

# Railway

## Master Specification

### RW-TC-D1 Track and Civil (Design and Construction)

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## RW-TC-D1 Track and Civil (Design and Construction)

### 1 General

- 1.1 This Part specifies the requirements for railway track and civil design and construction for the Department's train lines.
- 1.2 Where it is proposed that the track and civil design cannot meet a Departmental standard approval must be obtained for a waiver using the process detailed in PR-AM-GE-807 Development and Approval of Engineering Waivers.
- 1.3 The track and civil design must be comply with the operating regime in Table RW-TC-D1 1-1.

**Table RW-TC-D1 1-1 Operating Regime**

Designation	Maximum axle load	Maximum operating speed
Passenger diesel or diesel electric multiple units	21 tonnes	110 km/hr
Locomotives	22 tonnes	65 km/hr
Freight rolling stock	21 tonnes	65 km/hr

- 1.4 The track and civil design must allow trains to achieve the maximum speed for the traffic to be operated while maintaining passenger comfort. This is best achieved by minimising the grade and curvature of the track.
- 1.5 Location specific operational speeds must be obtained from TC1-DOC-000445 Speed Board Locations on the Adelaide Metropolitan Public Transport Network.
- 1.6 Acceptance of the design speeds shall constitute a **Hold Point**.
- 1.7 Acceptance of the final track and civil design must be obtained from the Unit Manager Track and Civil Engineering before any construction is undertaken. This shall constitute a **Hold Point**.

### References

- 1.8 The following DIT Engineering Standards, as a minimum, must be used for track and civil design and construction:
  - a) CPTS952 Structure and Application – Train.
  - b) CPTS953 Management and Principles – Train.
  - c) CPTS-TS-954 Operational Signage.
  - d) PTS-MS-10-TR-00000047 Structural Clearances – Design and Rating.
  - e) TC1-DOC-000448 Track Geometry –Train
  - f) TC1-DOC-001642 Structures –Train.
  - g) CS1-DOC-001218 Drainage – Train System .
  - h) CS1-DOC-001538 Formation and Earthworks – Train System
  - i) CPTS960 Track support systems –Train.
  - j) CPTS961 Rails and Rail joints – Train.
  - k) CPTS962 Guard rails / check rails, buffers and derails –Train.
  - l) CS1-DOC-001639 Buffer Stops – Train System (Draft).
  - m) CPTS963 Points and Crossings –Train.
  - n) CPTS964 Rail stress control –Train.
  - o) CPTS965 Access control + protection –Train.
  - p) CPTS966 Fire prevention and Control –Train.
  - q) CS4-DOC-000446 Standard for Railway Pedestrian Crossings.

- r) PI4-DOC-000897 Engineering Specification - Security Systems.
- s) CS1-DOC- 000454 Fencing and Gates Standard for Rail Corridors and Facilities.
- t) TC4-DOC-000357 Non-Rail Service Installations within the Rail Corridor.
- u) AR-EL-STD-0102 Guidelines for the Protective Provisions Related to Electrical Earthing and Bonding for the Adelaide Metro Electrified Rail Network.
- v) PTS-AR-10-TK-SPE-00000035 In-bearer Point Machines Technical Specification.
- w) PTS-AR-10-TK-SPE-00000062 Technical Specification for Train Points and Crossings.
- x) TC1-DOC-000456 Train Rail Profiling Specification.
- y) TC1-DOC-000386 Engineering Decision - Change to Track and Civil COP Vol 2 - Train System to Support Higher Track Speeds.
- z) TC1-DOC-000463 Revision of Determination of Maximum Allowable Stagger and Mid Span Offset.
- aa) CS1-DOC-000450 Engineering Instruction - Additional Tamping Requirements for 25kV Electrified Track.
- bb) TC1-DOC-000391 Engineering Instruction for Inspection of 1 in 9 Turnout and Diamond.
- cc) TC4-DOC-000457 Engineering Instruction - Formation Repair Mudhole Treatments.
- dd) TC1-DOC-000393 Engineering Instruction -Rail Stress Control of Onkaparinga Valley Bridge (Viaduct).
- ee) CS1-DOC-000883 Engineering Instruction - Design Requirements for Platform Stopping Markers for Rail Cars.
- ff) TC1-DOC-000954 Engineering Instruction - Excavation and Ground Penetration.
- gg) PR-AM-GE-807 Development and Approval of Engineering Waivers.
- hh) TC1-DOC-000445 Speed Board Locations on the Adelaide Metropolitan Public Transport Network.
- ii) PTS-MS-1O-SG-STD-00000094 Pit and Conduit Standard for Signalling and Communication Cables.
- jj) TP1-DOC-000389 Electrical and Mechanical Clearances for the 25kV Electrified Train Network.

