



TS 03612:1.0

Standard

Sleepers and Track Support

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1.0	26/08/2025	This standard is a first issue as TS 03612 and supersedes ESC 230 <i>Sleepers and Track Support</i> , version 4.8 and UGL Regional Linx standard TS 01048:1.0 (CRN CS 230) <i>Sleepers and Track Support</i>

Preface

This standard is a first issue as TS 03612 and supersedes ESC 230 *Sleepers and Track Support*, version 4.8 and TS 01048:1.0 (CRN CS230) *Sleepers and Track Support*.

This standard specifies the design and performance criteria, allowable configurations and acceptance standards for sleepers, bearers and fastening systems.

The changes from the previous version include:

- harmonisation of TS 03612 and TS 01048
- amendments to transition requirements
- amendment to jointed concrete bearers
- amendment to alternative materials for sleepers and bearers
- amendment to hollow steel bearers and sleepers.

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1 Scope

This standard specifies functional and design requirements, approved configurations, acceptance and repair standards for sleepers, turnout bearers and fastenings. It also includes fastening requirements for transoms and guard rails.

2 Application

This standard is intended for use by TAOs and is applicable to all of the MRA and CRN. This standard applies to the design of new track work, track renewal work and maintenance of existing track.

If, when using the standard, it is considered that the intent of stated requirements is not clear, a clarification should be sought from the AMB.

3 Referenced documents

The following documents are cited in the text. For dated references, only the cited edition applies. For undated references, the latest edition of the referenced document applies.

International standards

EN 16431 *Railway applications – Track – Hollow sleepers and bearers*

ISO 12856 (all parts) *Railway applications – Polymeric composite sleepers, bearers and transoms*

Australian standards

AS 1085.3 *Railway track material – Part 3: Sleeper plates*

AS 1085.8 *Railway track material – Part 8: Dogspikes*

AS 1085.13 *Railway track material – Part 13: Spring fastening spikes for sleeper plates*

AS 1085.18 *Railway track material – Part 18: Screw spikes and threaded inserts*

AS/RISSB 1085.17 *Railway track material: Part 17: Steel sleepers*

AS /RISSB 1085.19 *Railway track material – Part 19: Resilient fastening assemblies*

Transport for NSW standards

TS 00003.1 *Concessions to Transport Standards – Part 1 Concession Process*

TS 00021 *Track Type Approved Product Register*

TS 00172 *Glossary of Track Terms*

TS 02402 (T HR CI 12072 ST) *Track Slabs*

TS 03510 *Track System*

TS 03611 *Rail and Rail Joints*

TS 03616 *Timber Sleepers and Bearers*

TS 03617 *Concrete Sleepers*

TS 03618 *Concrete Turnout Bearers*

TS 03619 *Resilient Fastenings*

TS 03620 *Resilient Baseplates*

UGL Regional Linx standards

CRN CM 203 *Track Inspection*

CRN CM 211 *Track Geometry & Stability*

CRN CM 221 *Rail Installation and Repair*

CRN CM 223 *Rail Adjustment*

CRN CM 231 *Sleepers and Fastenings*

TS 01045 (CRN CS 210) *Track Geometry and Stability*

TS 01047 (CRN CS 220) *Rail and Rail Joints*

TS 01049 (CRN CS 240) *Ballast*

TS 01050:1.0 (CRN CS 250) *Turnouts and Special Trackwork*

TS 01099 (CRN CP 233) *Engineering Specification Steel Sleepers*

TS 01101 (CRN CP 235) *Engineering Specification Steel Turnout Bearers*

Other referenced documents

Sydney Trains, MN T 20203 *Track Inspection* (This document is not publicly available. To obtain access email standards@transport.nsw.gov.au)

Sydney Trains, MN T 20211 *Track Geometry and Stability* (This document is not publicly available. To obtain access email standards@transport.nsw.gov.au)

Sydney Trains, MN T 20223 *Rail Adjustment* (This document is not publicly available. To obtain access email standards@transport.nsw.gov.au)

4 Terms, definitions and abbreviations

The following terms, definitions and abbreviations apply in this document in addition to the terms in TS 00172.

AMB Asset Management Branch

BOEF beam on elastic foundation

CRN Country Regional Network

CWR continuous welded rail

DF10 sleeper plate dogspike BHP 2705 127dstb-df10 as listed in TS 00021

DF30 sleeper plate dogspike BHP 2706 146dstb-df30 as listed in TS 00021

DF62 sleeper plate e-clip BHP 146CFTB – DF62 legacy product

group 1 timber species that are expected to achieve an average life of 25 years

group 2 timber species that are expected to achieve an average life of 20 years

group 3 timber species that are expected to achieve an average life of 15 years

LWR long welded rail

MGT million gross tonnes

MRA metropolitan rail area

OC operating class; track operating classes are specified in TS 03510

PRS partial resleepering

RIM rail infrastructure manager; in relation to rail infrastructure of a railway, means the person who has effective control and management of the rail infrastructure, whether or not the person –

(a) owns the rail infrastructure; or

(b) has a statutory or contractual right to use the rail infrastructure or to control, or provide, access to it.

SC siding class; track siding classes are specified in TS 03510

TAO Technically Assured Organisation

TfNSW Transport for NSW

timber inspector a person who holds at least a Certificate III in Sawmilling and Processing which includes the competency FPICOT3240B – Grade heavy structural/engineered products unless otherwise approved by the RIM

ZLR zero load restraint

5 Design and performance criteria

5.1 Track configuration

The configuration of track elements, including sleepers, turnout bearers and sleeper fastenings is specified in TS 03510.

5.2 Sleepers and bearers

The design of sleepers and bearers shall take into account the following:

- loading:
 - service loads (and dynamic response) including effects of track alignment, maintenance standards and traffic task
 - resistance to impact loading (for example, wheel flats)
 - rail seat loads, sleeper bending moments, rail to sleeper pressure and sleeper to ballast pressure
- materials:
 - sleeper material, type and spacing
 - sleeper acceptance, inspection and testing requirements, and assessment of effectiveness prior to insertion in track
 - sleeper life and treatment (for example, timber preservatives)
 - deterioration of the sleeper material (for example, rust, concrete reactivity, fungal rot, white ant attack)
- interfaces with other rail infrastructure:
 - signalling balise and track circuit requirements
 - support of point switching equipment where necessary
- support requirements:
 - track support conditions and deflection criteria
 - required track modulus
- performance requirements:
 - need to provide resistance to the lateral buckling of the track
 - need to provide effective support, positioning and restraint of the rail in conjunction with the rail fastening system)
 - geometric requirements including the length and orientation of bearers in points and crossings structures.

5.3 Fastening assembly design

The fastening assembly design shall take into account the following factors:

- loading:
 - service loads (and dynamic response) including effects of track alignment, maintenance standards and traffic task
 - attenuation of vertical impact loads and vibration
 - pressure transmitted to the sleeper rail seat, for example the need for sleeper plates on timber sleepers
 - the need to control damage to sleepers by rail seat abrasion
- interfaces with other rail infrastructure:
 - the need to provide electrical insulation where required to enable track circuits to work or to avoid current leakage
- support requirements
 - required track modulus
- performance requirements:
 - the need to provide effective support, positioning and restraint of the rail (in conjunction with the sleepers and bearers)
 - the need to hold rails to gauge and at the correct inclination when subjected to lateral forces caused by vehicle curving, track alignment irregularities and wheelset steering and hunting
 - the need to provide lateral and torsional restraint (in the horizontal track plane) to the rail against buckling in hot weather
 - the need to provide rail longitudinal creep resistance when the rail is subjected to thermal loads and vehicle braking and traction forces.

6 Allowable configurations sleepers and bearers

6.1 Selection sleepers type

Sleeper type shall be selected in accordance with the track configuration requirements specified in TS 03510.

Selection of a different sleeper type may impose requirements for fastening type, rail welding or ballast depth. Fastening type, rail welding and ballast depth relevant to the specific type of sleeper shall be in accordance with TS 03510.

6.2 Timber sleepers

6.2.1 Selection

For all applications in ballasted plain track detailed in TS 03510, sleeper size shall be in accordance with Section 6.2.2 and the standard spacing shall be in accordance with Section 6.2.4.

For the design of new lines, the BOEF analysis may be used to determine sleeper size and spacing.

All timber sleepers shall be inspected for compliance and passed by a timber inspector prior to use on the TfNSW rail network in accordance with specification TS 03616.

6.2.2 Size

6.2.2.1 Standard sleeper size

Dimensions and acceptance tolerances for timber sleepers shall be in accordance with Table 1.

