Engineering Specification

Track

MTSP 030100-01

TRACK GEOMETRY MAINTENANCE TOLERANCES

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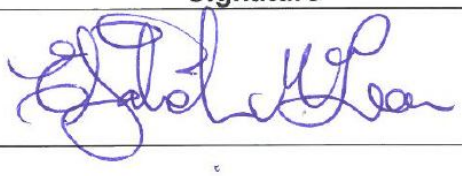
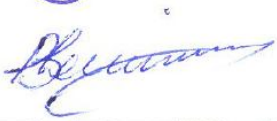
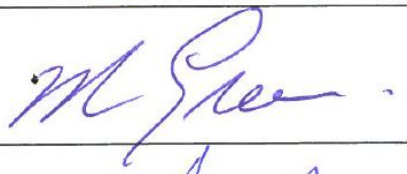
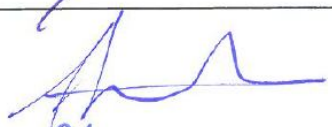
Document Author	Liz MacLean	Track & Structures Document and Planning Officer	
Document Endorsers	Brenden Jennion	Act/Track & Structures Asset Manager	
	Micheal Green	Infrastructure Operations Manager	
Document Endorser (Quality)	Ahmed Dwidar	Standards Development Manager	
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Amendment Record

Approval Date	Version	Description
18/09/2012	1	Initial issue under MTM. This document replaces MainCo document MTMI 3.01

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1. Purpose

This Specification sets out the required track geometry Specifications for track inspection and track recording to ensure safe train operating conditions on the Melbourne metropolitan train network maintained under the Franchise Agreement by Metro Trains Melbourne (MTM).

For each track geometry parameter, this Specification sets the minimum deviation from a standard value which shall be regarded as a fault.

This version incorporates the recommendations from MTM Engineering Services Paper "Track Geometry Parameter – Wide Gauge dated August 9 2011.

2. Scope

This Specification applies to all trackwork covered by the MTM franchise.

3. Abbreviations

MTM	Metro Trains Melbourne
MTMI	Metro (Trains Melbourne) Track Maintenance Instruction
CMMS	Computerised Maintenance Management System

4. Definitions

Definitions relevant to this Specification:

The terms "Gauge', "Line", "Top", "Cant" and "Twist" are used in this Specification as a deviation from a standard value of the related track parameter, not as a track parameter or the measurement of a track parameter.

A Fault	A measured deviation exceeding the A limit for any track geometry parameter, as indicated in Appendix 1. A Faults require prioritised corrective action.
Assessment	Evaluation of condition and deterioration identified by inspection or Track Recorder car to determine the necessary requisite actions.
B Fault	A measured deviation exceeding the B limit for any track geometry parameter, as indicated in Appendix 1. B Faults are monitored as part of the routine track inspection and are considered when planning maintenance programs.
Cant	The deviation of actual cant from design cant.
Design Cant	The required vertical difference in level between the running surfaces of each rail in a track. Note: The term "superelevation" is not used in this Specification.

Design Line	The required horizontal mid-ordinate offset from a 10 metre chord Note: the offset is zero for straights, the versine value for uniform curves and a value between zero & versine value for transition curves
Design Top	The required vertical mid-ordinate offset from a 10 metre chord. Note: Vertical curves usually have such a large radius that a 10 metre length of track may be considered planar and Design Top is therefore zero.
Design Track Gauge	The nominal track gauge between the two rails in a track before any tolerances are applied, measured from running edge to running edge at a point 16mm below the crown of the rail. The nominal gauge is 1600mm for broad gauge track and, 1435mm for standard gauge track.
Gauge	The deviation of actual track gauge from design track gauge. (Positive deviation = wide gauge; negative deviation = tight gauge).
Inspection	Process by which information on the condition of infrastructure is collected & recorded.
Line	The deviation of actual line from design line.
Top	The deviation of actual top from design top.
Nominated Representative	The nominated representative of any of the Track Officers mentioned within this Specification. Where there is a reference to Track Manager, Track Engineer, Track Foreman and Track Ganger the reference is also to be taken to include their nominated representative
Track Recorder	Plasser EM100, Krab Trolley, Leica Trolley or approved alternative, Track Geometry Recording Vehicle which used to measure track geometry.
Track Supervisor	A suitable qualified Track Manager, Roadmaster, Track Engineer, Track Foreman, Track Inspection Co-ordinator or Track Ganger.
Trackwork	All trackwork under MTM responsibility for the Melbourne metropolitan electrified network as defined in the Franchise documents.
Twist	The deviation of track from a plane (or “warp”), measured as the cross level change over a specified track length of 3.5 metres or 10 metres. Note: Track in straights & uniform curves should be planar. Track in transition curves has a design twist to allow ramping of cant, but no extra allowance is made in maximum twist.

