TS 01101:1.0

CRN CP 235

Specifications

Engineering Specification Steel Turnout Bearers

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Document information

Owner:	Director Corridor Infrastructure & Engineering, AMB, SER
Mode	Heavy rail
Discipline	Civil

Document history

Revision	Effective date	Summary of changes
Version 1.2	30 January 2022	TfNSW template applied.
Version 2.0	30 January 2022	Internal revision only – no change.
Version 3.0	30 January 2022	First full UGLRL release.

Table of contents

1. Scope and Application

This specification details requirements for the design and type approval of steel turnout bearers complete with resilient fastenings and insulators.

It is applicable for turnout bearers used on Country Regional Network (CRN) track infrastructure to meet the requirements of CRN Engineering Standard CRN CS 230 “Sleepers and Track Support”.

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

2. References

2.1. Australian and International Standards

AS 1085.1	Railway Track Material – Rails
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 230	Sleepers and Track Support
CRN CS 250	Turnouts
CRN CM 203	Track Inspection
CRN CM 221	Rail Installation and Repair
CRN CM 251	Turnouts
CRN CP 204	Product Approval
CRN CP 233	Steel Sleepers

2.3. Other References

Nil

3. Definitions and abbreviations

Refer to AS 1085.17 for definitions

MGT Million gross tonnes

TAL Tonnes Axle Load

TCI Track Condition Index

4. Design Requirements

The design shall be based on relevant Australian Standards and Codes of Practice except where otherwise specified in this document.

Steel bearers shall be designed in accordance with Australian standard AS 1085.17 - (Railway Track Material; Part 17: Steel Sleepers) unless otherwise specified in this document.

Fastenings, shoulder inserts, spacers and insulators must comply with CRN CP 233 “Steel Sleepers” and Australian Standard AS 1085.19.

4.1. General information

Bearers shall be designed to operate in the environment detailed in Table 1, which provides design information relating to track and rail operations where the steel bearers will be used.

Table 1 – General Information

Criterion	Detail / Description
Track gauge	1435mm gauge with installation tolerance ±4 mm (See CRN CS 210 “Track Geometry and Stability”).
Rail	Rail sizes to be used are detailed in CRN CS 250 and CRN CM 221
Rail cant	All running rails shall have zero cant.
Signalling	Track circuited signalling – in accordance with CRN Signalling standards.
Climate	Temperate
Minimum Service life	The design life of the bearer and fastening system shall be at least 50 years. The expected total tonnage for the design life will be as specified in 4.2 for Classes 1, 2 and 3.
Electrical Insulation	Bearers and fastenings together with open track panels shall ensure a minimum electrical resistance between running rails of 10 ohms per track kilometre.
Load distribution factor	Use applicable rail size as per CRN CS 230

Criterion	Detail / Description
Thermal expansion and contraction	Thermal expansion and contraction forces act on the continuously welded rails with a rail temperature range from -10°C to 75°C about a neutral rail temperature of 35°C.
Thermal coefficient of the steel	1.17 X 10^{-5} mm/mm degree

Maximum train speeds to be used are specified in CRN Engineering Standard CRN CS 200 “Track System” and detailed in Table 2.

Table 2 – Maximum Train Speed

Axle Load / Traffic Classification	19TAL	22TAL	23TAL	25TAL
Max Superelevation Deficiency	75 mm	75 mm	110 mm	75 mm
Maximum Speed on Tangent Track	160 km/h	115 km/h	100 km/h	80 km/h

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

4.2. Track information

Track configuration and operating requirements to be used are specified in CRN CS 200. Track structure data is detailed in Table 3.

Table 3 – Design information - track structure data

	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
Equivalent Eisenmann Factor	0.225	0.275	0.35
Axle Load	25 tonnes	25 tonnes	20 tonnes
Bearer Centres	600 mm	600 mm	600 mm
Total 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 bearers may be installed. Steel bearers installed on these lines shall meet the design requirements specified for Class 3 lines.

4.3. Bearer dimensions

Table 4 – Design information - track structure data

Parameter	Dimension
Bearer length	Varies; 2.5 to 7.5 metres
Width (at base)	250 mm - 260 mm
Width (at seat)	150 - 250
Depth	95 to 200
Thickness at rail seat	7.5-15 mm
Thickness at flare section	5.5-10 mm

The dimensional tolerances for approved designs shall be in accordance with Table 5.