Table 1 – Timber sleeper dimensions

Parameter	Dimension (mm)	Acceptance tolerance (mm)
Length	2440	+ 50 – 0
Width	230	+ 10 – 0
Depth	130	+ 10 – 0
Squareness	90°	± 2°

6.2.2.2 Half sleeper size

Dimensions and acceptance tolerances for half sleepers for use in the City Circle and Eastern Suburbs line tunnels shall be in accordance with Table 2

Table 2 – Timber half sleepers dimensions

Parameter	Dimension (mm)	Acceptance tolerance (mm)
Length	800	+ 50 – 0
Width	230	+ 10 – 0
Depth	130	+ 10 – 0
Distance from the centre line of the rail to the end of the timber in either direction	Minimum 345	N/A
Distance from the end of the sleeper plate to the end of the sleeper	Minimum 90	N/A

6.2.3 Usage

6.2.3.1 New timber sleepers

New timber sleepers shall be cut from the approved timber species as shown in Table 3. Use of timbers from group 3 shall be approved by the AMB. Treated sleepers shall not be used.

Table 3 – Approved timber species for sleepers

Group	Common name	Botanical name
Group 1	Ironbark Grey	<i>Eucalyptus siderophloia</i>
Group 1	Ironbark Grey	<i>Eucalyptus paniculata</i>
Group 1	Ironbark Grey	<i>Eucalyptus drepanophylla</i>
Group 1	Ironbark Red (Broad Leaved)	<i>Eucalyptus fibrosa</i>
Group 1	Ironbark Red (Narrow Leaved)	<i>Eucalyptus crebra</i>
Group 1	Ironbark Red	<i>Eucalyptus sideroxylon</i>
Group 1	Gum Slaty or Box Slaty	<i>Eucalyptus dawsonii</i>
Group 1	Box White	<i>Eucalyptus albens</i>
Group 2	Box Grey	<i>Eucalyptus microcarpa</i>
Group 2	Box Grey	<i>Eucalyptus moluccana</i>
Group 2	Tallow Wood	<i>Eucalyptus microcorys</i>
Group 2	Gum Grey	<i>Eucalyptus punctata</i>
Group 2	Gum Grey	<i>Eucalyptus propinqua</i>
Group 2	Gum Forest Red	<i>Eucalyptus tereticornis</i>
Group 2	Mahogany White	<i>Eucalyptus acmeniodies</i>
Group 3	Gum River Red	<i>Eucalyptus camaldulensis</i>
Group 3	Blackbutt	<i>Eucalyptus pilularis</i>

6.2.3.2 Recycled timber sleepers

Recycled timber sleepers (that is, sleepers that have previously been used in track) may only be used on main lines if they meet all of the following criteria: exception:

- sleepers are fitted with resilient plates
- sleepers have been assessed by the RIM as having a minimum remaining life of 5 years at the new location
- the connection between the plates and the sleeper is sound with no evidence of plate movement.

Recycled sleepers may be used in crossing loops and in sidings.

6.2.4 Spacing

6.2.4.1 Spacing in open track

Timber sleeper spacing shall be in accordance with Table 4 for all new track construction.

Table 4 – Timber sleeper spacing

Operating class	Sleeper spacing (mm)	Acceptance tolerance (spacing or skew) (mm) ^(1, 2)	Tolerance limit per metre
OC-1 to OC-6	600 ⁽³⁾	± 20 ⁽⁴⁾	25/15 (± 50 mm)
OC-7	623 ⁽³⁾	± 20 ⁽⁴⁾	24/15 (± 50 mm)
OC-8	610 ⁽³⁾	± 20	25/15 (± 50 mm)
SC-1 to SC-6	600 ⁽³⁾	± 20 ⁽⁴⁾	25/15 (± 50 mm)
SC-7	623 ⁽³⁾	± 20 ⁽⁴⁾	24/15 (± 50 mm)
SC-8	610 ⁽³⁾	± 20	25/15 (± 50 mm)

Notes:

1. Installation tolerance for new or face resleepering of track sections.
2. Skew is the variation from square from one side of the sleeper to the other.
3. Except at rail joints (see Section 6.2.4.2).
4. Up to 50 mm for spacing to allow for missing an aluminothermic weld (only over two sleepers).

6.2.4.2 Spacing at rail joints

Spacing of sleepers at rail joints in plain ballasted track shall be adjusted in accordance with Table 5.

Table 5 – Sleeper spacing at joints

Rail (kg/m)	Design spacing (mm)	Acceptance tolerance (mm)
60 insulated	430	± 20
53 insulated	430	± 20
53 mechanical	510	± 20
glued insulated joints (any rail size)	600	± 20
All others	510	± 20

On certain lighter sections of track where angle fishplates are used it may be necessary to adjust the sleeper spacing at joints to ensure dogspikes can be correctly located at the fishplate.

All sleepers shall be flat adzed when used with sleeper plates.

6.2.4.3 Spacing at bridge ends

Spacing of rail support (sleepers, abutment and transoms) at transom topped bridge ends shall be adjusted in accordance with Table 6.

Table 6 – Sleeper spacing at bridge ends

Operating class	Design spacing (mm)	Acceptance tolerance (mm)
All classes – new bridge structures	600	± 20
All classes – existing bridge structures	600 preferred up to 900 subject to AMB approval	± 20

6.2.5 Boring requirements in timber sleepers, transoms and bearers

Sleepers, transoms and bearers shall be bored to match the track plates used in the approved configuration. The boring patterns for DF30 sleeper plates using dogspikes, lockspikes, dogscrews and lockscrews shall be as in Appendix A.

Hole sizes shall be as in Table 7. Holes shall be bored completely through the timber.

Table 7 – Fastening hole diameters

Fastening type	Hole diameter (mm)
Dogspikes	21 ± 0.5
Lockspikes	16 ± 0.5
Dogscrews	17 ± 0.5
Lockscrews	14 ± 0.5
Screwspikes 27 mm dia	25 ± 0.5
Screwspikes 24 mm dia	18 ± 0.5
Screwspikes 22 mm dia	18 ± 0.5

6.2.6 Proximity of plates to sleeper and bearer ends in turnouts

The outer end of sleeper plates shall be located no closer than 200 mm to the end of timber sleepers or bearers. The RIMS may approve a reduction to no less than 50 mm in constrained situations at turnouts and special trackwork.

6.3 Steel sleepers

Steel sleepers are approved for installation in all classes of track in the CRN. Steel sleepers shall be designed and manufactured in accordance with AS/RISSB 1085.17. Steel sleepers are not approved for use in curves ≤ 200 m radius.

Where steel sleepers have been selected for track maintenance or renewal, the following requirements in Sections 6.3.1 to 6.3.6 shall apply.

6.3.1 Selection

The sleeper type chosen for installation will depend on the operational requirement as detailed in TS 03510 and the current and future requirements for track circuiting.

There are four types of steel sleeper, types 1, 1C, 2 and 2C. Sleeper type shall be selected in accordance with Table 8.

Table 8 – Selection of steel sleeper type

Sleeper type	Application	Insulation	Minimum approved configuration
1	OC-5 tracks with ≥ 10 MGT per year of 25 t axle load traffic where no track circuits are or may be provided	No	M8.5 as specified in AS/RISB 1085.17
1C	OC-5 tracks with ≥ 10 MGT per year of 25 t axle load traffic where track circuits are or may be provided	Yes	M10
2	All lines where type 1 sleepers are not required and where no track circuits are or may be provided	No	M7.5
2C	All lines where type 1 sleepers are not required and where track circuits are or may be provided	Yes	M8.5

Only approved products included in TS 00021 shall be used as sleepers, fastenings and insulators. Alternatively, the steel sleeper system, including fastenings, may be approved by the RIM if it complies with the requirements of TS 01099.

6.3.2 Size

Steel sleepers shall be designed to conform to the dimensions in Table 9.

Table 9 – Steel sleeper dimensions

Parameter	Dimensions
Length	2500 mm
Width (at base)	250 mm – 260 mm
Width (at seat)	150 mm – 160 mm
Depth	95 mm – 100 mm

6.3.3 Use

Steel sleepers may be installed in either:

- in a face in long sections or in a full curve
- interspersed with timber sleepers as PRS
- as replacements for isolated timber sleepers.

Steel sleepers are different to timber and concrete sleepers. They rely on the ballast in the sleeper 'pod' to add to their effective mass. Because of this the amount of, and degree of, compaction of the ballast in the pod is critical to the sleeper's in-service performance.

Steel sleepers shall be insulated where track circuits are present for example, at approaches to level crossings with active protection.

Where one or more rails are to carry signalling current both rails shall be insulated. Insulated sleepers shall comply with the insulation requirements in TS 01099.

Even with insulators fitted, contamination by conducting material around the fastenings or under the rail can cause signalling problems. This includes:

- locations where contaminants regularly invade the track area (coal, minerals, mud, clay, dirt and so on)
- locations where the track is continually wet.

Steel sleepers shall not be used in the locations in the preceding bullet list.

Steel sleepers should not be used in locations where corrosion or chemical damage is likely to be a problem. Such locations may include:

- slag ballast
- areas of frequent sanding (for example, steep grades)
- areas of high salinity
- continually wet or moist areas such as some tunnels or some types of level crossings
- areas where corrosive materials invade the track area (coal, minerals, mud, clay dirt and so on.)

