Iarnród Éireann

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CCE DEPARTMENT

TECHNICAL SPECIFICATION

CCE-TRK-SPN-010
Specification for Movement Monitoring of Railway Track

This CCE Department Technical Specification sets out the requirements for monitoring movements in railway track.

This CCE Department Technical Document is mandatory.

The principles in this Technical Specification are approved by the Head of Department and therefore constitute mandatory standard practices, which apply throughout the CCE Department.

Signed E Ballance **Chief Civil Engineer**

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1 Scope and Principles

1.1 Scope

1.1.1 This specification sets out the requirements that must be met by third parties or others in relation to monitoring tracks for possible settlement arising from works adjacent to the railway.

1.2 Principles

1.2.1 Monitoring is carried out at locations where the Senior Track & Structures Engineer (STSE) deems it necessary.

1.2.2 In the case of third party works:

1.2.2.1 An independent specialist survey company must be engaged by the third party to carry out the track monitoring surveys

1.2.2.2 This specification must be read in conjunction with I-DEP-0120 Guidance on Third Party Works

1.2.2.3 The STSE may appoint an Iarnród Éireann Designated Representative as described in I-DEP-0120 for the supervision of movement monitoring

1.2.3 In the case of Iarnród Éireann and other works:

1.2.3.1 This standard may be used as directed by the STSE where such works are likely to cause track movement

1.2.3.2 The STSE may direct that an independent specialist survey company be used

1.2.4 This specification replaces I-DEP-0123 which has now been withdrawn.

2 Specification Details

2.1 Equipment

2.1.1 The equipment used may be of an optical survey type with readings taken using an optical survey instrument to observe the levels of rail-mounted targets.

2.1.2 The equipment may alternatively involve an electronic track monitoring system, using rail-mounted sensors that transmit via radio signals to a nearby base station.

2.1.3 Details of the proposed monitoring system must be submitted to the STSE / Iarnród Éireann (IÉ) Designated Representative, as appropriate, for approval.

2.1.4 The proposed monitoring system must minimise the risk to railway operations as well as track surveyors. It must be possible to undertake the survey remote from the track. Viewing of survey targets must be from a position away from the track and the survey position must be securely fenced off to allow the survey measurements to be taken without the need for attendance by IÉ protection staff.

2.2 Establishment and Maintenance of Survey Points and Survey Control Points

2.2.1 Survey points and survey control points for monitoring railway track levels must be established before any construction works are carried out adjacent to the railway. For the purposes of this specification, 'adjacent to the railway' is defined as working within 3.0 m of the nearest rail or within the track support zone (see Appendix A).

2.2.2 At least 2 weeks of readings are required in advance of construction activities to establish baseline readings. Readings must be taken during the construction period and during the maintenance period thereafter.

2.2.3 It may be necessary to install the targets or sensors during a track possession.

2.2.4 Prior to any works, a method statement must be prepared and submitted (third parties should refer to I-DEP-0120, Appendix E, for guidelines), along with a location plan showing the numbering system and location of all survey points and survey control points. The method statement must describe how the targets or sensors are to be secured to the rails.

2.2.5 The method statement must contain all relevant IÉ contact details including emergency numbers. These numbers will be provided by IÉ on request.

2.2.6 The method statement must define the actions to be taken if/when limiting track geometry criteria are reached (i.e. the green, amber and red trigger levels). See Appendix B for these limiting criteria.

2.2.7 Where necessary due to site conditions, the limiting criteria set out in Appendix B may be reassessed by the STSE or, for third party works, by the IÉ Designated Representative in conjunction/agreement with the relevant STSE.

2.2.8 The survey points must be set up as follows:

2.2.8.1 Permanent station targets or sensors for the survey points must be located at 3.0 m intervals along each rail.

2.2.8.2 Pairs of targets or sensors must be set up at right angles to the centreline of the track.

2.2.8.3 The survey points must extend along the railway for the full extent of the anticipated area of influence of the works plus 24.0 m (8 stations) minimum beyond at each end, or as required by IÉ.

