

**GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS
(RAILWAY BOARD)**

2019/Proj./MEGA/C-1/30/01

New Delhi, dated 02.5.2024

Managing Director,
Gujarat Metro Rail Corporation Limited,
Block No.1, 01st Floor, Karmayogi Bhavan,
Behind Nirman Bhavan, Sector 10/A,
Gandhinagar, Gujarat - 382010

Sub: Approval of Fastening System (Annexure C2) for Ahmedabad Metro Phase II of Gujarat Metro Rail Corporation Limited (GMRCL).

Ref: (i) Board's letter No. 98/Proj./DLI/30/1 (Voll.III) dated 24.01.2013

(ii) Fastening System (Annexure C-2) documents alongwith its compliance submitted by GMRC on RDSO's online portal on 01.04.2024

Gujarat Metro Rail Corporation Limited (GMRCL)'s request for approval of Fastening System 336, as approved vide letter under reference (i), for use in Ahmedabad Metro Phase II has been examined in consultation with RDSO and approval of Railway Board is hereby conveyed. The approved copy of Annexure C-2 is enclosed herewith.

GMRCL shall ensure compliance of all the conditions stipulated in Board's letter under reference.

Encl: As above (07 Pages)


(F. A. Ahmad)

Director/Gati Shakti (Civil)-IV
Railway Board
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Copy to:

1. **Executive Director/UTHS**, RDSO, Manak Nagar, Lucknow w.r.t RDSO's letter No. UTHS/GMRC/81/Civil dated 16.04.2024
2. **OSD/UT & Ex-Officio Joint Secretary**, Ministry of Housing & Urban Affairs (MoHUA), Nirman Bhavan, New Delhi-110001



Compliance Matrix RDSO Annexure-C2 for Ahmedabad Metro rail Project PH-II

Part-A: Performance criteria of fastening system for ballastless track on Metro Railways / MRTS system

Name of the Fastening System: Fastening System 336

Clause	Sub Clause	Provision of the performance criterion Annexure-C2	Compliance / remarks with details
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.	Complied. Which is already approved by MoR vide letter no.: 2019/Proj./MEGA/C- 1/30/01 dated 07.01.2019.
	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.	NA, since it is already approved fastening system
	1.3	The fastening system already approved by MOR as per previous performance criteria for ballastless track dated 21.5.2010 will not require fresh clearance as per this revised criterion and any of these systems can be used by Metro/ MRTS systems.	Noted
	1.4	In case Metros Railways/MRTS system opts for a new fastening system for ballastless track which is not fully compliant to these performance criteria, they will approach MoR for approval before finalizing the use of fastening system.	NA however Noted
2		Operating Environment Fastening system is expected to perform generally in the following conditions:	
	2.1	Gauge –Broad Gauge, 1676/1673mm (nominal) and standard gauge – 1435mm	1435 MM
	2.2	Speed potential – 110 kmph (max.)	90 KMPH
	2.3	Rail section - 60kg(UIC)/60E1, 90 UTS/110UTS	60kg (UIC)/60E1 1080 UTS

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	2.4	Static axle load – BG & SG – 20t(Max)	16 T
	2.5	Design rail temperature range -10 degree Celsius to +70 degree Celsius	Yes
	2.6	Curvature and gradient will be specified in SOD.	Yes
	2.7	Rail seat inclination (slope) – 1 in 20	Yes
	2.8	In addition, the client Railway may specify any other operating condition such as support spacing etc.	Noted
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:	Track is to be laid on cast in situ plinth/slab.
	i)	Resist the track forces.	Yes
	ii)	Have adequate edge distance of concrete beyond the anchor bolts to provide resistance against edge failure.	Yes
	iii)	Provide a level base for uniform transmission of rail forces.	Yes
	iv)	Have geometrical accuracy and enable installation of track to the tolerances laid down.	Yes
	v)	Ensure adequate drainage	Yes
	vi)	Resist weathering	Yes
	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	Yes
	viii)	Ensure provision for electrical continuity between consecutive plinths/slabs by an appropriate design.	Yes
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	Yes, Complied

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Director – (Project & Planning)
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		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 5km in each metro having speed potential of at least 80 kmph & design axle load 16T 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.	Yes, Complied
	iii)	The fastening shall provide insulation to take care of return current of traction system.	Yes, Complied
	iv)	Fastening should satisfy the required performance norms as stated in para 4.2, 4.3, 4.4, 4.5, & 4.6.	Complied
	4.2	Following are the technical performance requirement 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: Atmospheric ultraviolet radiation. Proximity of track up to 10m from salt water source. Contact with oil, grease or distillate dropped from track vehicles.	Complied
	ii)	Permit quick and easy installation and replacement with special tools.	Yes, Complied
	iii)	Be capable of vertical adjustment during service life up to 12mm using shims.	Yes, Complied