5. References & Legislation

L0-SQE-MSM-003	Quality Management System Manual
L0-SQE-MAN-002	Safety Management System Manual
L0-SQE-PLA-002	Security Management Plan
	Book of Rules & Operating Procedures 1994

6. Responsibilities

General responsibilities are set out in the MTM Quality Management System Manual and the relevant personnel position descriptions.

All personnel who are assigned a task related to this Specification shall be trained, suitably qualified and competent to carry out that task.

This version recognises the introduction of Network Asset Management and Infrastructure Delivery Departments and offers a clear distinction between those undertaking inspections and those responsible for any subsequent reactive and corrective maintenance activities.

Should the title of any of the proposed positions alter the procedure is to apply to those undertaking the similar or like roles within any amended structure.

6.1 Network Asset Management

6.1.1 Track and Structures Asset Manager (TSAM)

The Track and Structures Asset Manager is responsible for;

- determining the inspection type, frequency and inspector skill level to ensure a safe and efficient track and structures infrastructure.
- creating Maintenance Scheduled Tasks within the CMMS to address all of the inspection types and frequencies identified by the Track and Structures Asset Manager.
- monitoring and reporting on the completion of all scheduled inspections, rescheduling any missed or incomplete inspections and scheduling any identified ongoing inspection requirements.
- the issue of regular reports on the compliance of Track and Structures Delivery in meeting the scheduled inspection requirements.
- scheduling and arranging all Third Party Inspections, reviewing the inspection output and ensuring all third party inspection results are loaded into the CMMS.
- analysing all inspection results to determine effectiveness of the inspection programs and identify any fault and defect trends.
- reviewing all inspection results and the subsequent corrective actions undertaken for both appropriateness and effectiveness in conjunction with the Trend Analysis reports.
- initiating work orders for follow up inspections and corrective actions.

6.2 Infrastructure Delivery

6.2.1 Infrastructure Delivery Manager

The Infrastructure Delivery Manager is responsible for;

- assessing the MST schedules and the availability of track access and suitably qualified inspectors to ensure the MSTs generated by the CMMS are met.
- scheduling and arranging track inspections undertaken by Track Delivery inspectors and inspection teams.
- the input of inspection results into the CMMS for inspections conducted by MTM.
- reviewing the inspection results and initiating any reactive maintenance requirements.
- reviewing third party inspection results along with MTM inspections to prioritise, scope and issue corrective maintenance works programs.
- ensuring all reactive and corrective works are undertaken in accordance with appropriate maintenance instructions.
- the input of completed corrective and reactive track works results to the CMMS.

7. Safety and Environmental

The general requirements in relation to safety are included in Metro Trains Melbourne's Security Management Plan (L0-SQE-PLA-002).

At all times track inspections must be carried out in accordance with the current Book of Rules & Operating Procedures 1994, and all relevant circulars.

8. Track Geometry Specifications

8.1 Track Condition

The condition of track geometry can deteriorate over time from installation in accordance with the prevailing construction standard, until the next Surfacing Gang maintenance cycle, depending on local conditions and traffic. Between maintenance cycles the track geometry is monitored, against a series of track parameters included in this Specification, to ensure, at all times, the track condition meets appropriate maintenance standards for the line speed and traffic.