Steel sleepers should not be used in the following situations because the stable bond between the sleeper and the ballast cannot be maintained:

- where the ballast formation is poor and where deflection under load is high
- at locations where track dynamic forces are high, such as at joints or where the inherent rail surface condition is poor.

Steel sleepers shall not be used as transoms.

Steel sleepers shall not be used shall not be used on either side of permanent mechanical rail joints.

Steel sleepers that have been welded, cut or otherwise altered from an approved design shall not be used.

Steel sleepers that have been bent or otherwise damaged by derailment or extraction process may be reused on sidings and lines carrying < 3 MGT (on curves > 1000 m radius and tangent rack) subject to the following requirements:

- engineering inspection and assessment of damaged sleepers shall be in accordance with CRN CM 231.
- damaged sleepers shall not be installed at intervals closer than 1 in 2.

Where steel sleepers are to be reused the extent to which their fatigue life has been used up shall be considered. Guidelines for the assessment of fatigue life are contained in CRN CM 231.

Gauge widening is not required for steel sleepers used in low radius curves.

The full extent of any curves shall be resleepered in all cases (for example, all timber, all steel, all concrete, all interspersed timber and steel and so on.)

Steel sleepers shall not be interspersed with concrete sleepers unless approved as part of a strategy to upgrade the track to be 100% concrete sleepered.

Steel sleepers may only be interspersed with timber sleepers in LWR track where they are in accordance with a specific strategy developed in accordance with Section 9 and approved by the RIM.

Where steel sleepers are being installed leading into fixed structures (such as transom top bridges, fixed level crossings and track slabs), the leading track area shall comply to transition the track stiffness in accordance with Section 6.12.

6.3.4 Compatibility with rail type

Steel sleepers shall only be used with rail sizes up to and including the size for which they have been designed and tested in accordance with TS 01099. Spacers may be used to provide adjustment so that more than one rail size can be accommodated.

Current approved steel sleeper types are able to accommodate variations in rail size as detailed in Table 10 and Table 11.

Table 10 – Hole punching and spacer selection in plain track

Parameter	Sleeper – M10 ⁽¹⁾ Sleeper configuration – M10 NI 60, M10 I 53	Sleeper – M8.5 ⁽¹⁾ Sleeper configuration – M8.5 NI 53, M8.5 I 53	Sleeper – M7.5 ⁽¹⁾ Sleeper configuration – M7.5 NI 53	Sleeper – M7.5 ⁽¹⁾ Sleeper configuration – M7.5 NI 47
Punched for foot size	146 mm	146 mm	146 mm	127 mm
Used without spacers for	60 kg ⁽²⁾ 53 kg (+ equivalents ⁽³⁾)	60 kg ⁽²⁾ 53 kg (+ equivalents ⁽³⁾)	60 kg ⁽²⁾ 53 kg (+ equivalents ⁽³⁾)	50 kg 47 kg (+ equivalents ⁽³⁾)
Used with spacers for		47 kg (+ equivalents ⁽³⁾)	50 kg 47 kg (+ equivalents ⁽³⁾) 41 kg (+ equivalents ⁽³⁾) 31 kg (+ equivalents ⁽³⁾)	

Notes:

1. Sleeper type as specified in AS/RISSB 1085.17.
2. 60 kg rail shall not be installed on steel sleepers.
3. Relates to equivalent rail foot sizes in TS 01047.

NI = non insulated

I = insulated

Table 11 – Hole punching and spacer selection at bonded insulated joints

Parameter	Sleeper – M10 ⁽¹⁾ Sleeper configuration M10 I 53	Sleeper type – M8.5 ⁽¹⁾ Sleeper configuration – M8.5 I 53
Used without spacers for	60 kg ⁽²⁾ 53 kg (+ equivalents ⁽³⁾)	60 kg ⁽²⁾ 53 kg (+ equivalents ⁽³⁾) (NOT 100AS (1928))
Used with spacers for		100AS (1928) 47 kg (+ equivalents ⁽³⁾) 41 kg (+ equivalents ⁽³⁾)

Notes:

1. Sleeper type as specified in AS/RISSB 1085.17.
2. 60 kg rail shall not be installed on steel sleepers.
3. Relates to equivalent rail foot sizes in TS 01047.

The selection of lock-in shoulder, insulator (where required) and spacers (where required) is largely dependent on rail head dimensions. Selection of combinations of sleeper, lock-in shoulder, insulator and spacers for individual rail sizes shall be in accordance with CRN CM 231.

Where sleepers are to be used for rail sizes less than 47 kg/m the sleeper systems to be used shall be adjustable to accommodate future rail upgrading to 53 kg/m (or larger size) unless otherwise approved by the RIM.

6.3.5 Spacing

Steel sleepers shall be spaced in open track in accordance with Table 12 and spacing at rail joints in accordance with Section 6.2.4.2

Table 12 – Steel sleepers spacing – all tracks and sidings

Track class	Sleeper spacing (mm)	Acceptance tolerance (spacing or skew) (mm) ⁽¹⁾ ⁽²⁾	Tolerance limit Number of sleepers/rail length (m)
OC-5	600 ⁽³⁾	± 20 ⁽⁴⁾	25/15 (±50 mm)
OC-6	600 ⁽³⁾	± 20 ⁽⁴⁾	25/15 (±50 mm)
OC-7	623 ⁽³⁾	± 20 ⁽⁴⁾	24/15 (±50 mm)
OC-8	610 ⁽³⁾	± 20	25/15 (±50 mm)

Notes:

1. Installation tolerance for new track or face resleepering only.
2. Skew is the variation from square from one side of the sleeper to the other.
3. Except at rail joints (see Section 6.2.4.2).
4. Up to 50 mm for spacing to allow for missing a thermit weld (only over two sleepers).

6.3.6 Anchors

Steel sleepers are attached to the rail with resilient fasteners that provide resistance to rail creep. Steel sleeper resilient fasteners typically provide at least equivalent creep resistance to fair type anchors. Fair type anchors shall be replaced against timber sleepers after PRS to restore the preexisting anchor pattern or, a minimum of one in three sleepers anchored (including both fair type anchors or resilient fasteners) whichever is greater.

6.4 Concrete sleepers

6.4.1 Selection

For all ballasted track configuration concrete sleepers shall be selected in accordance with TS 03510.

There are two types of concrete sleepers as follows:

- heavy duty which are suitable for heavy freight tonnages and axle loads ≤ 30 T or for providing greater lateral stability
- medium duty which are suitable for general use with axle loads ≤ 25 T.

Only approved products included in TS 00021 shall be used.

All new concrete sleepers shall meet the requirements of TS 03617.

6.4.2 Size

Concrete sleepers shall be designed to conform to the dimensions in Table 13.

Table 13 – Concrete sleeper dimensions

Parameter	Heavy duty	Medium duty
Length	2390 mm – 2500 mm	2390 mm – 2500 mm
Width (at base)	220 mm – 255 mm	220 mm – 255 mm
depth (centre of rail seat)	230 mm maximum	180 mm maximum
Rail seat area (flat surface)	28,800 mm ²	25,620 mm ²

6.4.3 Use

On sharp curves < 400 m radius where Pandrol e2003 clips are installed, heavy duty insulators shall be used for new installations and for replacement of insulators. Heavy duty insulators are not required with Pandrol Fastclip installations.

Where new concrete sleepers are used as replacement sleepers within existing sections of concrete sleepers, they shall reasonably match adjacent sleepers in dimensions and capacity.

Transitional requirements for concrete sleepers adjacent to fixed structures and turnouts with timber bearers shall be in accordance with Section 7.12.

Concrete sleepers may only be interspersed with timber sleepers where they are in accordance with a specific strategy approved by the AMB. Concrete sleepers are interspersed with timber sleepers shall be in accordance with Section 9.

6.4.4 Spacing

6.4.4.1 Spacing in open track

Concrete sleepers shall be spaced in accordance with Table 14 and Table 15.

Table 14 – Concrete sleeper spacing

Operating class	Sleeper spacing (mm)	Tolerance (spacing or skew) (mm) ⁽¹⁾	Tolerance limit / m
All classes of track and all classes of sidings	600	± 20 ⁽²⁾	25/15 (± 50 mm)

Notes:

1. Installation tolerance for new or face resleepering of track sections.
2. Up to 50 mm for spacing to allow for missing a thermit weld (only over two sleepers).

Table 15 – Concrete sleeper spacing – maximum spacing for existing sidings only

Operating axle load	Sleeper spacing (mm)	Tolerance (spacing or skew) (mm)	Tolerance limit number of sleepers/rail length (m)
≤ 25 T axle load	720	± 20	21/15 (± 60 mm)
> 25 T axle load	600	± 20	21/15 (± 60 mm)

6.4.4.2 Spacing at bonded insulated joints in open track

Spacing of concrete sleepers at glued insulated joints shall be 600 mm (± 20 mm).