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	iv)	Permit the attainment of the following tolerances when installed, and later during service	Yes, Complied																												
		<table><tr><th>S • n o</th><th>Parameter</th><th>Installati on (mm)</th><th>Maintenance (mm)</th></tr><tr><td>1</td><td>Gauge</td><td>+2, -1</td><td>+4, -2</td></tr><tr><td>2</td><td>XL on Straight track</td><td>+/- 1.5</td><td>+/- 5</td></tr><tr><td>3</td><td>SE on Curved Track</td><td>+/- 1.5</td><td>+/- 3</td></tr><tr><td>4</td><td>Vertical alignment over 20m chord</td><td>+/- 3</td><td>+/- 6</td></tr><tr><td>5</td><td>Lateral alignment over 20m chord on straight track</td><td>+/- 2</td><td>+/- 6</td></tr><tr><td>6</td><td>On curves variation over the theoretical versine on 20 m chord</td><td>+/- 2</td><td>+/- 5</td></tr></table>	S • n o	Parameter	Installati on (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 20 m chord	+/- 2	+/- 5	
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5	Lateral alignment over 20m chord on straight track	+/- 2	+/- 6																												
6	On curves variation over the theoretical versine on 20 m 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	Yes, Complied																												
	4.4	For all the fastening components as per approved assembly, the supplier shall furnish detailed drawings, specifications, and inspection & test plan to the Metros. Metros to ensure that components are supplied as per drawings & specifications.	Noted and Complied.																												
	4.5	The supplier should furnish the 'Installation and Maintenance Manual' which shall be approved by the Metro system.	Noted																												
	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	Noted																												
	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 C at 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.	Complied. Testing of fastening system 336 components have been done as per the approved ITP. Tests reports are Enclosed.																												
			ANAND SINGH BISHT Authorized Signatory Director – (Project & Planning) 01.04.2024 10:44																												

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Table-1: Test Plan for Fastening system (Bonded & non-bonded) for Ballastless Track (As per provision of latest EN 13481-1:2012 & EN 13481-5:2012)					Technical Parameter		
S. no	Technical Parameter	Test Method	Acceptance Criteria	Remarks	Technical Parameter	Acceptance Criteria	Result
1	Longitudinal rail Restraint	EN-13146-1-2012	7 KN (min)	This has to be tested before repeated load test	Longitudinal rail Restraint	7 KN (min)	12.1 Kn
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 fasteners parts	Vertical static stiffness of complete fastening assembly	35 KN/mm (Max)	20.0KN/MM
3	Dynamic/static stiffness ratio	EN-13481-5-2012	1.4 (max)	Ratio is calculated by dividing the dynamic stiffness to static vertical stiffness.	Dyn amic /static stiffness ratio	1.4 (max)	0.96 (20/20.7)
4	Clamping force	EN-13146-7-2012	18kN (min) Per rail seat	This has to be tested before repeated load test.	Clampin g forc e	18kN (min) Per rail seat	18.8KN
5	Electrical resistance	EN-13146-5-2012	5kΩ (min)	Higher value may be specified if required by Metros for trackcircuit	Elec trical resis tanc e	5kΩ (min)	7.4kΩ
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.		Effe ct of severe enviro nment al cond ition s	The fastenin g assembl y shall be capable of being dismantl ed, without failure of any compon ent & reassem bled using manual tools provided for this purpose after exposur e to the salt spray test.	According to EN 13146-6 One complete Fastening System With a short Rail section Is fixed on a Concrete block With one support Point. The Block has been Expo sed During 300 hours To an artificial Atmosphere According The Standard (NSS) After the testing Fastening system Has been Dismantled First and fixed Again Without Any
7	Effect of repeated loading	EN-13146-4-2012	No wear or deformation				
7a	On Vertical static stiffness	EN-13146-4-2012	Variation ≤ 25% of the initial value	No sign of bond failure/fracture/slippage			
7b	On Longitudinal rail restraint	EN-13146-1-2012	Variation ≤ 20% of the initial value	Except the rail and fastener, no sliding, yield or cracking is allowed for fastener parts.			

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					Longitudinal load/ deformation curve shall fall in the envelope of upper and lower limit which is to be submitted along with the report.			components After the test are Given in Appendices 9.3 to 9.4
		7 c	On Clamping force	EN-13146-7-2012	Variation \leq 20% of the initial value			
						Effect of repeated loading	No wear or deformation	No wear or deformation
						On Vertical static stiffness	Variation \leq 25% of the initial value	11.9%
						On Longitudinal rail restraint	Variation \leq 20% of the initial value	3.3%
						On Clamping force	Variation \leq 20% of the initial value	0.0%

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**Part-B: Salient features of Fastening System for Ahmedabad Metro Rail
Project PH-II (Document to be uploaded on Portal as C2.2)**

S. No.	Components / Items	Provisions in Metro
1.	Brief description of fastening system	Fastening system 336 as adopted in Ahmedabad Metro PH-I is also being used in Ahmedabad Metro PH-II which is being supplied by M/s. PRIL, Hyderabad.
2	Axle load	16 T
3	Speed potential	90 KMPH
4	Drawing and their numbers	Drawing are enclosed in Annexure – 2 (MOR Letter no. 98/Proj./DLI/30/1 (Vol.III) Dated 24.01.2013). (Assembly for 2 anchor bolt drawing No. 2549a, Assembly for four anchor bolt drawing no. 2424d)
5	Specifications and their numbers	Enclosed
6	Any variation for straight and curve portion? If yes, give detail	Four Number of Anchor bolts are used on the curve having the radius 500 m and sharper. Remaining sections are with two anchor bolts.
7	Vertical stiffness of complete fastening system	20.0 KN/MM
8	Service life of fastening system.	30 years
9	Reference of Railway Board's approval for proposed fastening system.	MOR vide their letter No.: 98/Proj/DLI/30/1 (Vol III) dated 24-01-2013 has accorded approval for DMRC. GMRCCL proposes to use the same type of fastening system 336.



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