Table 5 – Tolerances on bearer dimensions

Length	+ 10 mm / - 5 mm
Width	± 3 mm
Depth	± 3 mm

Once bearer depth has been selected for infill panel members or longest turnout members as appropriate, depth of members shall be arranged to ensure the underside of all members form a single plane.

4.4. Bearer design information

The design requirements detailed in Table 6 shall be used in bearer and fastening design.

Table 6 – Bearer design information

Parameter	Class 1 Track	Class 2 & 3 Track
Design Rail Seat Load	100 kN	80 kN
Design Bending Moments	As per Appendix A	As per Appendix A
Design Shear Forces	As per Appendix A	As per Appendix A
Lateral to Vertical Force Ratio	0.75 (Calculated for Rail Seat)	0.75 (Calculated for Rail Seat)
Steel sleeper Yield strength	250 MPa (min)	250 MPa (min)
Modulus of elasticity of steel	200 GPa	200 GPa
Allowable ballast stress	600-750 kPa	500-600 kPa

Other design and testing details shall be as specified in CRN CP 233.

4.5. Fastening design information

Table 7 – Bearer design information

Parameter	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)

4.6. Ancillary equipment

Provision for point machines shall be allowed for in the “A” and “B” bearers at the points. If swing nose crossings are used provision for the fastening of point machines is also required for the bearers affected at the crossing location.

4.7. Manufacturing

Approved designs shall be manufactured and tested in accordance with AS 1085.17

5. Handling and maintenance performance

5.1. Surface finish

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

5.2. Maintainability

Trackwork fitted with steel bearers 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.

6. System performance

System performance requires the steel bearer assembly to function as part of the track structure. The bearer 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 bearer tilting (about its longitudinal axis) in order to resist longitudinal track forces arising from thermal expansion, contraction and rail creep.

7. Allowance for retro fit

There is no allowance for retro-fitting of steel bearers

8. Bearer marking

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

- Mark of Manufacturer
- Year of Manufacture
- Bearer type identification marks
- Marking for insulated bearer system (e.g. “I”)
- Fastener identification number

The markings shall:

- not induce inherent fatigue weakness zones.
- be located on the top surface of the bearer and between the rail seats such that it can be identified when in place.
- be sufficient to remain visible for the bearer design life.

9. Type approval requirements

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

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

The steel bearer assembly (bearer, fastening system and insulators) shall conform fully to the requirements of AS 1085.17 and AS 1085.19 and as set out in this specification.

The supplier will be required to provide:

Design Documentation

- Schedule of technical data specifying bearer shape and dimensions including end details (spade).
- The calculated maximum mass of the bearers.
- Fastening details including the rail fastening clip deflection range.
- Material and Component Specifications for bearers, fastenings and insulators.
- The place of manufacture.
- Methods of manufacture, sampling and testing.

  Technical calculations.

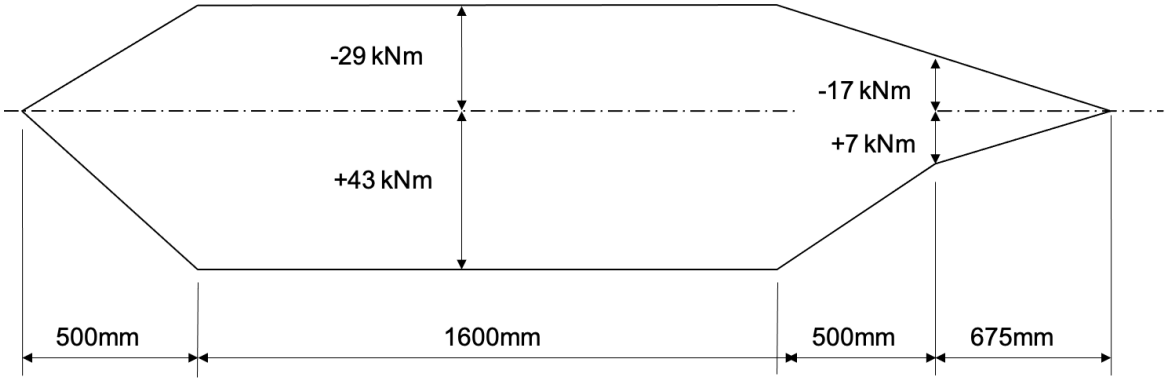
- Documentation of testing outcomes as specified in AS 1085.17
- The level of electrical resistivity achieved per bearer, in place, with insulators fitted.
- Insulator installation methods
- Safety instructions including handling and installation and safe fastening installation procedures. The instructions shall be in a form suitable for inclusion in CRN CM 251 “Turnouts”.