6.5 Direct fixation

Sleeper spacing > 600 mm may be designed for direct fixation track structures to a maximum of 700 mm where axle loads are ≤ 25 t as shown in Table 16.

Table 16 – Sleeper design spacing for direct fixation track

Operating class	Sleeper spacing (mm)	Tolerance (spacing or skew) (mm)	Tolerance limit/m
All track (mainline and sidings)	700	± 10	10/7 (± 30 mm)

6.6 Polymer concrete sleepers

6.6.1 Selection

Polymer concrete half sleepers are approved for use in areas where half-timber sleepers have previously been installed. Current installations include City Circle tunnels, Church Street,

Parramatta underbridge , Artarmon pedestrian subway, Circular Quay viaduct and Eastern Suburbs line. Further installations shall be designed and approved on a case by case basis.

Only approved arrangements in TS 00021 shall be used.

6.7 Concrete guard rail sleepers

6.7.1 Selection

Concrete guard rail sleepers are concrete sleepers that have been designed to allow attachment of guard rails inside the running rails in accordance with site specific designs.

Only approved arrangements in TS 00021 shall be used.

Selection, use and spacing shall be in accordance with Section 6.4.

6.8 Timber turnout bearers

6.8.1 Selection

Timber bearers for points and crossing structures may be designed using the BOEF similar to that used for sleepers, however some additional considerations may be necessary as follows:

- allowance for additional length of timber bearers over standard sleepers
- allowance for centrifugal forces through curved pairs of rail
- allowance for forces and moment induced from points motors and other such equipment.

All new timber turnout bearers shall be in accordance with TS 03616.

6.8.2 Timber bearer size

Dimensions of timber turnout bearers shall be as follows:

- Width – 250 mm.
- Depth –
 - 180 mm for general application.
 - 200 mm for bearers on which points motors will be attached.
 - 150 mm bearers are allowed to use in special circumstances such as replacement for existing 150 mm bearer.
- Length – the minimum length of timber bearers shall be calculated as the measurement from the 'outside' gauge face to 'outside' gauge face at the point at which the bearer is to be installed + 1.0 m. The length shall be rounded up to match the next available size for the selected bearer depth in Table 17.

Minimum dimensions for turnout switch and crossing timbers shall be as specified in in accordance with the requirements specified in Table 17.

Table 17 – Timber turnout bearer dimensions

Width (mm)	Depth (mm)	Standard timber lengths turnouts and crossovers (m)
250	150	2.8, 3.0, 3.2, 3.4, 3.6, 3.8
250	180	2.8, 3.0, 3.2, 3.4, 3.6, 3.8, 4.0, 4.2, 4.4, 4.6, 4.8, 5.0, 5.2, 5.4, 5.8, 6.0, 6.2, 6.4
250	200	2.8, 3.0, 3.2, 3.4, 3.6, 3.8, 4.0, 4.2, 4.8, 5.0, 5.2

The dimensional tolerances shall be as specified in Table 18.

Table 18 – Timber turnout bearer dimensions

Parameter	Tolerance
Length	+ 50 mm / – 0 mm
Width	+ 15 mm – 0 mm
Depth	+ 10 mm / – 0 mm
Squareness	± 2°

6.8.3 Usage

6.8.3.1 New timber bearers

Bearers shall be cut from timber species in Table 19. Treated timber is not approved for use.

Table 19 – Approved timber species for bearers

Group	Common name	Botanical name
Group 1	Ironbark grey	Eucalyptus siderophloia
Group 1	Ironbark grey	Eucalyptus paniculata
Group 1	Ironbark grey	Eucalyptus drepanophylla
Group 1	Ironbark red (broad leaved)	Eucalyptus fibrosa
Group 1	Ironbark red (narrow leaved)	Eucalyptus crebra
Group 1	Ironbark red	Eucalyptus sideroxylon
Group 2	Box grey	Eucalyptus microcarpa
Group 2	Box grey	Eucalyptus moluccana
Group 2	Tallow wood	Eucalyptus microcorys
Group 2	Gum grey	Eucalyptus punctata
Group 2	Gum grey	Eucalyptus propinqua
Group 2	Mahogany white	Eucalyptus acmenoides

6.8.3.2 Recycled timber bearers

Recycled timber bearers (that is, bearers that have previously been used in track) shall not be used on main lines.

Recycled bearers may be used in OC-8 track and in crossing loops and in sidings in all classes of track where timbers have been assessed as having a minimum remaining life of 5 years at the new location.

6.8.4 Spacing

Nominal design spacing of timber turnout bearers shall be 600 mm. The design may be varied up to a maximum spacing of 700 mm to suit turnout requirements except at mechanical joints or mechanical insulated joints where the maximum is 600 mm. Spacing shall not be less than 500 mm.

6.9 Concrete turnout bearers

6.9.1 Selection

Only approved products in TS 00021 shall be used.

All new concrete turnout bearers shall be designed and manufactured in accordance with TS 03618.

6.9.2 Concrete bearer size

Limiting dimensions of concrete turnout bearers shall be selected as follows:

- width – 240 mm – 300 mm
- depth – 220 mm – 300 mm
- length – varies 2.5 m to 7.5 m.

The dimensional tolerances for approved designs shall be in accordance with Table 20.

Table 20 – Tolerances on concrete bearer dimensions

Dimension	Tolerance
Length	+ 10 mm / – 5 mm
Width	± 3 mm
Depth	± 3 mm

6.9.3 Spacing

Nominal design spacing of concrete turnout bearers shall be 600 mm. The design may be varied up to a maximum spacing of 700 mm to suit turnout requirements except at mechanical

joints or mechanical insulated joints where the maximum is 600 mm. Spacing shall not be less than 500 mm.

6.9.4 Jointed concrete bearers

Jointed bearers at critical locations such as turnouts and crossings may be used with appropriate risk assessment. The jointed bearers shall be coupled with approved coupling arrangements in accordance with TS 00021.

6.10 Steel turnout bearers

6.10.1 Selection

Only approved designs in accordance with TS 01050 shall be used. For existing applications, detailed in TS 03510, all new steel turnout bearers shall be designed and manufactured in accordance with TS 01101.

Steel turnout bearers shall not be used in electrified network.

6.10.2 Steel bearer size

Limiting dimensions of steel turnout bearers shall be selected as follows:

- width – 250 mm – 300 mm
- depth – 95 mm – 200 mm
- length – 2.5 m to 7.5 m.

The dimensional tolerances for approved designs shall be in accordance with Table 21.

Table 21 – Tolerances on steel bearer dimensions

Dimension	Tolerance
Length	+ 10 mm / – 5 mm
Width	± 3 mm
Depth	± 3 mm

6.10.3 Spacing

Nominal spacing of steel turnout bearers shall be 600 mm. The design may be varied up to maximum spacing of 700 mm to suit turnout requirements . Spacing shall not be less than 500 mm.

6.11 Composite material sleepers and bearers

A composite material consists of polymer matrix typically recycled materials as a primary component, with reinforcing components or fillers for strengthening. Recycled plastics, fiberglass, rubber or other composites that offer the necessary properties, including strength, durability, resistance to environmental factors and thermal stability shall be considered.

Composite material sleepers and bearers may be used in MRA and CRN with an appropriate risk assessment. Only approved product listed in TS 00021 shall be used.

6.11.1 General requirements

All mandatory criteria and testings specified in ISO 12856 (all parts) shall be followed.

The dimension of sleepers and bearers shall be compatible to the dimensional requirements of approved sleepers and bearers. The sleepers and bearers shall maintain dimensional stability under varying temperature and moisture conditions to prevent warping, twisting or deformation that could affect track alignment and performance.

The sleepers and bearers shall allow for service load including effects of track alignment, environment and impact. The load-bearing capacity may be determined through testing or calculation, taking into account factors such as the sleeper's material properties, geometry and the loads it will be subjected to.

The design of sleepers and bearers shall ensure compatibility with existing approved rail fastening systems to facilitate installation and ensure proper track gauge and alignment. The design shall allow standard rail, sleepers plate and hold-down fasteners without any need for special parts.

Installation processes of sleepers and bearers shall be compatible to existing practice without requiring any special procedures for construction. The installation shall not adversely impact overall track structure maintenance regime.

The sleepers and bearers shall be designed to have a service life of at least 50 years and withstand the stresses and strains of railway operations during service life. The sleepers and bearers shall resist moisture, chemicals, UV radiation and other environmental factors to ensure sufficient load bearing capacity until the end of its service life.

The sleepers and bearers shall be designed to ensure the safety of railway operations, including the safety of passengers, workers and the environment. The sleepers and bearers shall be safe to handle with existing approved personal protective equipment and not requiring any special personal protective equipment.

Design of sleepers and bearers shall consider the electrical properties of the material to prevent interference with signalling and communication systems.

The sleepers and bearers shall be designed to have minimal environmental impact and shall not leach harmful substances into the environment during its lifecycle.

