

No. MC/LHB/Brake

Date: 26.03.2025

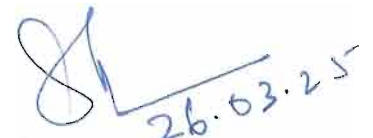
General Manager (Mechanical),

1. Central Railway, Chhatrapati Shivaji Terminus, Mumbai - 400 001
2. Eastern Railway, Fairlie Place, Kolkata - 700 001
3. Northern Railway, Baroda House, New Delhi - 110 001
4. Southern Railway, Park Town, Chennai - 600 003
5. South Central Railway, Rail Nilayam, Secunderabad - 500 071
6. South Eastern Railway, Garden Reach, Kolkata - 700 043
7. North Eastern Railway, Gorakhpur - 273 001
8. Northeast Frontier Railway, Maligaon, Guwahati - 781 011
9. Western Railway, Churchgate, Mumbai - 400 020
10. East Central Railway, Hajipur - 844 101
11. East Coast Railway, Chandrasekharapur, Bhubaneswar - 751 016
12. North Central Railway, Allahabad - 211 001
13. North Western Railway, Jaipur - 302 006
14. South Western Railway, Hubli - 580 023
15. West Central Railway, Jabalpur - 482 008
16. South East Central Railway, Bilaspur - 495 004
17. Integral Coach Factory, Chennai - 600 038
18. Rail Coach Factory, Hussainpur, Kapurthala, Punjab - 144 602
19. Modern Coach Factory, Raebareli, Lalganj- 229206
20. Konkan Railway Corp. Ltd. Corporate office, Belapur Bhawan, Nawi, Mumbai-400 614

Sub: Issue of revised specification of Axle Mounted Disc Brake & EP Assist Brake System for LHB type BG mainline coaches [RDSO specification no. RDSO/2011/CG-04 (Rev.04)] in Indian Railways.

In reference to the subject above, please find enclosed herewith the revised specification no. RDSO/2011/CG-04 (Rev.04) for Axle Mounted Disc Brake & EP Assist Brake System for LHB type BG mainline coaches in Indian Railways.

DA: As above.



(Sudhir Singh)

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Cl:-

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INDIAN RAILWAYS



सत्यमेव जयते

Document content	Technical Specification	Yes
	Schedule of Technical Requirement	Yes
Description of item	SPECIFICATION FOR AXLE MOUNTED DISC BRAKE & EP ASSIST BRAKE SYSTEM FOR LHB TYPE BG MAINLINE COACHES	
Remarks	Nil	

S. No.	Month/Year of Issue	Revision/ Amendment	Page No.	Reason for Amendment
1.	November, 2012	-	-	First issue
2.	November, 2014	Rev.-1	6, 17, 20, 21, 32, 33 & 35	
3.	September, 2016	Amendment-1	3	To include the ISO Doc. No. QO-D-7.1-11. New sub clause No.1.3 added under clause no. 1.0 of Foreword.
4.	March, 2023	Rev.02	Relevant Pages	To improve clarity with focus on functional requirements for enhancing indigenous vendor base.
5.	May, 2024	Rev.03	All Pages	To include the EP assist brake system.
6.	March, 2025	Rev.04	Relevant Pages	To include the STR for ensuring good quality products and improving safety in train operations also modification done in Para 16 (Page No.14) & Para 6 (Page No.19) for better clarity.

Issued by:

Carriage Directorate




Research Designs and Standards Organization

Manak Nagar, Lucknow - 226011

Signature			
Name & Designation	Prepared by: Man Singh Meena JE/Carriage	Checked by: Mahesh SSE/Carriage	Approved by: Sudhir Singh Director/Carriage

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PART-I: GENERAL CONDITIONS

1.0 FOREWORD

1.1 This specification is intended to cover Axle mounted disc brake system & EP assist feature for all AC (EOG), AC (SG), Power Car and Double Decker and Non-AC types of LHB design coaches with LHB shell fitted with FIAT bogies having twin pipes graduated release compressed air brake system for operation on BG (1676 mm) system of Indian Railway.

