Specification for Portable Track Geometry Measurement System (For Points &Crossings)

Specification No.- TM/SM/421

Track Machines & Monitoring Directorate

RESEARCH DESIGNS AND STANDARDS ORGANISATION

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1.0 Scope:

This specification covers the functional and technical requirements with testing details of Portable track geometry measurement system, which is used to measure track geometry parameters on Indian railways at plain track as well as on points and crossing. It should be able to measure and record the Track Parameters of all track structures (BG) with 52 Kg / 60 Kg rails under floating conditions on Indian Railways like (a) Gauge (b) Cross Level (c) Twist (d) Unevenness (e) Curvature/Alignment (f) Track Distance in switch, lead and crossing portion for straight track and turnout portion and plain track.

2.0 Reference :

Following manual has been referred to in this specification. Updated copy of latest version with correction slip/amendments of the manual shall be followed.

1.	IRPWM	Indian Railways Permanent Way Manual

2.1 Abbreviations:

RDSO:	Research Designs & Standards Organisation	SRJ:	Stock Rail Joint
CTE:	Chief Track Engineer	JOH:	Junction of Head
SRJ:	Stock Rail Joint	T/out:	Turn-Out
TTS:	Theoretical Toe of Switch	RH:	Right Hand Rail
ATS:	Actual Toe of Switch	LH:	Left Hand Rail
SEA:	Switch Entry Angle or Switch Angle	G:	Gauge
TNC:	Theoretical Nose of Crossing	XL:	Cross-Level
ANC:	Actual Nose of Crossing	V:	Versine

3.0 Materials, Processing and Workmanship:

3.1. Portable Track Geometry Measurement System shall be a compact, lightweight and easy to carry trolley like device.

3.2.PTGMS should be supplied with a display unit (min. 12inch screen) having in-built software which is able to record following items compare with permissible value for concerned items marked as *as per IRPWM (Latest Version). It should be able to display the value in red color which is beyond permissible limits. The software/system should have the provision for feeding the permissible values for Indian condition for various parameters to be measured by PTGMS (P&C). System should have the facility to inter the station code, Turn-out No., Curve No., Level crossing No. and Hectometer Post. It should also be possible to type Switch (Normal/Thick Web) and type of Crossing (Built-Up or CMS or Heat treated welded etc.). System should have provisions to record name and designation of the inspecting official.

3.2.1 General Details:

Section/Station:		Point No.:		
Location:		Rail Section:		
Type of Sleepers/Assembly:		Angle of crossing:		
Nominal Gauge of T/out:		Left Hand or Right Hand:		
Laid on Straight or on curve of Radius		Similar/Contrary Flexure:		
Date of laying sleepers (mm/yyyy)		Type of crossing:		
Details of Deep screening:	1st	2nd	3rd	4th
Date (mm/yyyy):				
Manual /Mechanised				
Details of laying new/ reconditioned Crossing	1st	2nd	3rd	4th
(mm/yyyy):				
Crossing Unique No.:				
Manufacture:				
Details of Laying new/ Reconditioned switch	1st	2nd	3rd	4th
(mm/yyyy):				
LH:				
RH:				

3.2.2 Inspection of Point and Crossing -

a) Visual Observation:

I) General:

Condition of ballast and drainage in turnout. (clean cushion to be measured only once in a year)		

II) Switch Assembly and Lead:

1. Condition of sleepers, slide chairs, plate screws, heel and distance blocks, other fittings of switch including tightness of bolts etc.		
1. Condition of Tongue Rails: a) Whether chipped or cracked over 200 mm length within 1000 mm from ATS.	LH	RH

b) Whether Twisted or bent (Causing gap of 5 mm or more at toe)		
c) Remarks over condition of tongue rail, whether it requires reconditioning or replacement		
2. Condition of stock rail, burr formation to be mentioned specifically.	LH	RH
3. Creep and squareness of tongue rail at toe of switch.	LH	RH
4. Straightness of straight stock rail if laid on straight (measured on 7.5 m chord)	LH	RH
5. Packing conditions under the switch assembly (preferably to be observed under traffic)	LH	RH
6. Housing of stock and tongue rails.		
7. Working of SSD (if provided)		

