



AUSTRALIAN RAIL TRACK CORPORATION LTD

Discipline: Engineering (Track & Civil)

Category: Engineering Specification

# Concrete Bearers - Design

## ETD-03-02

### Applicability

ARTC Network Wide	✓
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### Primary Source

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### Document Status

Version	Date Reviewed	Prepared by	Reviewed by	Endorsed	Approved
1.1	06 Jan 14	Standards	Stakeholders	Manager Standards	General Manager Technical Standards 9/01/2014

### Amendment Record

Version	Date Reviewed	Clause	Description of Amendment
1.0	01 May 06		First issue
1.1	06 Jan 14	All	Change to newer document template, updated applicability from western jurisdiction to network wide. Reviewed as part of major review of points and crossings documents. Obsolete information deleted and additional information added from otherwise redundant, withdrawn standards (ETG-03-01 & ETA-03-02).

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# 1 Introduction

## 1.1 Purpose

The purpose of this document is to provide a Specification for prestressed concrete bearers to suit points and crossings assemblies.

## 1.2 Scope

This Specification covers the design, manufacture, supply, delivery and type approval requirements of prestressed concrete bearers to suit points and crossings assemblies.

## 1.3 Responsibilities

The Manager Standards is the document owner and is the initial point of contact for all queries relating to this Specification.

# 2 Design Requirements

Final acceptability of any design will be dependent upon the checking of the proposal to ensure that the requirements of this specification are fulfilled.

Design, manufacture and testing of bearers and cast-in fastenings shall be in accordance with AS 1085.14 Prestressed Concrete Bearers.

## 2.1 General Information

Criterion	Detail
Railway System	ARTC
Track Gauge	1435mm, or mixed as specified
Rail	AS 1085.1 (60kg/m, 53kg/m). Continuously welded but concrete bearers should be suitable for use at mechanical joints.
Rail cant	Zero
Track circuits requiring insulation	Yes
Ballast Depth	250mm nominal
Axle loads/Associated speeds	20 tonnes /160km/h 30 tonnes/80km/h
Minimum Service Life	25 years/400MGT

## 2.2 Turnout Information

As shown on the contract drawings.

The footprints in figures 3.1(a), (b), (c), (d) and (e) in Section 3.1 of the National Code of Practice, Part 3 Guidelines should be adopted, or as otherwise specified by ARTC.

## 2.3 Concrete Bearer Design Information

Parameter	Value
Bearer length	Varies; 2.5m to 5.0m <sup>1</sup>

Bearer spacing	Maximum 700mm or as specified
Limits of cross section (width)	240mm – 300mm
Limits of cross section (depth)	220mm – 275mm <sup>2</sup>
Design rail seat load	AS 1085.14
Impact factor	3.0 (20t axle at 160km/h) 2.5 (30t axle at 80km/h)

*Notes:*

1. Longer lengths may be required to suit special configurations (e.g. mixed gauge)
2. Once member 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.

## 2.4 Fastening Design Information

Parameter	Value
Minimum clamping force on a rail seat using approved cast-in fastenings	21kN
Longitudinal static and dynamic creep resistance per rail seat	12kN

Synthetic inserts shall be threaded internally and externally so as to be replaceable and be provided with protective plugs to prevent entry of foreign material.

Other design and testing details shall be as specified in the ARTC Track & Civil Code of Practice.

## 2.5 Ancillary Equipment

Provision for point machines shall be allowed for the “A” and “B” bearers at the points.

The design of concrete bearers shall allow for the switch operation to be installed on either side of the track (i.e. either left or right hand operation).

If swing nose crossings are used, provision for fastenings of point machines is also required for the bearers affected at the crossing location.

## 2.6 Manufacturing Information

Approved designs shall be manufactured and tested in accordance with AS 1085.14.

Test certificates demonstrating materials’ conformity to relevant ARTC and Australian Standards shall be available for inspection by an ARTC Representative prior to commencement and at any time during the period of manufacture. Any unsatisfactory material may be rejected notwithstanding test certificates.

# 3 Installation, Handling and Maintenance

It is preferable that the bearers can be installed by turnout transportation and layout equipment. Bearers must be stable for stacking on flat-bed transportation vehicles or on site. Preference shall be given to designs where manual work such as the fitting of pads, insulators and installation of fastenings is kept to a minimum.

Trackwork fitted with concrete 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.

## 4 System Performance

System performance requires the concrete 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.

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

Clips must provide enough deflection capacity to accommodate rail movement on the pad indefinitely without loss of toe load

The area of the bearer bases must be adequate to ensure an even load distribution through the ballast bed with maximum ballast pressure

## 5 Allowance for Retrofit

For plated bearer designs there shall be two zones running the length of the bearer that are clear of reinforcement and which can be used for repair, or retrofitting of equipment. This includes an allowance of 10mm clearance to the reinforcement. Any cored holes shall be perpendicular to the bearer top surface (i.e. vertical in the installed position) to maintain this clearance. Cored holes shall be no deeper than 190mm from the top surface and the maximum diameter of any cored hole shall be 50mm. No hole shall be placed closer than 2 diameters from another hole unless the existing holes are filled. Epoxy suitable for high strength concrete repair, with similar mechanical and thermal expansion properties and strength >50Mpa, shall be used.

## 6 Bearer Marking

The following marks shall be displayed on each bearer, with markings being raised or indented to suit the manufacturer. Note that some are mandatory and some are optional.

- Mark of Manufacture (Optional)
- The letters "ARTC" (Optional)
- Year of manufacture with 50 mm high numbers (Mandatory)
- Batch number (including a design type designator) (Mandatory).

Lettering and marks shall be on the upper surface of the bearer between the rail seats.

## 7 Product Approval Requirements

All new sleeper designs shall be submitted to the ARTC Manager Standards and Systems for product approval. As part of the submission, the following data shall be provided by the supplier:

One set of design calculations including the following:

- Rail seat load
- Positive and negative resisting moments at the rail seat and at the centre of the bearer for all the various lengths of the bearers including the points motor bearers
- Fastening assemblies with all cast-in components, insulators and clips
- Tendon design stress including strain relaxation
- Tendon bond stress including losses from interface bond/anchorage
- Concrete strength including shrinkage creep and curing effects
- The complete integrated bearer system as a unit including spalling and delamination effects

- The effects on bearer strength from manufacturing tolerances (e.g. concrete shape and tendon placement) and the design attrition allowance.

New bearer designs shall undergo tests to prove the design in accordance with AS 1085.14- Prestressed Concrete Sleepers.

Independent design check of the design shall be undertaken by a competent designer, and details of this design check and information shall be provided.

Two sets of fully detailed drawings are to be supplied for each combination of bearer type, fastening assembly and rail size.

The drawing should detail the following:

- Tendon type, size and material
- Shoulder type, detail and material
- Insert details and material
- Insulator type, detail and material
- Clip type, detail and material
- Concrete mixture specification and properties
- Concrete curing specification.

The supplier will also be required to provide documentation of testing outcomes showing all components are equivalent to existing designs that have been proven in track under conditions of service similar to those detailed in this performance specification and referenced documents. This should include corrugation, rail flow, head check, wheel burn and weld dip rail head conditions. Reference site details and contact persons able to objectively discuss bearer system performance shall be provided.