1.9 Other Engineering Standards applicable to track and civil design and construction are as follows:

- a) EN13481 Railway Applications –Track-Performance requirements for fastening systems – Part 5: Fastening systems for slab track with rail on the surface or rail embedded in a channel.
- b) Rail Corp NSW Engineering Standard, Civil ESC 362 Track Slabs.
- c) AS 5100 Bridge Design Series.
- d) AS 7630 Track Classification.
- e) AS 7633 Clearances.
- f) AS 7635 Track Geometry.
- g) AS 7639 Track Structures and Support Systems.
- h) AS 7640 Rail Management.
- i) AS 7642 Turnouts and Other Special Trackwork.
- j) AS 5100 Bridge Design.
- k) AS 1597 Pre-Cast Reinforced Concrete Box Culverts.
- l) AS 2159 Piling: Design and Installation.
- m) AS 3600 Concrete Structures.

- n) AS 3700 Masonry Structures.
  - o) AS 3725 Design for Installation of Buried Concrete Pipes.
  - p) AS 4100 Steel Structures.
  - q) AP-R252 Austroads Standards for Bridge Management.
  - r) BS 7608 Guide to Fatigue Design and Assessment of Steel Products.
  - s) AS 7631 Railway Infrastructure Sighting.
  - t) AS 7632 Railway Infrastructure Signage.
  - u) AS1742.7 Part 7 Railway Crossings.
  - v) AS 7636 Australian Railway Infrastructure - Railway Structures.
  - w) AS 7637 Hydraulics and Hydrology.
  - x) AS 7638 Earthworks.
  - y) AS4799 Installation of Underground utility services and pipelines within railway boundaries.
  - z) DSAPT - Disability Standards for Accessible Public Transport.
  - aa) AS1428 .1 Design for access and mobility – General requirements for access - New Building work.
  - bb) AS1428 .1 Design for access and mobility – Enhanced and additional requirements – Buildings and facilities.
- 1.10 A full listing of the principle DIT Engineering standards and associated drawings for all engineering disciplines can be found at AM4-DOC-00218 Register of Rail Engineering Standards.

## 2 Design Development Report

- 2.1 A Design Development Report must be provided at the (100%) final design stage of the track and civil design.
- 2.2 The Design Development Report shall include:
- a) the design philosophy and principles applied to the track and civil design;
  - b) all design interpretations, assumptions, bases and parameters used in the track and civil design;
  - c) issues and solutions;
  - d) a list of track and civil approved waivers incorporated into the design;
  - e) a list of track and civil type approvals; and
  - f) a list of track and civil design decision records (DDR).
- 2.3 The provision of the Design Development Report shall constitute a **Hold Point**.

## 3 Operational Signage

- 3.1 All operational signage must comply with CPTS954 Operational Signage.
- 3.2 Existing Departmental operational signs must be salvaged, stored and reinstated in their existing location unless agreed by the Unit Manager Track and Civil Engineering.
- 3.3 Operational signs must be designed, manufactured and installed in accordance with standard Departmental operational signage drawings.
- 3.4 Where a new operational sign is required for which there is no current approved Departmental standard drawing a design drawing must developed and approved by the Unit Manager Track and Civil Engineering before manufacture and installation.

- 3.5 Rail operational signage must not adversely affect any critical sighting distances for train drivers, maintenance staff, pedestrians or members of the public.

## 4 Track Geometry

- 4.1 Track geometry must be designed and constructed in accordance with TC1-DOC-000448 Track Geometry –Train.
- 4.2 The number of horizontal curves must be minimised.
- 4.3 Transitions must be designed using a clothoid curve.
- 4.4 Track through train stations must be in accordance with TC1-DOC-000448.
- 4.5 Vertical curves must not be located on horizontal transitions or curves.