User Documentation

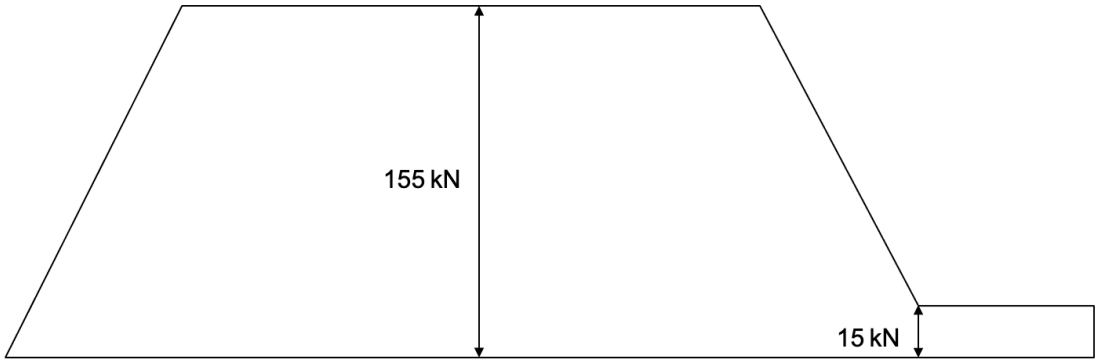
The following information shall be in a form suitable for inclusion in CRN CM 251 “Turnouts” and/or CRN CM 203 “Track Inspection”:

- Safety instructions including bearer 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.
- Bearer installation and maintenance requirements and methods, including any special tools and equipment.

Appendix A Bending moment and shear force envelopes



Bending moment envelope



Shear force envelope

Figure 1 - Bending moment and shear force envelope for turnout ties TYPE "A" - for points motor