8.2 Track Geometry Parameters

Track geometry faults can be broadly divided into two groups, those likely to affect the safe running of trains such as twist, gauge and cant (Key Geometry Parameters) and those more likely to affect the comfort of train passengers such as top and line (Comfort Parameters).

Two limits are given for each parameter deviation value: A limit and B limit. These limits mark the lowest value of a band of parameter deviations: the A limit marks the lower edge of the A band and the B limit marks the lower edge of the B band.

These bands & limits are used to categorise Track Recorder measurements to prioritise fault management, aid assessment of the overall condition of a track section, to determine rate of deterioration and to plan track maintenance programs.

8.3 Track Classes and Line Speeds

a) Each section of track within the MTM responsibility is assigned a track class dependant on the authorised maximum line speed for that section. The higher the line speed the more stringent the track geometry Specification and the lower the allowable deviation.

b) For any track class, the maximum permissible track geometry deviation value for each parameter is to be found in the column headed by that particular track class.

c) At any relevant line speed, the measured deviation for a track geometry parameter which exceeds the A limit shall be regarded as an A Fault requiring corrective action in accordance with MTPR 030200-01 Track FRACAS Fault Reporting, Analysis and Corrective Action System.

d) At any relevant line speed, the measured deviation for a track geometry parameter which exceeds the B limit shall be regarded as a B Fault. B Faults are considered when assessing trends and when planning track maintenance programs. B Faults require no mandatory corrective action.

e) The classification, and boundaries, for each track or section of track under MTM responsibility is given in Appendix 2.

f) Track characteristics typical of some track classes are given in Appendix 3.

g) Maximum speed refers to passenger trains for the purposes of this Specification, which is based largely on safety (“keeping trains on track”) and less on engineering economy (“how quickly will track deteriorate and what resources will be needed to keep track safe?”).

h) The distinction made between passenger and freight trains when establishing line speeds is mainly for the purposes of engineering economy. When imposing speed restrictions however, any track fault which would deteriorate to an unsafe condition under freight trains (but not under passenger trains) before corrective action can be undertaken will require consideration of separate speed restrictions for freight trains.

8.4 Track Exceedance Limits

a) The A limit marks the lowest value of parameter deviation which shall be regarded as a track fault requiring corrective action. All track faults falling into the A band (i.e. A faults) shall be removed or corrected so that they then fall into the B band or better.

b) A measured deviation may exceed the allowable A Fault limit for a higher line speed but fall within the A Fault limit for a lower speed. The imposition of a suitable lower speed restriction may then effectively downgrade an A Fault to a B Fault.

c) In some instances the track recorder will record an entire run using parameters for a higher Track Class than applies for all of the track covered in the run.

For locations where the line speed at a particular location is less than the Track Class speed against which the track was measured; the fault parameters which are to apply are those corresponding to the actual timetable line speed for that location.

8.5 Wide Gauge Limits

a) There is only one tolerance for wide gauge to be applied to both tangents and curves.

b) The limits for Wide Gauge in Appendix 1 apply to measurements from the Track Recorder, which may be greater than Wide Gauge measured in the field, either by use of track gauge or recording trolley such as Krab, Leica or similar. This is due to the dynamic nature of Track Recorder measurement. Track Supervisors should make appropriate allowance for these differences when locating track faults.

c) With the approval of the Track Manager, wide gauge on curves may be permitted to exceed these limits where the excess is due solely to rail wear and provided;

- rail "foot to foot" measurements remain as installed - including any requirement to construct the track "wide to gauge" due to curve radius restrictions – Refer MTMI 033000-08 Laying Bolted Rail, Welded Rail & LWR
- rail profiles are taken using a RailProf or similar recording unit to confirm rail wear corresponds with the recorded wide gauge.

d) Where there is any evidence of working track the wide gauge tolerance is absolute