2.2.8.4 The targets or sensors must be securely fixed to the rail, but must not interfere with the passage of trains. No rail may be drilled or marked in any way by the fixing of such targets or sensors. No target may protrude above the height of the plane of the top of the rails.

2.2.8.5 The design of the targets or sensors must be such that they are not susceptible to vibration from passing trains, vandalism and the like.

2.2.8.6 Each target or sensor must be permanently and uniquely labelled with an identifying number which is to be used in reports.

2.2.8.7 The level of each target or sensor must be related to the level of the top of the rail, as all target readings must be converted to give a top of rail level from which twist and top measurements are calculated.

2.2.9 In surveys undertaken by independent specialist survey companies, the monitoring of these survey points must be carried out remotely as access to the track area will not be permitted.

2.2.10 A remote tower(s), mound(s) or the like may be required to allow monitoring of the targets. Accuracy of readings is of particular importance, as tolerances are tight, and the monitoring tower, mound, etc. should not be subject to any type of movement.

2.2.11 Baseline surveys must be established as required (e.g. after removal and/or replacement of trackwork or increase in line speed).

2.2.12 At least 3 survey control points must be established for monitoring the levels of the survey points. The location of each survey control point must not be affected by settlement due to construction works or traffic.

2.2.13 The national grid co-ordinates and level (mOD) of each survey control point and survey point and position must be taken prior to commencement of works as above.

2.2.14 The survey points and survey control points must be maintained for the duration of construction and the duration of the maintenance period thereafter. Where any of these points becomes damaged, as may happen through the use of track maintenance machinery, the STSE / IÉ Designated Representative, as appropriate, must be notified and proposals submitted for its repair.

2.3 Monitoring

2.3.1 The minimum track geometry parameters to be measured and monitored are as follows:

2.3.1.1 Short twist (3.0 m baseline).

2.3.1.2 Long twist (15.0 m baseline) between relevant targets/sensors. Note: the baseline for measuring long twist is 16.0 m. However for the purposes of practicality on site, the baseline used is 15.0 m – i.e. a multiple of 3.0 m.

2.3.1.3 Top (6.0 m baseline). Note: the baseline for measuring top is 5.0 m. However for the purposes of practicality on site, the baseline used is 6.0 m – i.e. a multiple of 3.0 m.

2.3.2 The frequency of monitoring is a minimum of once daily, and more frequently if so prescribed by the STSE.

2.4 Reporting

2.4.1 A report of the monitoring results must be e-mailed or faxed on the day that the readings are taken to the STSE / IÉ Designated Representative and/or any other persons as directed by the STSE / IÉ Designated Representative.

2.4.2 The format of the report must be approved by the STSE / IÉ Designated Representative and may not be changed without consent. The minimum content of each report must be as follows:

2.4.2.1 Project title

2.4.2.2 Survey date

2.4.2.3 Instrument calibration check before and after survey at the survey control points as referred to in 2.2.12

2.4.2.4 Target/sensor unique reference number

2.4.2.5 Target/sensor location

2.4.2.6 Level, easting and northing of each target/sensor

2.4.2.7 Rail level versus previous surveys, and trends to be highlighted

2.4.2.8 Short twist (3.0 m baseline)

2.4.2.9 Long twist (15.0 m baseline)

2.4.2.10 Top (6.0 m baseline)

2.4.2.11 Green, amber and red geometric limit criteria to be highlighted

2.5 Generic Actions to be Taken Following Readings

Note: These actions may be amended by the STSE to suit the specific circumstances of the works to which they apply.

2.5.1 All Green Reading

2.5.1.1 A report must be issued to the STSE / IÉ Designated Representative, and/or any other persons as directed by the STSE / IÉ Designated Representative.

2.5.1.2 The report should clearly state 'ALL GREEN'.

2.5.2 An Amber Reading or Readings

2.5.2.1 Verbal contact must be made immediately with the STSE / IÉ Designated Representative for instruction. It is not acceptable to leave messages, send facsimiles or e-mails etc.