III) Crossing Assembly:

1) Condition of crossing: a) Sign of propagation of crack (if any) in crossing assembly.	
b) Burring on top surface at nose.	
c) In case of Heat treated welded crossing, weld texture on top surface. If any flow or separation of weld portion.	
d) Tightness of bolts at CI/distance block at toe, heel, and nose of crossing as applicable.	
e) Condition of gapless joint.	
2) Condition of check rail fitting i.e. bearing plates, keys, blocks, bolts and elastic fastenings.	
3) Availability of 150 mm additional ballast shoulder width on outside of turn-in curve.	

IV) General:

Any other special feature/defects:	

3.3 Measurement by PTGMS (P&C):

3.3.1 Inspection of Turn-Out: The system should be able to measure the following items on its own and the data should be having portability facility to be integrated with the details in para 3.2.1 & 3.2.2 so as to generate report as per format in Annexure I. All the parameters should be measured in millimeter.

1. Throw of Switch: *	LH			RH			
2. Gap b/w top edge of leading stretcher bar and bottom of rail foot*	LH			RH			
3. Gauge and cross level in switch &Lead: *	G	XL		G	XL		
a) At 450 mm ahead of Toe of Switch.							
b) At ATS between two stock rails.							
c) Gauge and cross levels for ML and T/outside. Versine of stock rail for Turn Out side upto end of lead. ATS/HEEL *Note: 1) Station no. 0 to be marked at heel of switch for straight switch and ATS for curved switches. Subsequent stations shall be marked at every 3 m Versines to be recorded on 6 m chord length commencing from station no.1. 2) Versine reading shall be taken for turnout side except for symmetrical split turnout where it shall be taken on mainline side. 3) In case of gap between T/R and S/R, that should be added to gauge measurement.*	Station No.	Main Line			T/out		
		G	XL	V	G	XL	V
	0.						
	1.						
	2.						
	3.						
	4.						
	5.						
	6.						
	7.						
	8.						
	9.						
	10.						
	11.						
	12.						
	13.						
	….						
4.Wear of crossing (to be measured with Straight edge at 100 mm from ANC) * For CMS crossing; * actual wear for 52 kg section = measured wear (gap) - 2 mm, & actual wear for 60 kg section = measured wear (gap) - 2.5 mm.	LH wing rail		Nose		RH wing rail		
5. Gauge and Cross level at crossing*	Main Line				T/out		

	G	XL	G	XL
a) 1 m ahead of ANC				
b) 150 mm behind ANC				
c) 1 m behind ANC				
6. Clearance of check rails*	LH		RH	
a)Opposite ANC.				
b) At 1st block towards toe of crossing & 1st block towards heel of crossing.				
c) At the flared end towards heel& at the flared end towards toe.				
7. Clearance of wing Rail (Only for Built-up crossing): *	LH		RH	

8. Turn in Curve: Turn in curve - stations to be marked at3 m interval. Versines to be measured on 6 m chord. Station no. 0 to be marked at the centre of last long sleeper in case of PSC sleepers otherwise at heel of crossing.	Station No.	V	G	XL
	0.			
	1.			
	2.			
	3.			
	4.			
	…..			

Note: Gauge should be reported as variation from nominal gauge of 1676 mm with excess from nominal gauge being shown as '+' and shortage from nominal gauge as '-'.

3.3.2 Inspection on Curve: System shall be able to measure three stations before starting of curve and three stations after end the curve. System shall be able to record/ report following parameters in curve track. System shall be able to measure succession on curves of Left and right hands and different degree in a continuous way without interruption/ rotating the trolley.

SN	Station No.	*Gauge (mm)	Cross-level (mm)	Unevenness (mm)	Versine (mm)	*Twist (mm)
1.	**A**					
2.	**B**					
3.	**C**					
4.	**0**					
5.	**1**					
6.	**2**					
7.	**3**					
8.	**4**					
9.	**…**					
10.	**X**					
11.	**Y**					
….	**Z**					

3.3.3 Inspection on Straight track**:** System shall be able to record following parameters in straight track. Alignment and unevenness shall be recorded on user selectable chord in the range of 2 m to 20 m. The initial measurement shall be based on inertial principle.

