

**Part-A: Performance criteria of fastening system for Ballast less track
on Metro Railways/MRTS system
(Compliance to be given, document to be uploaded on Portal as C2.1)**

1. Purpose and Selection:

- 1.1** The performance criteria define the performance standard of fastening system for ballastless track of Metro Railway System. Apart from other things, the fastening system is required to moderate vibration and noise transmitted through the rail and to reduce the track stiffness and the impact on the track structure, so as to obtain the parameters as detailed in the ensuing paragraphs.
- 1.2** A new fastening system, which is fully compliant to performance criteria and not approved by MoR can also be used by Metro Railways/MRTS system as they are free to choose fastening systems for ballastless track complying with this performance criterion. The detail of such fastening system used shall be submitted to MoR and the same shall be kept in observation by MoR for a period of 2 years under service conditions in association of Metro Railways/MRTS system. The Performa for the monitoring performance shall be advised by MoR to concerned Metros Railways/MRTS system. After successful performance for 2 years, Metro Railways/MRTS system shall process for approval of MoR for further use of fastening system.
- 1.3** The fastening system already approved by MOR as per previous performance criteria for ballast less track dated 21.5.2010 will not require fresh clearance as per these revised criteria and any of these systems can be used by Metro/ MRTS systems.
- 1.4** In case Metros Railways/MRTS system opts for a new fastening system for Ballast less track which is not fully compliant to these performance criteria, they will approach MoR for approval before finalizing the use of fastening system.

2. Operating Environment:

Fastening system is expected to perform generally in the following conditions:

- 2.1** Gauge –Broad Gauge –1676/1673 mm (nominal) and standard gauge –1435 mm
- 2.2** Speed potential – 110 kmph (max.)
- 2.3** Rail section – 60E1, 90 UTS/110UTS
- 2.4** Static axle load – BG & SG –20 T (Max)
- 2.5** Design rail temperature range – (-)10 degree Celsius to (+)70 degree Celsius
- 2.6** Curvature and gradient will be specified in SOD.
- 2.7** Rail seat inclination (slope) – 1 in 20

In addition, the client Railway may specify any other operating condition such as support spacing etc.

3. Ballastless Track Structure:

Track shall be laid on cast in situ/pre-cast reinforced plinth or slab, herein after referred to as the ‘track slab’. The track slab shall be designed as plinth beam or slab type ballastless track

structure with derailment guards. The track slab dimensions and the clearance between rail and derailment guard shall be sufficient to accommodate the base plates of the fastening system and to facilitate easy and convenient replacement of the fastening system. The clearance between rail and derailment guard shall be within the range provided in Annexure-C-1.

In general, track slab on which the fastening and rails are to be fitted shall:

- i) Resist the track forces.
- ii) Have adequate edge distance of concrete beyond the anchor bolts to provide resistance against edge failure.
- iii) Provide a level base for uniform transmission of rail forces.
- iv) Have geometrical accuracy and enable installation of track to the tolerances laid down.
- v) Ensure adequate drainage
- vi) Resist weathering
- vii) Be construction friendly, maintainable and quickly repairable in the event of a derailment. The 'Repair and Maintenance methods' shall be detailed in the 'Track Maintenance Manual' to be prepared and made available before the line or a portion of a line is opened for traffic.
- viii) Ensure provision for electrical continuity between consecutive plinths/slabs by an appropriate design.

4. Performance Requirement of Fastening System:

4.1 General

- i) The fastening system shall be designed to hold the two rails of the track strongly to the supporting structure in upright position by resisting the vertical, lateral and longitudinal forces (including thermal forces) and vibrations.
- ii) The fastening shall be with a proven track record. The fastening system should have satisfactory performance record of minimum three years in service in regular revenue operation on ballastless track on any two different established railway systems (except exclusive freight tracks) for a length of at least 5 km in each metro having speed potential of at least 80 kmph & design axle load 16 T irrespective of wheel profile and rail section. In this regard, supplier should submit certificate of performance from user railways administration including proof of use of the fastening system. The supplier has also to submit a certificate that the components of fastening assembly are having same material and specification in case the proven system is having different rail section and wheel profile along with details of test results as per test plan of Table 1.

Note: For any metro system having design axle load <16T, the above criteria shall be applicable for the axle load for which the metro system is designed."

- iii) The fastening shall provide insulation to take care of return current of traction system.
- iv) Fastening should satisfy the required performance norms as stated in para 4.2, 4.3, 4.4, 4.5 & 4.6.

4.2 Following are the technical performance requirements of fastenings:

The Fastening shall

- i) Have design service life of 30 years in general. However, its components such as rubber pad, rail clip etc. can be designed for 300 GMT or 15 years whichever is less. Anchor bolts or studs used for fixing base plate to the concrete should not be required to be replaced during service life. Its components must not suffer any degradation during service life to a degree so as to affect the performance and safety of the track. Full-service life is to be attained under the following conditions:
 - a) Atmospheric ultra violet radiation.
 - b) Proximity of track up to 10 m from salt water source.
 - c) Contact with oil, grease or distillate dropped from track vehicles.
- ii) Permit quick and easy installation and replacement with special tools.
- iii) Be capable of vertical adjustment during service life up to 12 mm using shims.
- iv) Permit the attainment of the following tolerances when installed, and later during service.