2.5.2.2 If the STSE / IÉ Designated Representative cannot be immediately contacted, verbal contact must be made with the other IÉ emergency contacts set out in the method statement.

2.5.2.3 In relation to third party works, the IÉ Designated Representative must, in turn, contact the STSE by the first available means.

2.5.2.4 Monitoring of all targets or sensors must be continued until further instruction.

2.5.3 A Red Reading or Readings

2.5.3.1 All operations must be suspended immediately and immediate verbal contact made with the STSE / IÉ Designated Representative for instruction. It is not acceptable to leave messages, send facsimiles or e-mails, etc.

2.5.3.2 If the STSE / IÉ Designated Representative cannot be immediately contacted, verbal contact must be made with the other IÉ emergency contacts set out in the method statement.

2.5.3.3 In relation to third party works, the IÉ Designated Representative must, in turn, contact the STSE by the first available means.

2.5.3.4 IÉ will carry out remedial works as necessary.

2.5.3.5 Monitoring of all survey points must be continuous until further instruction.

2.5.3.6 All works must remain suspended until the STSE has confirmed that they may recommence.

2.6 Sample Template

2.6.1 A sample monitoring table is included in Appendix C. This table indicates when the limiting track geometry criteria are reached for different trigger action levels (red, amber and green). The limiting criteria are set out in Appendix B.

2.6.2 On request, the monitoring table is issued in electronic format as an Excel worksheet for use by third parties or others. It automatically calculates twist and top values based on the readings entered. All measurements must relate to the top of rail level and pairs of readings must be taken at right angles to the track centreline:

2.6.2.1 Short twist is defined as the difference in cant over a 3.0 m baseline

2.6.2.2 Long twist is defined as the difference in cant over a 15.0 m baseline (see 2.3.1.2)

2.6.2.3 Top is defined as the difference in rail level between the mid-point and end points over a 6.0 m baseline (see 2.3.1.3)

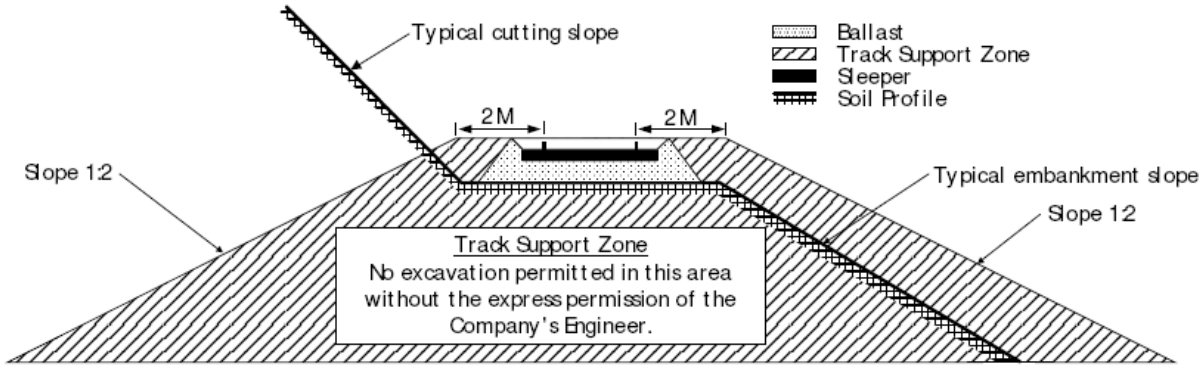
3 Revision History

Version No and Date	Section No and Reason for Change
1.0	First issue. This document replaces I-DEP-0123 which is now withdrawn.