SN	Station No.	*Gauge (mm)	Cross-level (mm)	Unevenness (mm)	Alignment (mm)	*Twist (mm)
1.						
2.						
3.						
4.						
5.						
….						

3.4.PTGMS should be able to integrate details of para3.2 with 3.3 so as to generate report as per Annexure I. It should also compare it with permissible value for concerned items marked * and undesirable data falling outside permissible limits shall be marked in red ink in printout.

3.5. The system shall be capable of track geometry measurement. There should be provision to record/ report the Twist on user selectable base from 2 m to 20m at sampling interval.

3.6. The System shall have the facility of recording, storing and transferring Data. The on-board system shall have a capacity (Nonvolatile memory) to record and store track parameters for at least 100 no. of turn-outs and 100 kms.

3.7. The device shall also be capable of recording and storing the locations of turnout. An odometer shall be available to record distance.

3.8. System Data shall be stored in CSV/ASCII format which is compatible for use in Track Management System (TMS) software being used in Indian Railways.

3.9. System should be mounted on a light weight framed structure which can be split in main parts and assemble easily within 15 minutes so as to be handled by max two persons and kept off track during any approaching train. Total weight of the system shall not be more than 36 kg max.

3.10. It should be insulated to work without interfering with signaling equipment and also work in electrified sections. The track recording system and its accuracy of measurement shall not be affected in any manner due to the induction effect of the electric traction and signaling systems.

3.11. Rechargeable battery/ hot swappable batteries shall be used as power source for operation of the system. The battery shall have sufficient capacity for continuous working of at least 06 hrs. An additional battery should also be provided at the time of supply.

3.12. The system shall be compact and robust and capable of working continuously during the severe Indian atmospheric and climatic conditions. It shall also be water resistant and dust proof for functioning in harsh environment of dust, vibration, shock, rain, wind and fog, which are normally encountered on Indian Railways. The complete system shall be at least IP 67.

3.13. The system shall be capable of recording as set into motion up to 05 km/h.

3.14. Sampling distance/ measurement interval of the system should be user selectable of 0.05 m for turn-out and 0.25m for straight/curved track. Reporting/exporting interval can be

decided by user. However, the sampling interval shall not be changed during measurement.

3.15. Facility to suspend/ pause the recording at marked location and again restarting from same location shall be available so that system trolley can be removed from track on arrival of train on the same path. The system should also have the flexibility for intermittent recording i.e for closing the work at a particular location/time and re-starting from the same location at a different time.

3.16. The system should have the facility for recording and storage of various track features and track defects along with their locations through keyboard entry by operator during recording. The track features to be recorded along with track geometry parameters are at least: Kilometer/Hectometer post (KM/HM),Points & Crossing (P&C), Rail fracture, Missing ERC, Missing Rubber pad, Missing Liner, Missing Fish plate, Loose bolts, Broken Rail, Broken Sleeper. Other required features are tabulated below: (Please see Annexure 3.16)

3.17. The system must have the provisions to transfer the measured data from Portable Track Geometry Measurement System (P&C) to associated laptop where the integrated measurement shall be processed. These integrated data should be portable to any computer. The measurement data files shall be.password-protected.

3.18. The system must have the provisions to generate off-line report & output on different user-selectable chord lengths from 2m to 20m at sampling interval.

3.19. System shall have the facility for calibration of odometer and sensor along with continuous monitoring of odometer and sensor signals to ensure reliable recording of parameter.

