.4. Inspection holes

Each steel sleeper shall include four 20mm diameter inspection holes, one each side of each rail seat, to allow for inspection and assessment of ballast profile and compaction within the sleeper pod when the sleepers are installed in the track. The holes shall be placed away from locations of high stress but generally within 300mm each side of the centre of each rail seat.

11. System performance

System performance requires the steel sleeper assembly to function as part of the track structure. The sleeper must be able to transfer all the relevant track forces generated by train operations and the forces of rail thermal expansion and contraction to the ballast.

Insulators must possess sufficient edge stiffness to prevent the sleeper tilting (about its longitudinal axis) in order to resist longitudinal track forces arising from thermal expansion, contraction and rail creep.

12. Identification marking

The following markings shall be incorporated in the sleepers by raised or indented letters not less than 12mm high, nor more than 2mm raised or indented:

- Mark of Manufacturer
- Year of Manufacture
- Sleeper type identification marks
- Nominal Rail Size(s) without spacers
- Marking for insulated sleeper system (e.g. “I”)

The markings shall:

- not induce inherent fatigue weakness zones.
- be located on the top surface of the sleeper and between the rail seats, and in the spacer such that it can be identified when in place.
- be located so that they can be readily seen when the sleeper is installed and so that a stack of sleepers can be fully identified
- be sufficient to remain visible for the sleeper design life.

Sleeper fastenings shall be marked in accordance with the requirements of AS 1085.19. Spacers shall be identified for original size of sleeper and reduced rail fitting. An identification is required for gauge side or field side as well as insulated or non-insulated (e.g.60kg/41kg-GI represents 60kg sleeper holes, 41kg reduced rail fitting for gauge side and insulated).

13. Type approval requirements

13.1. General

The following type approval requirements apply to new steel sleeper designs and to new manufacturers producing steel sleepers of an existing design.

The requirements also apply to changes to existing approved designs, including changes in fastening type.

All submissions for type approval shall be documented to meet the requirements of CRN Engineering Specification CRN CP 204 “Product Approval”.

The steel sleeper assembly (sleeper, fastening system, insulators and spacers) shall conform fully to the requirements of this specification.

13.2.Information to be provided

The following information shall be submitted: -

Design documentation

- Design assumptions used in applying the design method in AS 1085.17.
- Calculated design loads.
- Evidence of considerations of the range of possible applications of the sleepers in determining design loads.
- Design outputs, testing loads and justifications.
- Schedule of technical data specifying sleeper shape and dimensions including end details (spade).
- The calculated maximum mass of the sleeper.
- Fastening details including the rail fastening clip deflection range.
- Material and Component Specifications for sleepers, fastenings, insulators and spacers.
- The place of manufacture.
- Methods of manufacture, sampling and testing.
- Technical calculations.
- Documentation of testing outcomes as specified in AS 1085.17.
- The level of electrical resistivity achieved per sleeper, in place, with insulators fitted.

User Documentation

The following information shall be provided in a form suitable for inclusion in CRN Engineering Manuals CRN CM 231 “Sleepers and Fastenings”, CRN CM 211 “Track Geometry and Stability” and/or CRN CM 203 “Track Inspection”:

- Safety instructions including sleeper handling and installation and safe fastening installation procedures.
- Spacer and insulator installation methods.
- Maintenance documentation giving details of inspection requirements including frequency, method and requirements.
- Sleeper installation and maintenance requirements and methods, including any special tools and equipment.