8.6 Quality Index for Victorian Track

a) The index used as a measure of track quality in Victoria is called the Victorian Quality Index (VQI) and it is calculated from the individual Parameter Index (PI) values of certain track parameters.

b) Victorian Quality Index (VQI) is calculated for each feature as an indicator of total track quality over the length of that feature or at the integer kilometre for the previous kilometre. This calculation is described in MTMI 060100-01 Operation of EM100 Track Recorder.

c) VQI's shall not be used to set priorities for the removal of A faults by Track Gangs. Comparisons of VQI, taken over time for the same location, may be used, together with B Fault occurrence and distribution, to assist the setting of priorities for programmed maintenance, renewals and upgrades.

d) VQI's are dependant on track features and local conditions. A timber sleepered kilometre of track with dog spikes and 47 or 53kg rail will generally have a higher VQI than a kilometre of concrete sleepered track with 60kg rail.

e) A true comparison can only be made of VQI's for the same section of track, or track feature, over time to determine any emerging trends. A comparison of VQI's for different kilometres of track must consider the track class (line speed) and any local conditions and should only be used as a guideline in drawing conclusions on actual track condition.

9. Related Documents

MTMI 000300-01	Glossary of Terms
MTPR 030400-01	Track Inspection Frequencies
MTPR 030200-01	Track FRACAS Fault Reporting, Analysis and Corrective Action System
MTMI 033000-08	Laying Bolted Rail, Welded Rail & LWR
MTMI 060100-01	Operation of EM100 Track Recorder
	MTM Engineering Services "Track Geometry Parameter – Wide Gauge dated 9 August 2011

10. Records

Nil

11. Appendices

Appendix 1: Track Geometry Specifications

Appendix 2: Track Class Listing

Appendix 3: Typical Differences in Track Structure/Configuration with Track Class.

11.1 Appendix 1: Track Geometry Specifications

		TRACK CLASS & MAXIMUM SPEED											
		1/HP	2M	2	3		4		5		Note (i)	Sidings	Stop Services Note (ii)
TRACK GEOMETRY PARAMETER	**Limit**	160 km/h	130 km/h	115 km/h	100 km/h	90 km/h	80 km/h	65 km/h	50 km/h	40 km/h	25 km/h	15 km/h	0 km/h
Wide Gauge (mm) (Applies to both Tangents and Curves)	A B	18 12	18 12	18 12	20 13	21 14	21 14	23 15	25 16	26 16	27 17	28 18	38
Tight Gauge (mm)	A B	-14 -8	-14 -8	-14 -8	-14 -8	-14 -8	-14 -8	-14 -8	-14 -8	-14 -8	-14 -8	-14 -8	-18
Cant (mm)	A B	28 18	30 20	35 25	40 30	45 35	55 45	55 45	55 45	57 46	59 47	61 49	65
Twist / 3.5m (mm)	A B	15 10	18 12	20 15	25 18	28 23	30 25	35 27	40 30	41 33	42 35	43 36	45
Twist / 10m (mm)	A B	30 18	35 20	40 30	45 35	50 37	55 40	57 45	60 50	61 51	62 52	63 53	65
Line (mm)	A B	18 10	20 12	25 18	30 20	32 23	35 25	37 30	40 35	50 37	55 38	60 41	65
Top (mm)	A B	18 12	21 13	25 20	28 22	31 24	35 25	37 27	40 30	42 32	43 34	45 36	50

Note (i) Speeds below 25 km/hr require drivers to be stopped and given an operating speed.

Note (ii) Zero speed means suspension of service until work lifts the track geometry parameters to 15 km/hr capability or better.

11.2 Appendix 2: Track Class Listing

Any tracks added subsequent to the issue of this Specification are to be included at the appropriate Class and with the defined boundaries.