3.20. Display of the data on the screen should be clearly visible with naked eyes in direct sunlight.

3.21. Height of the display above rail-head shall be adjustable within the range between 1.0 m to 1.5 m.

4.0 Technical Features:

Range and accuracy of the system shall be as under:

SN	Parameter	Chord	Range	Accuracy
i.	Unevenness	User selectable	±50 mm	±1.0mm on 10 m chord
ii.	Alignment (measured 14 mm below rail table)	User selectable	± 200mm	±1.0mm on 10 m chord(for straight track)
				±1.0mm on 20 m chord(for curved track)
iii.	Twist	User selectable	----	------
iv.	Gauge (measured 14 mm below rail table)	_____	-25 to + 50 mm	+1.0 mm
v.	Cross level	_____	± 250mm	±1.0mm

vi.	Check rail clearance/ Throw of Switch	_____	35 mm to 200 mm	±1.0mm
vii.	Wear	_____	_____	±1.0mm

5.0 Tests: Following tests shall be carried out in sequence.

5.1 Visual & Dimensional check:

The device shall be checked visually and dimensionally. The device shall be free from all visual defects in material, construction and fabrication. The weight of system device including battery shall also be taken and recorded by the Inspecting officer.

5.2 System Functionality Test: The data should meet the accuracy requirements and other parameters as given in para4.0 for technical features. More than 95% measured parameters should fall within the accuracy levels given in the para 4.0.The system shall be checked for its performance in the following manner:

a) Turn-out: Two no. of turn-outs should be measured and parameters recorded. The measured data shall be compared with the data recorded manually separately viz. Gauge and cross-level shall be measured by Gauge cum Level in lead portion of turn-outs, versines shall be measured at 6m chord length. Wear in crossing shall be measured using wear measuring tool. Gaps at check rails, throw of switch will be measured using scale.

b) Curve: At least two curves of length exceeding 500m and 0.5 degree shall be measured with the system. The measured data shall be compared with the data recorded manually. Gauge and cross level shall be measured by Gauge cum Level. Alignment and unevenness shall be measured on standard chord length of 20.0m using string.

c) Straight: At least 500m of straight track shall be measured. The measured data shall be compared with the data recorded manually separately viz. Gauge and cross-level shall be measured by Gauge cum Level and Alignment shall be measured at the 10m chord length.

5.3 Test for compatibility of recorded data:

It should be compatible with Track Management System(TMS).The system should have the facility to upload the recorded data for turnouts, straight track, curves etc. directly on TMS.The TMS data format is CSV/ASCII.

5.4 Environmental Tests:

The firm shall submit the test certificates from NABL accredited laboratory/certificate or an equivalent for foreign firms/OEM's for such tests to be conducted in-house by manufacturer for following:

a) Dry heat test b) Cold test

a) Dry heat test: This test is intended to determine suitability of the device to withstand high temperature severities prevailing in hot days of summer. This test shall be conducted as specified in IS: 9000 (Part III/Section 3) at the following severity:

Temperature	+ 40±2^0 C
Duration	4 hrs.

b) Cold test: This test is intended to determine the suitability of the device at the specified low temperature likely to be encountered in coldest days of winter.

The test shall be conducted as specified in IS: 9000 (Part-II/ sec 3) at the following severity:

Temperature	+5±3^0 C
Duration	4 hrs.

6.0 Acceptance test :

Inspecting authority shall carry out acceptance test on all the equipment /subunits. The following shall comprise the acceptance test:

6.1 Maker's test certificate for the outsourced items:

a) Test certificate for odometer.
b) License of windows operating system
c) License of Antivirus software of reputed supplier with 24 months subscription.

6.2 Visual Inspection(As per clause 5.1.1):

i) General Workmanship:
ii) Portability, compactness, Lightweight of system
iii) Indications and displays
iv) Mounting, fitment and clamping of connectors
v) Painting, labeling and marking

6.3System level Functionality Test: It shall be carried out as per clause 5.2.

7.0 Inspection:

7.1 The inspection of machine during procurement as per para 6.0 shall be carried out by RDSO.This inspection will be conducted in the presence of firm's authorized representative Minimum level of inspecting official shall be SSE/SSRE.

7.2 Each machine shall be inspected for its acceptance as mentioned in clause no. 6.0. If the samples satisfy all the tests prescribed as per acceptance criteria, the machine is acceptable.

7.3 After the machines have been supplied at consignee's end, the supply shall be considered as complete only after conducting training on operation etc. within four weeks of supply provided by the manufacturer /supplier as per clause 8.0.