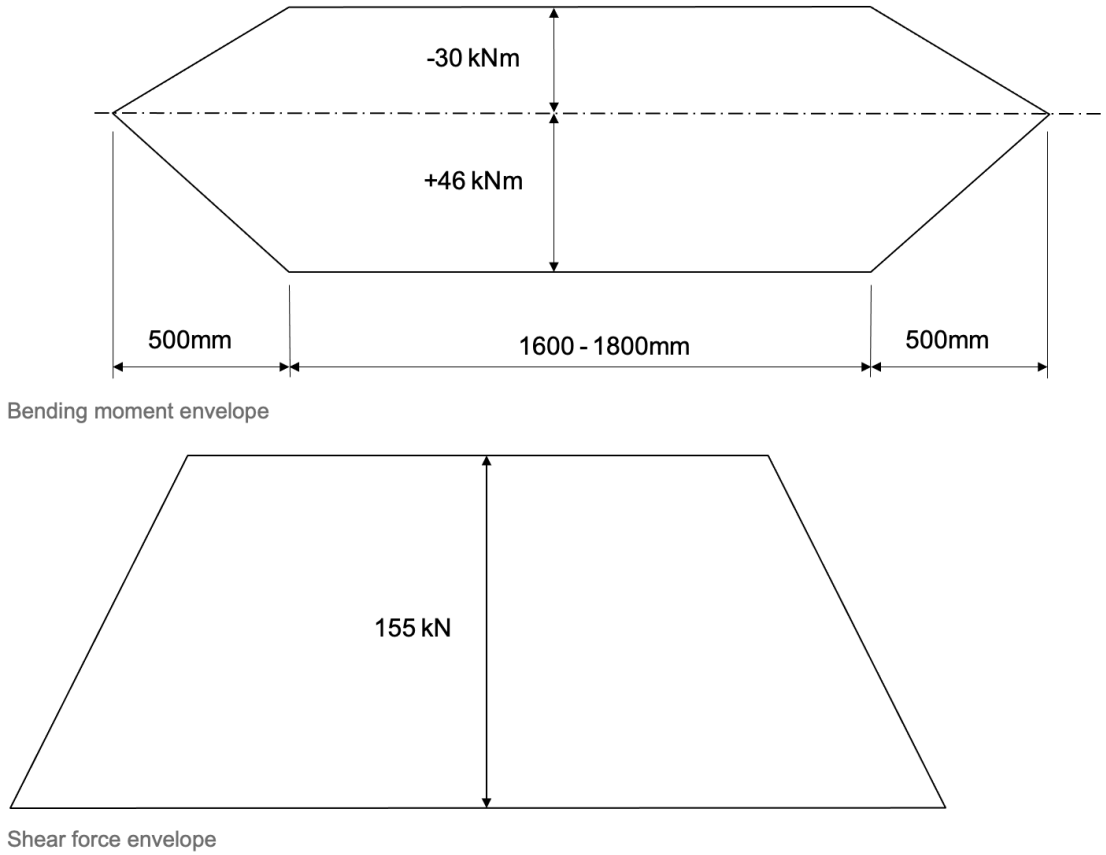
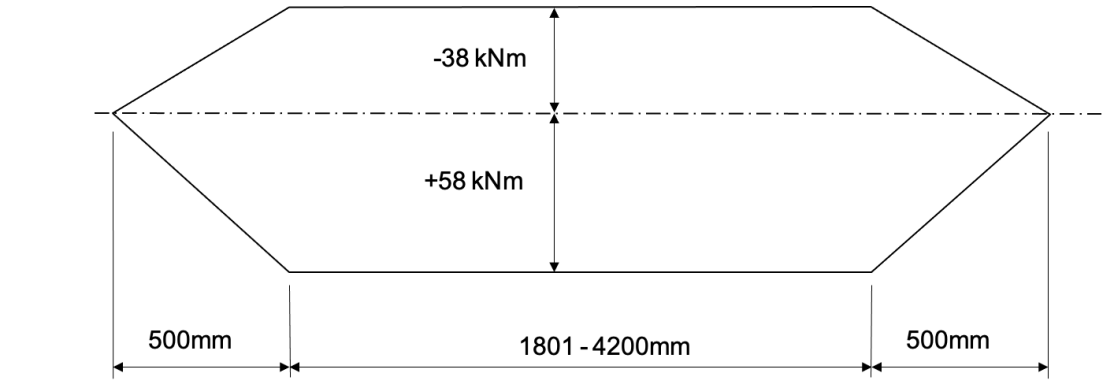
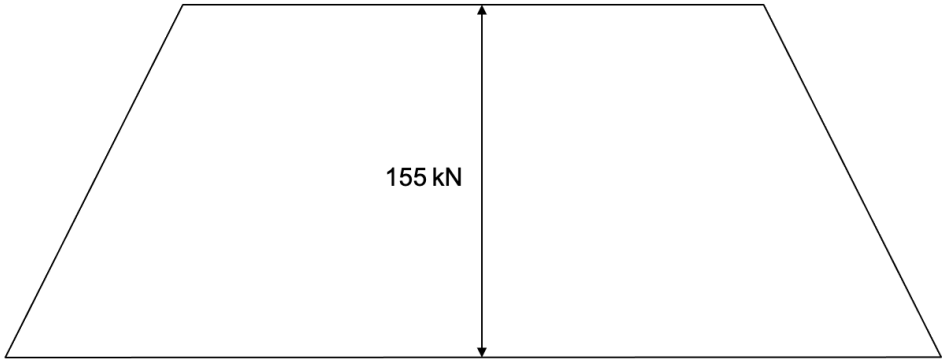


Figure 2 - Bending moment and shear force envelope for turnout ties Type “B” - length 2.600 - 2.800 metres