End of Specification

Appendix A Track Support Zone

Figure: Track Support Zone



Appendix B Limiting Track Geometry Criteria

LIMITING CRITERIA FOR SHORT TWIST (3.0 m baseline)	
Short Twist <1 in 500	Green
Short Twist between 1 in 500 and 1 in 250	Amber
Short Twist >1 in 250	Red

LIMITING CRITERIA FOR LONG TWIST (15.0 m baseline)	
Long Twist <1 in 800	Green
Long Twist between 1 in 400 and 1 in 800	Amber
Long Twist >1 in 400	Red

LIMITING CRITERIA FOR TOP (6.0 m baseline)	
Difference in Top <7.5 mm over 6000 mm	Green
Difference in Top between 7.5 mm and 10 mm over 6000 mm	Amber
Difference in Top >10 mm over 6000 mm	Red

Appendix C Track Monitoring Template

											Abs. Value	Abs. Value
Ref No.	Reduced Level at target on Up Rail	Difference in height between target and top of Up Rail	Reduced level at top of Up Rail	Ref No.	Reduced Level at target on Down Rail	Difference in height between target and top of Down Rail	Reduced level at top of Down Rail	Top at Up Rail mm	Top at Down Rail mm	Cant [mm]	Short Twist 3.0m Baseline	Long Twist 15m Baseline
											Twist	Warp
1	98.788	0.078	98.866	2	98.780	0.082	98.862			4		
3	98.805	0.078	98.883	4	98.795	0.082	98.877	-2	-1	6	1500	
5	98.818	0.078	98.896	6	98.809	0.081	98.890	-2	-2	6	105553116266496	
7	98.826	0.078	98.904	8	98.818	0.082	98.900	2	1	4	1500	
9	98.838	0.078	98.916	10	98.829	0.082	98.911	1	-1	5	3000	
11	98.852	0.078	98.930	12	98.839	0.082	98.921	-8	-1	9	750	3000
13	98.851	0.077	98.928	14	98.845	0.083	98.928	7	-1	0	333	2500
15	98.862	0.078	98.940	16	98.851	0.082	98.933	0	7	7	429	15000
17	98.874	0.079	98.953	18	98.869	0.083	98.952	-1	-3	1	500	5000
19	98.886	0.078	98.964	20	98.882	0.083	98.965	2	1	-1	1500	2500
21	98.902	0.077	98.979	22	98.899	0.082	98.981	5	-6	-2	3000	1364
23	98.927	0.078	99.005	24	98.902	0.082	98.984	-12	11	21	130	714
25	98.926	0.081	99.007	26	98.928	0.081	99.009	7	-4	-2	130	1667
27	98.946	0.078	99.024	28	98.943	0.083	99.026	-1	-3	-2	99999	5000
29	98.963	0.076	99.039	30	98.956	0.081	99.037	0	1	2	750	5000
31	98.975	0.079	99.054	32	98.970	0.081	99.051	-7	-1	3	3000	3000
33	98.978	0.078	99.056	34	98.982	0.081	99.063	11	2	-7	300	536
35	99.002	0.079	99.081	36	98.997	0.082	99.079	-7	-1	2	333	3750
37	99.014	0.078	99.092	38	99.011	0.081	99.092	0	1	0	1500	7500
39	99.024	0.079	99.103	40	99.023	0.083	99.106	-1	-2	-3	1000	3000
41	99.033	0.078	99.111	42	99.034	0.081	99.115	-3	-4	-4	3000	2143
43	99.035	0.079	99.114	44	99.036	0.081	99.117	3	4	-3	3000	3750
45	99.043	0.079	99.122	46	99.045	0.081	99.126	-2	-2	-4	3000	2500
47	99.047	0.079	99.126	48	99.048	0.082	99.130	2	2	-4	99999	3750
49	99.056	0.077	99.133	50	99.054	0.083	99.137	0	0	-4	99999	99999
51	99.062	0.078	99.140	52	99.062	0.082	99.144	-1	0	-4	211106232532992	1055531162664960
53	99.068	0.078	99.146	54	99.069	0.081	99.150	-1	-2	-4	211106232532992	99999
55	99.073	0.078	99.151	56	99.071	0.081	99.152	1	4	-1	1000	5000
57	99.079	0.079	99.158	58	99.079	0.083	99.162			-4	1000	99999