8.0 Training and Commissioning:

Supplier should provide training to Railway officials for three days at consignee's end in operation, trouble-shooting and precaution during handling of the system on site. It shall include both hardware and software training which is required for the smooth operation and maintenance of the system. A video presentation regarding (a) basic features (b) operation of

system (c) trouble-shooting (d) precaution during handling and operation should be supplied in English language with sub-title language in Hindi/English.

9.0 Documentation:

9.1 Operation, maintenance, trouble shooting and training manuals shall be prepared in sufficient detail to the satisfaction of purchaser and supplied in three copies each. However, calibration will be carried out by the supplier after 1 year of commissioning by deploying specially trained staff and whenever demanded by the consignee within warranty period.

9.2 Installable version of Software shall be provided on magnetic media such as in CD or zip disk or pen drive etc.

10.0 Service Facility:

10.1 Spare Parts: An additional Data Transfer Module unit(Pen Drive /Data Transfer cable etc.)and battery shall be supplied with the system so that even during warranty period in case of malfunction of these parts system can be made functional immediately.

10.2 Tools: All tools including measuring equipment required for normal maintenance should be supplied as complete kit in one set. The list of such tools and equipment proposed to be supplied with system shall be furnished as part of technical details of offer.

11.0 Warranty

11.1 The contractor shall ensure that the system supplied including all parts, components etc. used is free from defects and faults in design, material, workmanship and shall be of highest quality and in conformity with the contract specifications.

11.2 . The warranty shall expire 24 (twenty four) months from the date of acceptance i.e. from the date of issue of commissioning certificate by the purchaser/consignee for the system except in respect of complaints, which are lodged before the expiry of the 24 months.

11.3 The supplier shall be required to supply and install free of cost all the equipment, components, PCB cards, ICs , cables transducers, connectors, spares and consumables which may fail, malfunction, become defective or required for uninterrupted working of system during the currency of Warranty period except external battery(s) in display unit and / or system. However, manufacturer's warranty will be applicable for external batteries.

11.4 The supplier shall also keep adequate stock of such components, spares consumables and modules, which are critical and may require repairs/ replacement from time to time for ensuring uninterrupted working of the system during the warranty period.

12.0 Marking:

Each machine shall be legibly and indelibly marked with the following details:

a) Name and trade mark of the manufacturer.
b) Year and month of manufacturing.
c) Contact details of Manufacturer/ Supplier

d) Date of supply- The warranty period should be calculated from the date of supply/commissioning of the machine whichever is later.
e) Warranty period of such machine should be at least 02 years.
f) Alphanumeric code and of machine exhibiting important features/Specification should be engraved or marked on a plate bolted on.

13.0 Packaging:

System shall be enclosed in a wooden carton / suitable box and care shall be taken during transportation so that no moisture can percolate into the wooden/card board boxes and the functioning do not get hamper due to mishandling.

14.0 Manufacturers/suppliers have sole responsibility to maintain quality of products supplied to Railways.

15.0 PREFERENCE TO MAKE IN INDIA POLICY:

Compliance of the instructions contained in public procurement (Preference to Make in India) order 2017 shall be ensured.

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Annexure 3.16

Bridge (Start)-	Level Crossing (LC) In	Joggle Fish Plate
Bridge (End)	Level Crossing (LC) Out	Missing fastening
Broken Sleeper	Points & Crossing (P&C)	OHE Mast (OHEM) Location
Curve-IN	Switch Expansion Joint (SEJ)	Dipped Welds
Curve out	Broken Rail	Missing Rubber Pad
Missing Liner	Missing Fish Plate	

Annexure I

PROFORMA FOR INSPECTION OF POINTS AND CROSSINGS

Station:		Point No.:	
Location:		Rail Section:	
Type of Sleepers/Assembly:		Angle of crossing:	
Nominal Gauge of T/out:		Left Hand or Right Hand:	
Laid on Straight or on curve of Radius		Similar/Contrary Flexure:	
Date of laying sleepers (mm/yyyy)		Type of crossing:	

Details of Deep screening:	1st	2nd	3rd	4th
Date (mm/yyyy):				
Manual /Mechanised				
Details of laying new/ reconditioned Crossing	1st	2nd	3rd	4th
(mm/yyyy):				
Crossing Unique No.:				
Manufacture:				
Details of Laying new/ Reconditioned switch	1st	2nd	3rd	4th
(mm/yyyy):				
LH:				
RH:				

Particulars	Details of Inspection	Action taken with date and sign	Details of Inspection	Action taken with date and sign
1	2	3	4	5
I) General:	Date of Inspection		Date of Inspection	
1) Condition of ballast and drainage in turnout. (clean cushion to be measured only once in a year)				
II) Switch Assembly and Lead:				
2) Condition of sleepers, slide chairs, plate screws, heel and distance blocks, other fittings of switch including tightness of bolts etc.				