Design of sleepers and bearers shall consider the whole-of-life of the sleepers and bearers including factors such as material sourcing, manufacturing processes, energy consumption and end-of-life disposal and recycling options.

6.12 Hollow steel bearers and sleepers

Hollow steel bearers and sleepers shall be manufactured in accordance with EN 16431.

6.12.1 Hollow steel bearer (in bearer)

Hollow steel bearers are used to include the switch mechanism and rodding inside the bearer. Approved steel hollow bearers shall be used within switch panels in accordance with the site specific design to suit the operation of points machines. Only approved steel bearers in TS 00021 shall be used.

6.12.2 Hollow steel sleepers

Hollow steel sleepers are used for conveyance of electrical and signal cables for site specific requirements. Hollow steel sleepers shall only be installed in exceptional circumstances where a concession has been obtained in accordance with TS 00003.1. Only approved steel sleepers in TS 00021 shall be used.

6.13 Transitions

Where open track interacts with more rigid infrastructure (that is, track slabs, transom top bridges), the track stiffness at the approaches shall be reviewed to ensure that there is no significant deterioration of track geometry at the interface. To achieve this, the track stiffness shall be increased by a factor of 2 every 5 m to 10 m. Minimum approaches to transitioning track stiffness are in Table 22, further treatment may be required in the form of longer bearer lengths or softening of the fixed structure.

Table 22 – Standard transition details – main lines

Sleeper material	Timber turnout transition arrangement	Concrete turnout transition arrangement	Track slab or transom top bridge and so on transition arrangement
Timber	Nil	Minimum of 8 concrete sleepers in front of switch	<ul style="list-style-type: none"> • 16-20 heavy duty concrete sleepers for OC-1 to OC-5 track, Minimum 14 concrete sleepers for OC-6 to OC-8 track • Consideration of resilient fasteners on track slab and transom top bridge • Consideration of approach slab or special sleepers
Steel	Minimum of 8 timber sleepers in front of switch	Minimum of 8 concrete sleepers in front of switch	<ul style="list-style-type: none"> • Minimum of 14 concrete sleepers • Consideration of resilient fasteners on track slab/transom top bridge • Consideration of approach slab or special sleepers
Concrete	Minimum of 8 timber sleepers in front of switch and 10 mm elastomeric rail pads shall be installed on the 20 concrete sleepers to moderate the stiffness to an adjoining section of timber sleepers	Nil	<ul style="list-style-type: none"> • 16-20 heavy duty concrete sleepers for OC-1 to OC-5 track • Consideration of resilient fasteners on track slab/transom top bridge • Consideration of approach slab or special sleepers

Notes:

Sleeper transitions shall be avoided over a curve.

There are no transition requirements for sidings.

7 Allowable configuration fastening systems

Resilient or non-resilient fastening systems shall be selected in accordance with the existing or proposed track structure class in TS 03510.

7.1 Non resilient fastening assemblies

The non resilient fastening assembly generally consists of sleeper plates, dogspikes and spring fastening spikes which shall have following specifications:

- sleeper plates – double shouldered and provide a nominal rail cant of 1 in 20 towards the centre of the track (except in special circumstances such as turnouts)
- dogspikes – two 22 mm round shank dogspikes (or approved equivalent) per sleeper plate
- spring fastening spikes – two 16 mm lockspikes (or approved equivalent) per sleeper plate.

Double shouldered sleeper plates are not manufactured for 31 kg/m rail or 60 lb/yard rail. On OC-8 tracks where 31 kg/m rail or 60 lb/yard rail is installed, re-punched second-hand single shoulder plates shall be used if available. If not available, or where sleepers are placed at rail joints where angle fishplates are used, sleeper plates shall not be installed. In such cases where sleeper plates are not used, dogspikes are driven directly into the sleeper. Lockspikes shall not be used.

Non resilient fastening assembly components shall be designed and manufactured to conform to the appropriate Australian standard in Table 23.

Table 23 – Australian standards for non-resilient fastening assemblies

Component	Standard
Fastenings dogspikes (and equivalent fastenings)	AS 1085.8
Fastenings lockspikes (and equivalent fastenings)	AS 1085.13
Fastenings screw spikes	AS 1085.18
Sleeper plates	AS 1085.3

Only approved fastenings products in TS 00021 shall be used. Approved non-resilient configurations are detailed in Table 25 and Table 26..

7.2 Resilient fastening assemblies

The resilient fastening assembly for timber sleepers, transoms and turnout bearers generally consists of following:

- sleeper plates – double shouldered and provide a nominal rail cant of 1 in 20 towards the centre of the track (except in special circumstances such as turnouts)
- resilient rail clips – two fastening clips (Pandrol e-Clip or approved equivalent) per sleeper plate
- spring fastening spikes – four 16 mm lockspikes (or approved equivalent) per sleeper plate.

The resilient fastening assembly for steel sleepers generally consists of following:

- lock-in shoulders
- resilient rail clips – two fastening clips (Trak-Lok clips or approved equivalent) per rail seat
- spacers (where required)
- insulators (where required).

The resilient fastening assembly for concrete sleepers generally consists of following:

- cast in shoulders – these are integral to the design of the sleeper
- resilient rail clips – two fastening clips (Pandrol e-Clip or approved equivalent) per sleeper plate
- insulators
- rail seat pads

The resilient fastening assembly for concrete turnout bearers, generally consists of following:

- base plates
- screwspikes – four 24 mm screwspikes (or approved equivalent) per plate
- resilient rail clips – two fastening clips (Pandrol e-Clips or approved equivalent) per rail.

All new resilient fastenings shall be designed and manufactured in accordance with TS 03619.

Resilient fastening assembly components shall be designed and manufactured to conform to the appropriate Australian standard in Table 24.

Table 24 – Australian standards for resilient fastening assemblies

Component	Standard
Fastenings – clips	AS/RISSB 1085.19
Fastenings – lockspikes	AS 1085.13
Fastenings – screw spikes	AS 1085.18
Sleeper plates	AS 1085.3
Threaded inserts	AS 1085.18
Cast-in components	AS/RISSB 1085.19

Only approved fastenings and configurations in TS 00021 shall be used.

Approved fastening configurations for timber sleepers, transoms and turnout bearers are in Section 7.3.

Approved configurations for concrete sleepers are in Section 7.4.

Approved configurations for direct fixation are in Section 7.5.

Approved configurations for steel sleepers are in Section 7.6.

7.3 Fastenings for timber sleepers, transoms and bearers

Standard configurations of fastening assemblies for timber sleepers, bridge transoms and turnout bearers are in Table 25, Table 26, Table 27 and Table 28..

Note: Table 25 to Table 27 have common notes which appear after Table 28.

Table 25 – Timber sleeper fastening configuration – non-resilient main lines

Operating class	Fastening type number per plate or per rail	Sleeper plates identifier	Lockspikes ⁽¹⁾ number per plate
OC-1 – OC-5	2 dogspikes ⁽²⁾	DF30 or approved equivalent	2
OC-6 – OC-7	2 dogspikes ⁽²⁾	DF10 or approved equivalent	2
OC-7	Nil	DF30 or approved equivalent	2
OC-8 (rail size 53.47, 41 kg) ⁽³⁾	2 dogspikes ⁽²⁾	DF10 or approved equivalent (41 kg, 47 kg) DF30 or approved equivalent (53 kg)	2
OC-8 (rail size 31 kg) ⁽⁴⁾	4 dogspikes ⁽²⁾	Nil	Nil

Table 26 – Timber sleeper fastening configuration – non resilient – sidings

Operating class	Fastening type number per plate/ rail	Sleeper plates identifier	Lockspikes ⁽¹⁾ number per plate
SC-1 – SC-4	2 dogspikes ⁽²⁾	DF30 or approved equivalent	2
SC-5	2 dogspikes ⁽²⁾	Nil	Nil
SC-6	2 dogspikes ⁽²⁾	DF30 or approved equivalent	2
SC-7	2 dogspikes ⁽²⁾	DF10 or approved equivalent	2 (curves only)
SC-8	2 dogspikes ⁽²⁾	Nil	Nil

Table 27 – Timber sleeper fastening configuration – resilient – main lines

Operating class	Fastening type number per plate/ rail	Sleeper plates identifier	Lockspikes ⁽¹⁾ number per plate
OC-1 – OC-6	2 resilient fastening clips (Pandrol e2003 or approved equivalent)	DF62 or approved equivalent, cast plates	4
OC-7	2 resilient fastening clips (Pandrol e2003 or approved equivalent)	DF62 or approved equivalent	4
All classes – for existing installations only ⁽⁵⁾	2 resilient fastening clips (Pandrol e1853 or approved equivalent)	Reformed plates	2 lockspikes + 2 gauge lockspikes (or approved alternatives) ⁽⁶⁾
Turnouts in all classes	2 resilient fastening clips	Baseplates as per Turnout design	4
Transoms in all classes	2 resilient fastening clips (Pandrol e2003 or approved equivalent)	DF 62 or approved equivalent, cast plates	4 ⁽⁶⁾
Transoms in all classes	2 resilient fastening clips	Type Pandrol ISP96486 S plates or approved equivalent	4 x 24 mm screw spikes ⁽⁷⁾
Insulated joints in all classes	Low profile fastening clips (Pandrol e1627 or approved equivalent)	DF62 or approved equivalent	4

Table 28 – Timber sleeper fastening configuration – resilient – sidings

Operating class	Fastening type number per plate/ rail	Sleeper plates identifier	Lockspikes ⁽¹⁾ number per plate
All classes	2 resilient fastening clips (Pandrol e2003 or approved equivalent)	DF62 or approved equivalent	4
All classes – for existing installations ⁽⁷⁾	2 resilient fastening clips (Pandrol e1853 or approved equivalent)	Reformed plates	2 lockspikes + 2 gauge lockspikes (or approved alternatives) ⁽⁵⁾
Turnouts in ALL classes	2 resilient fastening clips	Baseplates as per turnout design	4

Notes:

1. Lockspikes (L6) or approved alternative fastenings may be used. Approved alternative configuration are in Section 7.8. Only approved products included in TS 00021 shall be used.