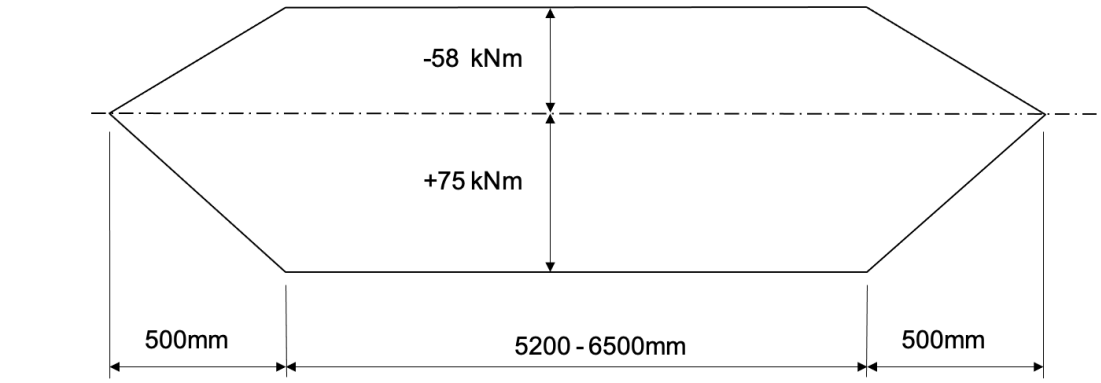


Bending moment envelope

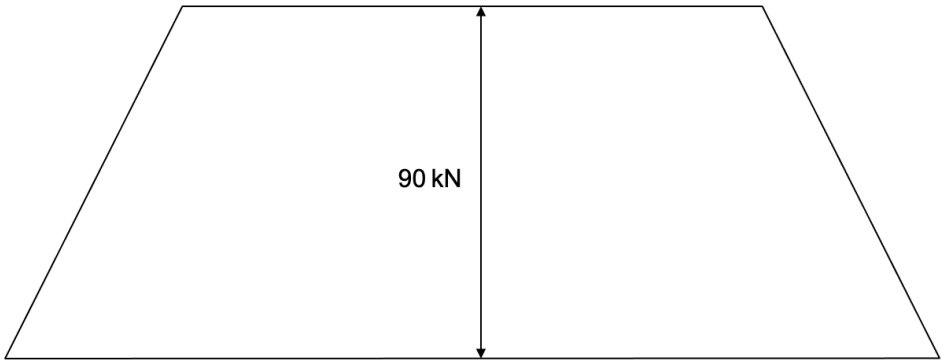


Shear force envelope

Figure 3 - Bending moment and shear force envelope for turnout ties Type “C” - length 2.801 – 5.200 metres

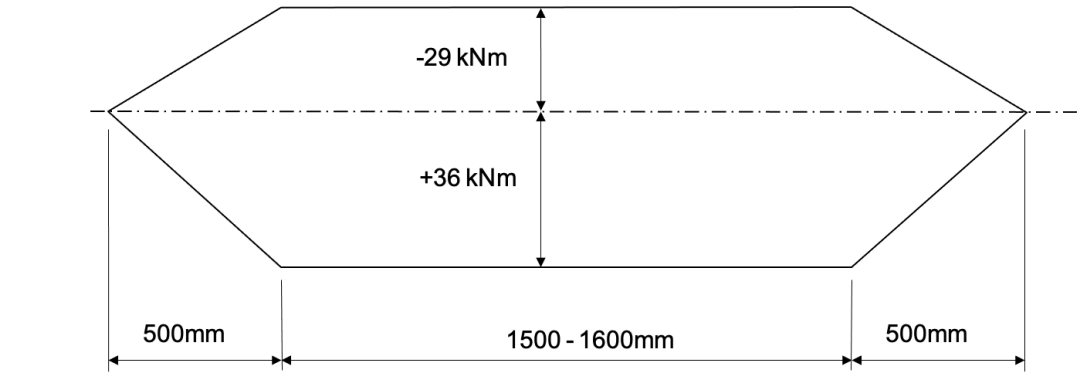


Bending moment envelope

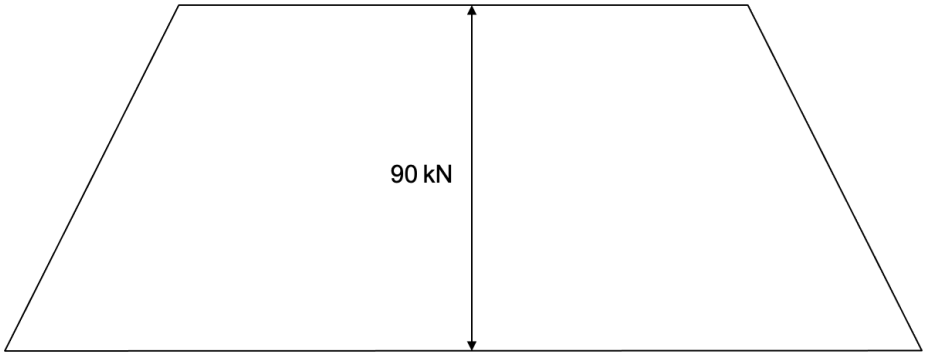


Shear force envelope

Figure 4 - Bending moment and shear force envelope for turnout ties Type "D" - length 6.200 - 7.500 metres (ACROSS PARALLEL TRACKS)



Bending moment envelope



Shear force envelope

Figure 5 - Bending moment and shear force envelope for turnout ties Type "F" – Flat Ties