## 5 Structural Clearances

- 5.1 Structural clearances must comply with:
- a) PTS-MS-10-TR-00000047 Structural Clearances – Design and Rating;
  - b) 200-A3-82-1658 - Maximum Outline for Metropolitan Railway Rollingstock & Equipment 1600mm gauge;
  - c) 301-A2-86-2239 - STA Allowable Infringements , Minimum Structures 1600 mm Gauge;
  - d) 301-A3-85-1874 - Platform Clearance -1600 mm Gauge – Existing Platform;
  - e) 301-A3-2010-2389 - Platform Clearance -1600 mm Gauge – New or Reconstructed Platform; and
  - f) TP1-DOC-000389 Electrical and Mechanical Clearances for the 25kV Electrified Train Network.
- 5.2 Track centres must not be less than 4.0 metres.
- 5.3 Fouling points on siding tracks entering a main line must be installed in a position that ensures no two trains can come closer to each other than 4.0 metres.

## 6 Structures

- 6.1 The design and construction of structures on the AMPRN must comply with TC1-DOC-001642 Structures –Train.

## 7 Drainage

- 7.1 The design and construction of stormwater and drainage infrastructure must comply with CPTS958 Drainage / CS1-DOC-001218 Drainage – Train System
- 7.2 Open cess drainage must not be obstructed by overhead wiring poles or signal masts, cables or associated equipment.

## 8 Formation and Earthworks

- 8.1 The design and construction of formation and earthworks infrastructure must comply CS1-DOC-001538 Formation and Earthworks – Train System.

## 9 Track Structure and Support Systems

- 9.1 The Track Structure and Support Systems must be designed and constructed in accordance with CPTS960 Track support systems –Train.
- 9.2 The track configuration must be continuously welded AS50 kg rail on concrete sleepers.

- 9.3 The concrete sleepers shall be as detailed in drawing 225-22D-F2 gauge Convertible Concrete Sleeper (Broad / Standard).
- 9.4 Where rail fastenings are used in locations where they are covered or not accessible for inspection they must be galvanized.

## 10 Slab Track (Where Required and Approved)

- 10.1 Where the track gradient is between 1 in 45 and 1 in 33 a concrete slab track or slabs must be used.
- 10.2 The track must be directly fixed to the slab.
- 10.3 Embedded systems are not permitted.
- 10.4 Slab Track must be designed in accordance with:
  - a) EN13481 Railway Applications –Track-Performance requirements for fastening systems – Part 5 : Fastening systems for slab track with rail on the surface or rail embedded in a channel;
  - b) Rail Corp NSW Engineering Standard, Civil ESC 362 Track Slabs ;
  - c) AS 5100 Bridge Design series TC1-DOC-001642 Structures –Train and;
  - d) an alternate specification approved by the Unit Manager Track and Civil Engineering.
- 10.5 The design must include a track support transition between the track slab and the concrete sleepered ballasted track to:
  - a) provide a progressive change in track stiffness;
  - b) provide an easily maintained track form transition which will not be prone to differential settlement;
  - c) provide accurate matching of track alignment under all loading conditions in order to avoid stress concentrations in components or uneven ride characteristics;
  - d) achieve the nominated levels of vibration and regenerated noise attenuation; and
  - e) minimise the number of transition sections.
- 10.6 Noise impacts must be minimised to meet legislative and regulatory requirements.
- 10.7 Vibration impacts must be minimised to meet legislative and regulatory requirements.
- 10.8 The slab track construction methodology must be clearly defined. The construction definition shall constitute a **Hold Point**.

## 11 Rails and Rail Joints

- 11.1 The design and construction of rails and rail joints must be in accordance with CPTS961 Rails and Rail joints – Train.
- 11.2 The track and civil design shall provide for continuously welded rail (CWR).
- 11.3 AS50kg standard carbon rail must be used for plain track unless otherwise approved by the Unit Manager Track and Civil Engineering.
- 11.4 Welds must be “Flash Butt” in accordance with AS1085.20.
- 11.5 Aluminothermic welds can only be used with the approval of the Unit Manager Track and Civil Engineering.
- 11.6 All new welds must be ultrasonically tested and certified defect free before handover for rail traffic operations, including test trains.
- 11.7 Mechanical rail joints must not be used in any permanent configuration.



## 12 Guard Rails, Check Rail and Derails

- 12.1 Design and construction of guard rails must comply with CPTS962 Guard rails / check rails, buffers and derails –Train.
- 12.2 The specified concrete sleepers have provision for the coring of holes for the installation of a ferrule allowing for the attachment of (if required) checkrails, guardrails and signalling equipment. Where this is required the design and construction must accommodate the item required without impairing the concrete sleeper function.
- 12.3 Check blocks and bolts must be used to secure the check rail to the running rail.
- 12.4 Derails must not be used.