2. Round shank dogspikes or approved alternative fastenings may be used. Approved alternative configurations are in Section 7.8. Only approved products included in TS 00021 shall be used.

3. Double shoulder sleeper plates shall be installed where 53 kg/m, 47 kg/m or 41 kg/m rail has been installed on OC-8 tracks.

4. On OC-8 tracks (CRN Class 5 tracks) with 31 kg/m (60 lb/yard) rail, re-punched single shoulder sleeper plates shall be used if available. Otherwise sleeper plates shall not be installed. Four dog spikes per rail to be used for fastening and sleepers shall be cant adzed (1:20)

5. Configuration shall not be used for new installations.

6. Gauge lockspikes are approved for existing installations only and shall not be used in new installations. Gauge lockspikes shall not be re-installed when a sleeper is replaced.

7. In electrified or track circuited areas, where one of the spikes would cause shorting to the underframe of a steel underbridge, 3 spikes per plate may be used on curves ≥ 300 m radius, preferably with the two spikes on the gauge side of the rail.

Non resilient fastenings on transoms should be upgraded to resilient fastenings when transoms are renewed.

Special arrangements apply for the fastening of chairs to A and B timber bearers in turnouts as detailed in Table 29 and Table 30.

Table 29 – A and B timber bearer fastening configuration for new installations

Rail size	Fastening type
60 kg/m steelwork	Screwspikes
Other rail sizes	Screw spikes or holding down bolts or approved equivalent swage fastenings

Table 30 – A and B timber bearer fastening configuration for repair or replacement

Rail size	Fastening type
60 kg/m steelwork	Screw spikes. If the screw spikes are no longer able to provide adequate grip or if timber quality is suspect use holding down bolts or approved equivalent swage fastenings.
Other rail sizes	Screw spikes or holding down bolts or approved equivalent swage fastenings

For non-interlocked points screwspikes shall be used for fastening for all rail sizes in A and B timber bearers.

7.4 Fastenings for concrete sleepers and bearers

Resilient fastening systems shall be used with concrete sleepers and bearers.

Conforming fastening systems shall use resilient fastening clips such as Pandrol e2003 clips, Fastclip or other approved alternatives.

Rail pads of nominal 7.5 mm thickness for e-clip fastenings and 10 mm thickness for Fastclip fastenings shall be used.

Resilient fastenings are interchangeable for 53 kg and 60 kg rail sections.

Standard configurations of fastening assemblies for concrete sleepers and turnout bearers are in Table 31.

Table 31 – Concrete sleeper fastening configuration

Sleeper design	Fastening type No. per plate or per rail
Medium duty (low profile)	2 resilient fastening clips (Pandrol e2003 or 2 Pandrol FC1507 or approved equivalent)
Heavy duty	2 resilient fastening clips (Pandrol e2003 or 2 Pandrol FC1507 or approved equivalent)
Insulated joints on all concrete sleepers or bearers with cast in shoulders and insulating material	Low profile resilient fastening clips (Pandrol e1629 or Pandrol FC1507 or approved equivalent)
Insulated joints on all concrete bearers with baseplates	Low profile fastening clips (Pandrol e1627 or approved equivalent)

7.5 Fastenings for slab track

For direct fixation track systems (slab track) or wherever standard sleepers or bearers are not used, the following shall apply:

- Conforming fastening systems shall use resilient fastening clips such as Pandrol e2003 clips, Pandrol Fastclip or other approved alternatives.
- Resilience of the track system shall be considered. The default minimum resilient system shall be type 1 as specified in TS 03620 (for example, Delkor alternative 1 or equivalent).

Approved configurations of fastening assemblies for slab track are in Table 32.

Table 32 – Slab track fastening configuration

Slab design	Fastening type No. per plate/ rail	Base plate identifier	Comments
City Circle and Eastern Suburbs line underground	2 resilient fastening clips (Pandrol PR409 or approved equivalent)	DF62 or approved equivalent	2 screwspikes minimum in curves ≥ 300 m radius 4 screwspikes in curves < 300 m radius

Where baseplates are used the minimum requirement is:

- curves < 300 m radius –four screwspikes (two on each side)
- curves ≥ 300 m radius –two screwspikes (one on each side).

On slab track where screwspikes are used they shall be fitted with helical spring washers.

Where epoxy grout is used under resilient baseplates the minimum thickness of high-density polyethylene (HDPE) pads shall be at least 8 mm to reduce the potential for warping of the pads from thermal warping.

7.6 Fastenings for steel sleepers

Standard configurations of fastening assemblies for steel sleepers are in Table 33.

Table 33 – Steel sleeper fastening configuration

Sleeper design	Fastening type number per plate per rail	Connection
All designs	2 fastening clips such as Trak-Lok or approved equivalent	2 lock-in shoulders

7.7 Resilient fastenings on bridges

7.7.1 Transom top bridges

7.7.1.1 Transom top steel openings with spans < 18 m

On bridges where resilient fastenings are installed, normal resilient fastenings shall be installed on the entire length of each span.

7.7.1.2 Transom top steel openings with spans ≥ 18 m long and < 80 m

On bridges where resilient fastenings are installed, normal resilient fastenings shall be installed on one third of the span from the fixed end and ZLR fastenings installed on the remaining two thirds of the span. Where spans are located on curves < 400 m radius, advice on fastenings requirements shall be obtained from AMB.

Provision shall be made for play at the movable end of a bridge for the guard rail V to expand and contract (depending on length). This can be achieved when using medium duty fast clips

(MDFC) concrete termination sleepers by setting the lock-in shoulders 6 mm clear of the nose end rail. ZLR fastenings shall be used to secure the guardrail nose ends, allowing limited movement.

7.7.1.3 Transom top bridge spans > 80 m with expansion switches

On bridges where resilient fastenings are installed, normal resilient fastenings shall be installed on the entire length of each span.

7.7.2 Direct fixed bridges

For concrete and other track structures an assessment shall be made of the expansion requirements of the bridge structure as they affect rails.

7.7.2.1 Direct fixed structures with spans < 25 m

On structures where resilient fastenings are installed, normal resilient fastenings shall be installed on the entire length of each span.

7.7.2.2 Direct fixed structures with spans \geq 25 m

An assessment shall be made of the expansion needs and appropriate ZLR fastenings installed. Proposals shall be submitted to AMB for approval.

Note: Whilst the expansion of concrete is similar to that of steel there is a difference in the temperature variation expected in concrete.

7.7.3 Ballast top bridges

Requirements for expansion of the rails and the ballast shall be taken into account if the span is more than 40 m in length. If the span is less than 40 m in length standard fastening systems can be applied.

7.8 Alternative and special configurations

7.8.1 Pandrol clips at insulated joints

Special low profile rail fastening clips shall be used at insulated joints in 53 kg and 60 kg rails to eliminate contact between clips and fishbolts.

The clips are:

- For concrete sleepers and bearers low profile fastening clips such as Pandrol e1629 or Pandrol FC1507 or approved equivalent
- For timber sleepers and bearers low profile fastening clips such as Pandrol e1627 or approved equivalent

Clearances may be compromised with the low-profile clips in timber bearers while using with type certain types of baseplates such as Pandrol PZ 147 baseplates and type 1 baseplates. Any clips that can causes foul shall be removed as long as sufficient fastenings remain in place to retain gauge security.

7.8.2 Steel sleepers at insulated joints

Modified Trak-Lok JB296 clip with insulator such as pad 2218 shall be used for steel sleepers around insulation joints. The lock-in shoulder has various options depending on sleeper and rail size. Refer to sizing selection charts in CRN CM 231.

7.8.3 Approved alternatives to dogspikes and lockspikes

Dogscrews and lockscrews are approved alternatives to dogspikes and lockspikes respectively. They may be installed with the approval of the RIM.