Track Class	Line Speed generally applicable to this Track Class	Lines with this Track Class under MTM responsibility	Boundaries
1/HP	**160 km/hr**	Pakenham – Pakenham East for the South track (former up track) only.	58.900 (Down end of crossover in South track DN end of Racecourse Rd) - 60.835 (MTM boundary) *Pakenham=58.193,* *Racecourse Rd=58.751*
		Sydenham to Sunbury	24.100 (Melton Road PCR) – 39.074 (new MTM boundary)
2M	**130 km/hr**	Nil (***see Note A below table***) but Sprinters are permitted to operate at 130 km/hr from Champion Rd – Werribee, and Broadmeadows – Donnybrook, which are Class 2 tracks maintained to 115 km/hr track geometry specification.	For information only: Sprinters are restricted to; 110 km/hr from St Albans – Sydenham and 115 km/hr from Dandenong – Pakenham East/Nar Nar Goon.
2	**115 km/hr**	Newport – Werribee (East & West tracks via Paisley)	12.090 (Down end of curve after Champion Rd) – 32.273 (MTM boundary). *Champion Rd = 11.748* *Werribee = 31.697* *Werribee St = 32.382*
		St Albans – Sydenham (Watergardens) (up & down tracks)	17.950 (Down side of Main St) - 24.026 *St Albans = 17.814* *Main St = 17.914* *Watergardens = 23.279,* *old Sydenham = 23.966* *Melton Rd = 24.026*

Track Class	Line Speed generally applicable to this Track Class	Lines with this Track Class under MTM responsibility	Boundaries
		Broadmeadows – Donnybrook (up & down tracks)	17.100 (Down end of turnout 432D into C Siding) – 29.816 (MTM boundary) *Broadmeadows = 16.848* *Down End of Turnout 432D = 17.042* *Donnybrook = 33.213*
		Dandenong – Pakenham East (down track)	31.750 (Down side of Webster St) – 60.835 (MTM boundary) *Dandenong =31.194* *Webster St = 31.729*
		Dandenong – Pakenham (up track)	31.750 (Down side of Webster St) – 58.900
		Dandenong – Cranbourne (single track)	31.750 (Down side of Webster St) - 45.152 (MTM boundary) *Cranbourne = 45.082.* *South Gippsland Hwy = 45.277}*

Track Class	Line Speed generally applicable to this Track Class	Lines with this Track Class under MTM responsibility	Boundaries
3	**Up to 100 km/hr for passenger trains**	<u>All tracks (up, down, centre, single) of:</u> North Melbourne – Williamstown (via Through Suburban lines) Newport Station – down end of curve after Champion Rd. Altona Junction – Laverton Junction (via Altona) North Melbourne – St Albans (via Main Suburban lines) North Melbourne – Kensington (via Broadmeadows Suburban lines) North Melbourne – Kensington (via East Suburban lines) Kensington - Broadmeadows Newmarket – Flemington Racecourse North Melbourne – Upfield (via Upfield Suburban lines) MURL (4 loops) Inner metropolitan area (North Melbourne – Richmond) Main Goods Line (from Viaduct to Dudley St where electrified) Jolimont – Epping Clifton Hill – Hurstbridge Richmond – Lilydale Ringwood – Belgrave	

Track Class	Line Speed generally applicable to this Track Class	Lines with this Track Class under MTM responsibility	Boundaries
		Camberwell – Alamein Burnley – Glen Waverley Richmond – Dandenong Caulfield – Frankston Frankston – Stony Point South Yarra – Sandringham	
4	**80 km/hr**	Spencer St passenger yard (incl Layby Sidings) Lysaghts Sidings at Long Island	