## 13 End of Track Protection / Buffers

- 13.1 End of track Protection must be designed and constructed in accordance with CS1-DOC-001639 Buffer Stops – Train System (Draft).
- 13.2 Friction type buffers must be used for all main line end of track protection.

## 14 Points and Crossings

- 14.1 Points and crossings must be designed and constructed in accordance with CPTS963 - Points and Crossings –Train.
- 14.2 New points and crossings must be 1 in 9, 250mR, 1600mm gauge as currently utilised on the AMPRN (refer Vossloh drawing AOB15459 for typical arrangement).
- 14.3 Points and crossings operational speed is 35 km/hr for the diverging route and location specific line speed for the straight route.
- 14.4 Contraflexure and similar flexure turnouts must not be used unless approved by the Unit Manager Track and Civil Engineering.
- 14.5 New points and crossing must be designed and manufactured:
  - a) using AS60 kg rail;
  - b) in broad gauge configuration;
  - c) not gauge convertible; and
  - d) for point machine operation.
- 14.6 Acceptance of the points and crossings configuration shall constitute a **Hold Point**.

## 15 Rail Stress Control

- 15.1 Control of rail stress must be in accordance with CPTS964 Rail stress control –Train.
- 15.2 A Rail Stress Management Plan must be provided which will detail the methodology and order of stressing.
- 15.3 Full records of all rail stressing must be provided to the Department at handover and include details of;
  - a) date, location;
  - b) rail temperature / initial temperature;
  - c) total rail length / initial rail length;
  - d) rail extension;
  - e) rail movement;

- f) cut rail gap;
- g) weld gap;
- h) rail adjustment calculation;
- i) use of rail tensor, or artificial heating or cooling / stressing method;
- j) direction of traffic;
- k) statement of completion of track-geometry marking and ballasting;
- l) type of welding method;
- m) name of person responsible during the work;
- n) name of supervisor; and
- o) type of fastener used.

15.4 Supply of all rail stressing records shall constitute a **Hold Point**.

## 16 Fire Prevention and Control

16.1 Design and construction for fire protection and control must be in accordance with CPTS966 Fire prevention and Control –Train.

## 17 Pedestrian Crossings

- 17.1 New pedestrian crossings are not permitted.
- 17.2 The track and civil design of upgraded pedestrian crossings must comply with CS4-DOC-000446 Standard for Railway Pedestrian Crossings.
- 17.3 All upgraded pedestrian crossings must have a single constant grade across all tracks, preferably flat, but no steeper than 1 in 20.

## 18 Level Crossings

- 18.1 New level crossings are not permitted.
- 18.2 Full depth concrete is preferred where the level crossing track structure is being replaced. Level crossing track structure to be approved by the Unit Manager Track & Civil Engineering prior to construction.
- 18.3 New AS50kg rail must be used where the level crossing track structure is being replaced.
- 18.4 A 65mm flange gap must be installed where the level crossing track structure is being replaced.
- 18.5 Where existing crossings are rebituminised the rail fastenings must be replaced and must be galvanized.

## 19 Fencing and Gates

19.1 Fencing and gates must be designed and constructed in accordance with CS1-DOC-000454 Fencing and Gates Standard for Rail Corridors and Facilities.

## 20 Undertrack Crossings

- 20.1 The use of undertrack crossings must be minimised. Under track bores are preferred to trenching for UTX's
- 20.2 The track and civil design of new or upgraded undertrack crossings must comply with:

- a) PTS-MS-1O-SG-STD-00000094 Pit and Conduit Standard for Signalling and Communication Cables;
  - b) TC4-DOC-000357 Non-Rail Service Installations within the Rail Corridor; and
  - c) AS4799 Installation of Underground utility services and pipelines within railway boundaries.
- 20.3 A monitoring proposal for newly constructed UTX's must be provided for the Department to review and endorse.

## 21 Hold Points

21.1 The following is a summary of Hold Points referenced in this Part:

Document Ref.	Hold Point	Timing
1.6	Acceptance of design speeds	Before design commences
1.7	Acceptance of final track and civil design	Before construction commences
2.3	Design Development Report	At Final Design
10.8	Slab Track construction methodology (where applicable)	At final design
14.6	Acceptance of points and crossings configuration and componentry	Before design commences
20.3	Endorsement of monitoring proposal for UTX's	Before construction commences
15.4	Supply of all rail stressing records	Before train services commence including test trains