The dogscrew consists of a 19 mm threaded shank with a 22 mm shoulder below the flange. On top of the flange is a 6-lob head designed to fit an E24 drive socket.

The lockscrew consists of a 16 mm threaded shank with a flange and 6 lob head, the same as the dogscrew. There are two types of lockscrew as follows:

- Small flange – for general use.
- Large flange – for use with the automatic magnet pickup machines used by production gangs. Large flange dogscrews shall not be used on rolled Pandrol plates because of the flange interferes with the rolled shoulder and does not sit flush on the plate.

7.8.4 Resilient baseplate assemblies

Resilient baseplate assemblies may be used as an alternative to standard base plates on timber sleepers, transoms and bearers, concrete sleepers and bearers and for direct fixation track applications in the following applications:

- bridges where noise and vibration, noise or vibration reduction is required
- ballasted track where noise and vibration, noise or vibration reduction is required
- direct fixation track where noise and vibration, noise or vibration reduction is required
- at interfaces between ballast and non-ballasted track where graded changes in track stiffness are required.

Only approved resilient baseplates in TS 00021 shall be used.

All new resilient baseplate assemblies shall be designed and manufactured in accordance with TS 03620.

7.8.5 Zero load restraint assemblies

ZLR assemblies allow longitudinal rail movement whilst retaining gauge and limiting upward movement of the rail. ZLR assemblies shall be used in accordance with Section 7.7.1. Only approved products included in TS 00021 shall be used.

When used in conjunction with resilient baseplate assemblies, special configurations shall be used to fit the dimensional restrictions of the baseplate.

Approved ZLR assemblies are listed in Table 34.

Table 34 – ZLR assemblies

Configuration type	Assembly	Components
Standard baseplates (with lockspikes or screwspikes)	Pandrol PMP 41027 for AS60kg rail as specified in TS 00021	ZLR cap 41027 clip e2079 as specified in TS 00021
Alternative 1 resilient baseplates	Pandrol 12730 for AS60kg rail as specified in TS 00021	ZLR cap 12731 Clip e2079 Insulator IN55088 5 mm rail pad RP-65026 as specified in TS 00021
Delkor egg resilient baseplates	Pandrol 12730 for AS60kg rail as specified in TS 00021	ZLR cap 12731 Clip e2079 Insulator IN55088 5 mm rail pad RP-65026 as specified in TS 00021

8 Prohibited configurations

The following configurations shall not be used for permanent works in the MRA and CRN:

- steel sleepers in electrified networks
- non-resilient fastening systems with 60 kg/m rail
- non-resilient fastening systems with concrete sleepers
- steel sleepers mixed with concrete sleepers
- resilient and non-resilient fastenings on the same sleeper
- resilient fastenings on more than 1 in 3 sleepers in LWR track
- concrete sleepers used for rail sizes other than 53 kg and 60 kg
- guard rail on resilient fastening.

9 Mixed configurations

There are some limitations and special requirements when configurations are mixed. Mixed configurations are applicable to existing track only.

9.1 Mixing concrete and timber sleepers

Concrete sleepers may be interspersed with timber sleepers in accordance with the following requirements:

- interspersing shall be part of a line strategy and not random
- interspersing shall be used with medium duty sleepers and on line sections where medium duty sleepers may be used
- interspersing shall lead eventually to 100% concrete
- interspersing shall achieve the minimum ballast cleanliness standard
- interspersing shall be installed to a standard pattern of 1 in 2, 1 in 3 or 1 in 4 but with variation of one sleeper position permitted to suit local conditions
- interspersing shall be resleepered whole curve and reasonable lengths of tangent track to a consistent pattern.

Mixing sleepers shall not be allowed for jointed track beyond the limits detailed in TS 03611 for standard welded track.

Mixing sleepers may be used in patterns of 1 in 3 and 1 in 4 in poor ballast conditions. A higher mixing ratio shall only be used in track where design concrete sleeper ballast depth is achieved and ballast is free draining.

When configuration changes are being undertaken by PRS methods PRS shall be followed through in successive cycles until the changeout is complete. Mixed configurations shall not be a final product.

9.2 Mixing steel and timber sleepers

Steel sleepers may be interspersed with timber sleepers in accordance with requirements in Section 9.2.

Minimum tie patterns detailed in Table 35 shall be used. Denser tie patterns may be used to address sleeper fatigue and fastening failure issues.

Table 35 – Minimum tie patterns for steel sleepers in timber sleepered track

Track class	Curvature – MGT/year	Curvature – < 400 m radius	Curvature – < 600 m radius	Curvature – > 600 m radius & tangent track
OC-5		1 in 4 ⁽¹⁾	1 in 4	1 in 4 ⁽²⁾
OC-6	≥ 2	1 in 4	1 in 4	1 in 4 ⁽²⁾
OC-6	< 2	1 in 4	1 in 6	1 in 6
OC-7		1 in 4	1 in 6	1 in 6

Notes:

1. Steel sleepers should not be used. Concrete sleepers should be used as they provide better lateral stability. If steel sleepers are installed, use a denser tie pattern.
2. May be extended to 1 in 6 if sleeper condition permits.

A variation in the tie pattern of one sleeper is still considered to be a tie pattern as long as the pattern is generally maintained (for example, 1 in 4 would allow odd sleepers to be the 3rd or 5th sleeper) excepting that clumping should be avoided.

When undertaking planned PRS sleeper replacement shall be planned to meet clumping requirements detailed in Table 36.

Table 36– Clumping of steel sleepers

Track class	General steel sleeper pattern	2 together	≥ 3 together
OC-5, OC-6	1 in 2	Permitted	Permitted
OC-5, OC-6	1 in ≥ 3	Not recommended	Prohibited
OC-7	1 in 2	Permitted	Permitted
OC-7	1 in ≥ 3	Permitted	Prohibited
OC-8	1 in ≥ 2	Permitted	Permitted
CRN sidings	1 in ≥ 2	Permitted	Permitted

Where face renewal is normal practice at special locations such as level crossings, this practice is exempt from clumping requirements.

Single sleepers may be installed as required.

A track length is considered face resleepered (not clumped) when the rail length with 100% steel sleepers reaches 110 m on straights or the full curve tangent point to tangent point in curved track.

Shorter lengths are also considered face resleepering when it applied on whole structures for example, ballast top bridges and level crossings.

9.3 Mixing resilient and non-resilient fastenings

9.3.1 In track with loose rail

There are no restrictions on the installation of resilient fastened timber or steel sleepers mixed with non-resilient fastened timber sleepers in track with loose rail.

9.3.2 In long welded track track

Sleepers with resilient fastenings shall not be interspersed with timber sleepers with non-resilient fastenings in LWR where interspersing would result in timber sleepers with non-resilient fastening being more frequent than 1 in 3 unless a management strategy has been approved by the RIM in accordance with the following:

- Where sleeper installation is part of a PRS program, rail adjustment of the rail section (110 m minimum) shall be checked and corrected. Consideration should be given to conversion of LWR to CWR in these circumstances.
- Before achieving an average pattern of 1 in 2 resilient fastenings the rail length shall be converted to CWR.
- Where individual sleepers are being installed to replace failed sleepers, rail stresses shall be freed up in the local area by releasing adjacent non-resilient fastenings and anchors and destressing the rail. Refer to the rail adjustment for method in MN T 20223 for the MRA and CRN CM 223 for the CRN network. Rail adjustment shall be done at rail neutral temperature.
- Weld locations shall be recorded so they are identified for special attention during track examination and welded track stability analysis Refer to track inspection and welded track stability in MN T 20203 for the MRA and CRN CM 203 for the CRN.
- Additional controls for example, extra ballast, additional anchors and so on shall be applied. Welded track stability issues shall be reduced to a minimum. Refer to MN T 20211 for the MRA and CRN CM 211 for the CRN for guidance.

9.3.3 In continuous welded rail track

Timber sleepers with resilient fastenings may only be interspersed with timber sleepers with non-resilient fastenings in CWR track where they are in accordance with a specific strategy and provided a consistent tie pattern is maintained (for example, 1 in 2, 1 in 3 and so on.).

Where back-canting is evident in timber sleepers with non-resilient fastenings, replacement with resilient fastenings shall meet the minimum tie patterns in Table 37 to avoid clip breakage.

Table 37 – Minimum resilient fastening patterns in back-canted track

Tie pattern	Limit of back-canting (mm) – DS plates	Limit of back-canting (mm) – resilient plates
1 in 3	3	5
1 in 2	6	10

Where back canting is ≥ 8 mm, complete renewal in resilient fastenings may be required to prevent clip breakage.

10 Changing configurations

The following configurations shall not be used in new installations:

- timber sleepers on curves < 400 m radius on mainline track
- steel sleepers on curves < 400 m radius on CWR track
- non-resilient fastenings in timber sleepers on mainline track
- resilient fastened track on transom topped steel bridges with spans > 18 m that does not meet the requirements of Section 8.7.1 relating to the installation of ZLR fastenings.