3) Condition of Tongue Rails:

   a) Whether chipped or cracked over 200 mm length within 1000 mm from ATS.

   b) Whether Twisted or bent (Causing gap of 5 mm or more at toe)

   c) Remarks over condition of tongue rail, whether it requires reconditioning or replacement.

4) Condition of stock rail, burr formation to be mentioned specifically.

5) Creep and squareness of tongue rail at toe of switch.

6) Straightness of straight stock rail if laid on straight (measured on 7.5 m chord)

7) Packing conditions under the switch assembly (preferably to be observed under traffic)

LH	RH	Action taken	LH	RH	Action taken

8) Throw of Switch:

9) Housing of stock and tongue rails.

10) Gap between top edge of leading stretcher bar and bottom of rail foot.

11) Working of SSD (if provided)

LH	RH	Action taken	LH	RH	Action taken

12) Gauge and cross level in switch & Lead:

   a) At 450 mm ahead of Toe of Switch.

   b) At ATS between two stock rails.

   c) Gauge and cross levels for ML and T/out side. Versine of stock rail for Turn Out side upto end of lead.

ATS/HEEL

Gauge	XL	G	XL

Station No.	Main Line			T/out		
	G	XL	V	G	XL	V
0						
1						
2						
...						

Note: 1) Station no. 0 to be marked at heel of switch for straight switch and ATS for curved switches. Subsequent stations shall be marked at every 3 m Versines to be recorded on 6 m chord length commencing from station no.1.

2) Versine reading shall be taken for turnout side except for symmetrical split turnout where it shall be taken on mainline side.

3) In case of gap between T/R and S/R, that should be added to gauge measurement.

III) Crossing Assembly:

13) Condition of crossing:

a) Sign of propagation of crack (if any) in crossing assembly.

b) Burring on top surface at nose.

c) In case of Heat treated welded crossing, weld texture on top surface. If any flow or separation of weld portion.

d) Tightness of bolts at CI/distance block at toe, heel, and nose of crossing as applicable.

e) condition of gapless joint.

14) Wear of crossing (to be measured with Straight edge at 100 mm from ANC)

For CMS crossing;
actual wear for 52 kg section = measured wear - 2 mm, &
actual wear for 60 kg section = measured wear - 2.5 mm.

LH wing rail	Nose	RH wing rail

15) Gauge and Cross level at crossing

a) 1 m ahead of ANC

b) 150 mm behind ANC

c) 1 m behind ANC

Main Line		T/out	
G	XL	G	XL

16) Condition of check rail fitting i.e. bearing plates, keys, blocks, bolts and elastic fastenings.

LH	RH	Action taken	LH	RH	Action taken

17) Clearance of check rails:

a) Opposite ANC

b) AT 1st block towards toe of crossing & 1st block towards heel of crossing.

c) At the flared end towards heel & at the flared end towards toe

18) Clearance of wing Rail (Only for Built-up crossing):

LH	RH	Action taken	LH	RH	Action taken

IV) Turn In Curve:

19) Turn in curve - stations to be marked at 3 m interval. Versines to be measured on 6 m chord. Station no. 0 to be marked at the centre of last long sleeper in case of PSC sleepers otherwise at heel of crossing.

St. No.	V	G	XL		St. No.	V	G	XL
0								
1								
2								
3								
4								
...								

20) Availability of 150 mm additional ballast shoulder width on out side of turn-in curve.

V) General:

21) Any other special feature/defects:

22) Signature of the inspection official with date.

(*Note– Locations where the gauge and cross levels are to be checked should be painted on the web of the rail.*)

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