Track Class	Line Speed generally applicable to this Track Class	Lines with this Track Class under MTM responsibility	Boundaries
5	**50 km/hr**	**North Melbourne – Newport area**: Melbourne Stabling Yard (at rear of North Melbourne platform 6), North Melbourne stabling sidings (near Moonee Ponds Creek), North Melbourne suburban carriage mtnce depot & wash dock sidings, Macaulay repair depot sidings, Williamstown stabling sidings at up end of Newport, electrified sidings into Siemens Depot in Newport Workshops, Garden platform electrified sidings in Newport Workshops (new sidings at Williamstown). **Stabling sidings** at St Albans & Sydenham; Broadmeadows; Upfield; Epping; Macleod & Eltham & Hurstbridge; Camberwell & Ringwood & Lilydale; Bayswater & Upper Ferntree Gully & Belgrave; Burnley & Glen Waverley; Westall & Dandenong; Mordialloc & Carrum & Frankston (2 areas); Sandringham. **Depots & associated sidings** at Epping & Camberwell & Bayswater & Westall. **Other sidings** at Flemington Racecourse, Broadmeadows, Victoria Park, Bell, Mitcham, Lilydale, Ashburton, Caulfield, Oakleigh, Springvale, Dandenong, Pakenham, Frankston, Brighton Beach & Sandringham. (Cranbourne, Craigieburn, Lundhurst, Showgrounds, Altona Junction (Track Maintenance Sidings) Kensington Mill Sidings	**Tracks not recorded by EM100** **Track to be recorded by Krab Trolley**

Note A: Sprinter trainsets were permitted to operate at 130 km/hr on certain Class 2 tracks. Class 2 tracks have a nominal line speed of 115km/hr and are maintained to track geometry Specification applicable to 115 km/hr. But it was the position of PTC track engineers that the Sprinter should have been restricted to 115 km/hr operation unless tracks were maintained to a higher standard of track geometry more suited to 130 km/hr. The Sprinter case is an anomaly which may be partly repeated with the VLocity trainsets: the VLocity may be allowed to operate at 130km/hr where the Sprinter currently operates at this speed on Class 2 track, but on those sections of fast country track requiring upgrade for the VLocity to operate at 130 km/hr, tracks were upgraded to Class 2M.

Lines in the metropolitan area which are not under MTM responsibility include:

1. Dudley St Carriage Maintenance Depot & associated sidings.
2. SG line & loops & sidings from North Melbourne flyover to Donnybrook.
3. Goods lines & sidings from West Melbourne to Albion (including Bluescope sidings & works sidings at E Gate, Appleton Dock, South Dynon locomotive depot, South Dynon goods yard, North Dynon yard, South Kensington sidings, South Kensington Goods Line, Maribyrnong River Goods Line, double dual gauge tracks from Maribyrnong River to West Footscray, Tottenham Goods Yard, Sunshine & Albion electrified sidings).
4. SG line & loops & sidings from Tottenham to Werribee (including Tottenham-Brooklyn-Spotswood dual gauge line).
5. BG non-electrified lines & loops & sidings from Tottenham & Sunshine to Werribee (including Sunshine-Spotswood BG line, former Spotswood Perway Depot, former Spotswood Workshops/Goninan Workshops, former Newport Workshops & associated sidings, industrial sidings from Altona Junction to Laverton Junction, Laverton BG crossing loop).
6. BG non-electrified lines & loops & sidings from Albion to Jacana / Broadmeadows.

11.3 Appendix 3: Typical Differences in Track Structure/Configuration with Track Class

Note these are the historical typical differences between tracks structures.

However these distinctions are becoming blurred with the introduction of low profile concrete sleepers and the table is retained only for the historical record.

	Class 1/HP	**Class 2M**	**Class 2**
Minimum rail size	53 kg/m	47 kg/m	47 kg/m
Minimum rail length	CWR	CWR	82m jointed.
Min. Sleepers & Fastenings on Tangent Track	Timber with resilient fastenings.	Timber with double-shouldered sleeper plates fastened with 2 lockspikes and 2 dogspikes.	Timber with double-shouldered sleeper plates fastened with 2 dogspikes.
Min. Sleepers & Fastenings on Curves	Concrete sleepers.	Timber with resilient fastenings.	Timber with double-shouldered sleeper plates fastened with 2 dogspikes.
Ballast Depth	300mm	300mm	300mm for new tracks; 100-300mm effective depth for older tracks.
Maximum applied cant	140mm	110mm	100mm
Maximum cant deficiency	120mm (RFR vehicles.)	100mm (RFR vehicles.)	85mm