S.N.	Parameter	Installation (mm)	Maintenance (mm)
1	Gauge	+2,-1	+4,-2
2	XL on straight track	±1.5	±5
3	SE on curved track	±1.5	±3
4	Vertical alignment over 20m chord	±3	±6
5	Lateral alignment over 20m chord on straight track	±2	±6
6	On curves-variation over the theoretical versine on 20m chord	±2	±5

- 4.3 Anchor bolts/studs used for fixing the bearing plate in concrete shall have splayed ends. Detailed calculations for the number of anchor bolts required on tangent and curved tracks shall be furnished by the supplier and approved by the Metro system.
- 4.4 For all the fastening components as per approved assembly, the supplier shall furnish detail drawings, specifications and inspection & test plan to the Metros. Metros to ensure that components are supplied as per drawings & specifications.
- 4.5 The supplier should furnish the 'Installation and Maintenance Manual' which shall be approved by the Metro system.
- 4.6 Any change in component subsequent to the approval of the fastening system by MoR shall be permitted only for specific requirement of the metro. MoR approval of such changes shall be processed by metro with specific recommendations enclosing test report of the component / whole assembly with detailed justification.
- 4.7 The rail fastening system shall be tested to the following specifications (Table 1) for different technical parameters and should meet the acceptance criteria as mentioned in the

following table. Test report of the reputed independent institute / laboratory will have to be submitted. The testing is to be done for Cat B as specified in EN-13481- Part-I 2012 & EN-13481-5 :2012 with rail section to be used in proposed system if other design particulars are meeting the requirement of Cat-B.

Table-1

Test Plan for Fastening system (bonded & non bonded) for Ballastless Track

(As per provisions of latest EN 13481-1:2012 & EN 13481-5:2012)

S.N.	Technical Parameters	Test Method	Acceptance criteria	Remarks
1	Longitudinal rail restraint	EN-13146-1-2012	7 KN (min)	This has to be tested before repeated load test
2	Vertical static stiffness of complete fastening assembly	EN-13146-4 -2012	35 KN /mm (max)	No sliding, yield or cracking is allowed for the fastener parts.
3	Dynamic/static stiffness ratio	EN 13481-5-2012	1.4 (max)	Ratio is calculated by dividing the dynamic stiffness to static vertical stiffness.
4	Clamping force	EN-13146-7-2012	18 KN (min) Per Rail seat	This has to be tested before repeated load test
5	Electrical resistance	EN-13146-5-2012	5 k Ω (min)	Higher value may be specified if required by Metros for track circuit

6	Effect of severe environmental conditions	EN-13146-6-2012	The fastening assembly shall be capable of being dismantled, without failure of any component & reassembled using manual tools provided for this purpose after exposure to the salt spray test.	-
7	Effect of repeated loading	EN-13146-4-2012	No wear or deformation	-
7A	On Vertical static stiffness	EN-13146-4-2012	Variation \leq 25% of the initial value	No sign of bond failure/fracture/slippage
7B	On Longitudinal rail restraint	EN-13146-1- 2012	Variation \leq 20% of the initial value	Except the rail and fastener, no sliding, yield or cracking is allowed for fastener parts. Longitudinal load/deformation curve shall fall in the envelope of upper and lower limit which is to be submitted along with the report.
7C	On Clamping force	EN-13146-7-2012	Variation \leq 20% of the initial value	-

Note: In case the acceptance criteria in the latest version of EN Code is different from the values mentioned in Table-1 above, the acceptance criteria shall be as per the latest revision in EN Code.

Part B : Salient features of Fastening system (document to be uploaded on Portal as C2.2)

S. N.	Components / Items	Provisions in Metro
1.	Brief description of fastening system	
2	Axle load	
3	Speed potential	
4	Drawing and their numbers	
5	Specifications and their numbers	
6	Any variation for straight and curve portion? If yes, give details.	
7	Vertical stiffness of complete fastening system	
8	Service life of fastening system.	
9	Reference of Railway Board's approval for proposed fastening system.	

Part C: Checklist of submissions (document to be uploaded on Portal as C2.3)

SN	Document Number	Document Name	
1	C 2.3.1	Compliance of Part - A	
2	C2.3.2	Sets of drawings (two numbers)	
3	C 2.3.3	Performance record of fastening system	
4	C2.3.4	Test report of fastening system.	

ASAD
MUSTAFA
RIZVI

Digitally signed by
ASAD MUSTAFA
RIZVI
Date: 2021.08.19
11:56:14 +05'30'

Revised draft Annexure -C2 of Metro manual is put up to competent authority for perusal, modification and approval as found suitable.

Manoj
Kumar
Singh

Digitally signed by
Manoj Kumar
Singh
Date: 2021.08.17
17:23:29 +05'30'

RAHUL
SHAH

Digitally signed
by RAHUL SHAH
Date: 2021.08.17
17:41:39 +05'30'

DEEPAK
DWIVEDI

Digitally signed by
DEEPAK DWIVEDI
Date: 2021.08.13
17:35:23 +05'30'

SACHIN
VERMA

Digitally signed by
SACHIN VERMA
Date: 2021.08.23
15:40:14 +05'30'

HIRENDRA
KUMAR
RAGHU

Digitally signed by
HIRENDRA KUMAR
RAGHU
Date: 2021.09.10
10:23:52 +05'30'