Renewal strategies shall be directed to eliminate issues in preceding bullet list.

11 Acceptance standards

11.1 General

Acceptance standards for condition and installation of sleepers, bearers and fastenings shall be as detailed in Sections 6, 7, 8, and 9.

11.2 Direct fixation track system (slab track)

Track slabs shall be designed and constructed in accordance with TS 02402. In addition, at the slab fastening system interface the acceptance limits in Table 38 shall apply:

Table 38 – Slab track acceptance limits

Item	Limit	Tolerance
Finished surface of the slab	Design level	+ 0 mm – 5 mm
Finished surface of the slab	No voids	N/A
Inward cant of rail for plain tracks	1:20	± 1 in 400
Inward cant of rail for turnouts	0	± 1 in 400

Item	Limit	Tolerance
Turnout transition to plain track (cant transition over 2400 mm)	0 to 1:20	± 1 in 400
Differential tilt of the rail seat in the direction of the rail	0	1 in 100
Concavity or convexity of the rail seat in any direction	0	± 0.5 mm

11.3 Sleeper plates

The following shall not be used for re-use of sleeper plates:

- reformed Pandrol plates, old pattern plates or single shoulder plates
- any sleeper plates with evidence of excessive corrosion, notch marks or oxyacetylene burn marks on the rail seat, shoulder or at spike holes
- any sleeper plates with shoulders that are worn to a sharp edge shall not be used
- any sleeper plates with cracks
- any sleeper plates with plate underside concavity or convexity greater than 1 mm
- any sleeper plates with lockspike holes wider than 19 mm at bottom surface
- any sleeper plates with dogspike holes wider than 25.5 mm at bottom surface
- any sleeper plates with rail seat width greater than 150 (+1) mm.

11.4 Installation of steel sleepers

All sleepers in the area covered by a steel sleeper installation program shall be resurfaced at the completion of the installation process. This includes new and existing steel and timber sleepers. Following resurfacing:

- The height of the ballast in the sleeper pods shall be such that the gap between the underside of the sleeper deck and the ballast in the sleeper pod is ≤ 25 mm.
- The ballast within the sleeper shall be tight.
- Deflection of steel and timber sleepers under normal traffic loadings should be consistent and no more than 5 mm.
- There should be no cyclic top or line in evidence.

The method of measurement and inspection for the items listed in preceding bullet list is detailed in CRN CM 231

The ballast profile for steel sleepers shall meet the minimum standards in TS 01049. Extra ballast may be placed on the outside of the sleeper ends but shall be no higher than the superelevated rail height.

Track geometry shall comply with the geometry maintenance limits specified in TS 01045.

12 Repair standards

12.1 Timber sleepers and bearers

Timber sleepers and bearers may be cross bored (once only on each side of each rail) if they are otherwise sound.

12.2 Concrete sleepers and bearers

Cast in-situ shoulders may be replaced using an approved process as detailed in Table 39.

Table 39 – Approved repair processes

Repair item	Description	Manufacturer
Pandrol cast in shoulders	Epoxy concrete repair of damaged concrete shoulders	Pandrol
Pandrol Fastclip shoulders	Welded repair of Fastclip cast-in shoulder components	Pandrol

12.3 Fastenings

Sleeper fastening components may be repaired using an approved process. Approved processes are detailed in Table 16.

The Fastclip repair process shall not be used for repair of consecutive sleepers.

Appendix A Sleeper boring patterns (normative)

Table 40 lists sleepers boring patterns for sleeper plates using dogspikes, lockspikes, dogscrews and lockscrews for various type of rail. Figures 1 and 2 shows hole configuration with hole sizes for dogspikes, lockspikes, dogscrews and lockscrew.

Table 40 – Sleeper boring pattern

Rail type (as specified in CRN CM 221)	Plate catalogue number	A (mm)	B (mm)	Comment
53 kg	DF 30 new pattern	1348	171	Lockspike and dogspike arrangement is a mirrored and inverted image of old pattern
53 kg	DF 30 old pattern	1348	171	
100 lb AS	DF 30 old pattern	1348	171	
100 lb AS 1916	DF 10 old pattern	1354	171	
AS 50, AS 47, 90 lb 1925/28, 80 lb AS 'A' 1928	DF 10	1366	152	
90 lb AS 1916		1346	162	Unplated, that is, not on tapered base or cant adzed and no lockspike holes
90 'J' 1913		1343	162	Unplated, that is, not on tapered base or cant adzed and no lockspike holes
80 lb AS 'B' 1928, A, A ¹ , A ² , A ³		1346	152	Unplated, that is, not on tapered base or cant adzed and no lockspike holes
71.5 lb 'D' 1875		1346	146	Unplated, that is, not on tapered base or cant adzed and no lockspike holes
60 lb AS 1916, AS 'A', AS 'B'		1365	133	Unplated, that is, not on tapered base or cant adzed and no lockspike holes
60 lb B 1896 and 'B ^A ' 1907		1366	127	Unplated, that is, not on tapered base or cant adzed and no lockspike holes

Notes:

For cant adzed increase A by 6 mm.

Dimension for parameter A is based on tapered base sleeper plates except for unplated.

All dimension tolerance are ± 1 mm.

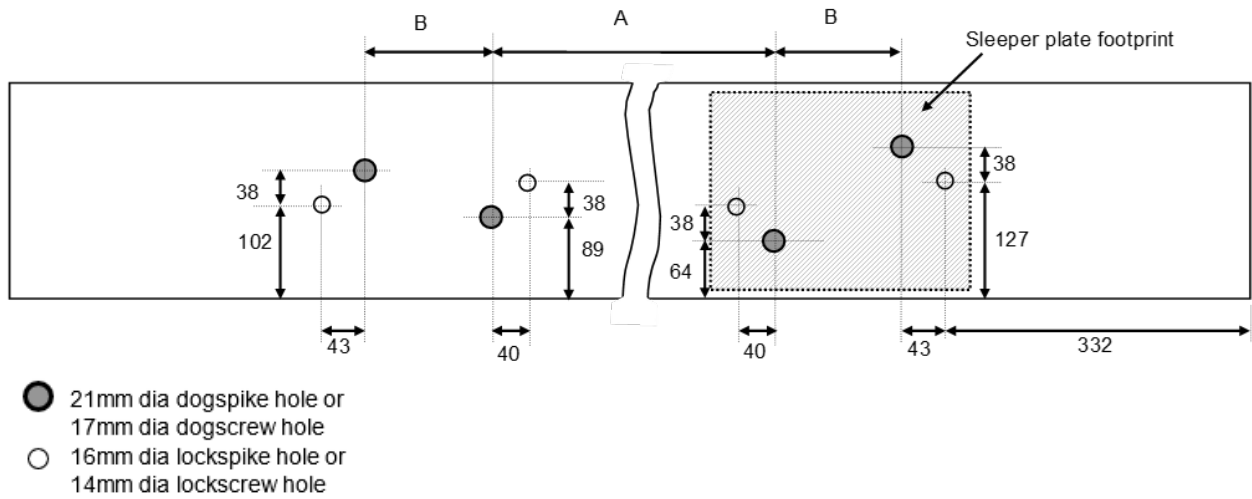


Figure 1 – New pattern boring details

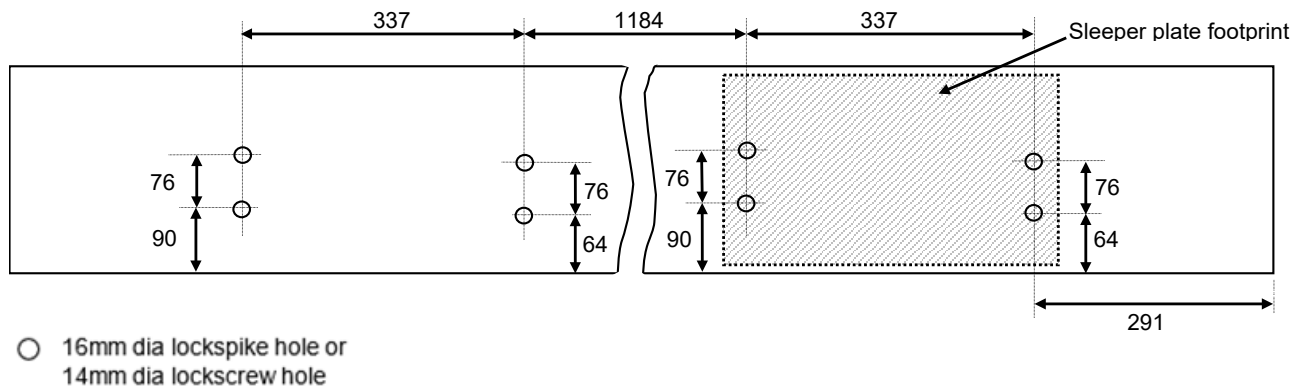


Figure 2 – Boring pattern for Pandrol for 53 kg and 60 kg/m rail