1.2 Following specification may be referred to in conjunction with this specification:

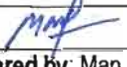
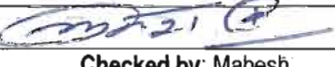
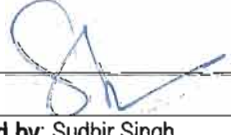
- i. UIC specification no.540
- ii. UIC specification no.541-1
- iii. UIC specification no.541-3
- iv. UIC specification no.541-5
- v. UIC specification no.542
- vi. UIC specification no.543
- vii. UIC specification no.544-1
- viii. UIC specification no.545
- ix. UIC specification no.546
- x. UIC specification no.547
- xi. UIC specification no.831 R
- xii. RDSO specification no.02-ABR-02
- xiii. RDSO specification no.04-ABR-02
- xiv. RDSO specification no.C-K209
- xv. RDSO specification no.C-K013
- xvi. T.S.No.17.503 Part Doc 100 version-00
- xvii. T.S.No.17.614 Part Doc 100 version-01
- xviii. T.S.No.17.501 Part Doc 100 version-00
- xix. T.S.No.17.505 Part Doc 100 version-00
- xx. T.S.No.17.499 Part Doc 100 version-00
- xxi. Relevant DIN, EN & ISO standards as applicable

1.3 General:

1.3.1 Following shall be applicable when this item appears in RDSO's vendor directory:

"All the provisions contained in RDSO's ISO procedures laid down in Document No. QO-D-7.1-11 dated 19.07.2016 (titled "Vendor-Change in approved status") and subsequent versions/amendments thereof, shall be binding and applicable on the successful vendor/vendors in the contracts floated by Railways to maintain quality of products supplied to Railways."

1.3.2 The Govt. of India policy on 'Make in India' shall apply.

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1.3.3 Manufacturer will ensure the usage of environment friendly material and energy efficient instruments/equipments.

2.0 DEFINITION AND EXPLANATION

2.1 'TENDERER' means firm/company from whom the offer for the supply of disc brake equipment is invited.

2.2 'CONTRACTOR' means the firm/company on whom the order for the supply of the brake equipment is placed/will be placed.

2.3 'PURCHASER' means the Indian Railways on behalf of the President of the Republic of India who are purchasing the brake equipment.

2.4 'INSPECTING AUTHORITY' means the organization or its representative nominated by the purchaser to inspect the brake equipment on his behalf.

2.5 The Research Designs & Standards Organization, Manak Nagar, Lucknow-226011 is hereafter referred to as 'RDSO'.

2.6 Rail Coach Factory, Kapurthala (Punjab) is hereafter referred to as RCF.

2.7 The Indian Railways is hereafter referred to as IR.

2.8 In case the tenderer needs any clarification in respect of any clause of this specification or regarding the exhibited drawings, the tenderer shall obtain the same from RCF/RDSO.

2.9 The Axle Mounted Disc Brake system is hereafter referred to as 'AMDBS'.

2.10 The EP assist is hereafter referred to as 'EPA'.

3.0 SCOPE

3.1 This specification covers the technical requirements related to inspection, testing and performance of Axle mounted disc brake system & EP assist feature for LHB design coaches fitted with FIAT bogies of Indian Railways and does not include all the necessary provisions of the contracts.

3.2 Firm willing to supply Axle mounted disc brake system & EP Assist feature must ensure that its' offered brake system is compatible to work with the locomotive with EP Assist feature whose requirements are mentioned in relevant RDSO specifications for diesel & electric locomotives respectively.




4.0 PARTICULAR REQUIREMENTS

4.1 The firm should possess ISO: 9001 certificate issued by International Accreditation Forum (IAF) under Multilateral Recognition Arrangement (MLA) for his works address, covering the items for which he seeks registration with RDSO.

4.2 The firm along with their principals shall have adequate infrastructures for manufacturing, testing and quality control requirements for complete disc brake & EP assist brake system. This will be verified by RDSO at the time of registration of the firm.

5 GUARANTEE/WARRANTY

5.1 For brake system supplied by the contractor, in case of any part of the brake system failing or proving unsatisfactory in service due to defective design, material or workmanship, within 36 months from the date of delivery or 24 months from the date of placing in service whichever is earlier, shall be replaced by the contractor at his own expense. For Distributor Valve, warranty clause of RDSO spec C-K209 shall be applicable.

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6 SPARE PARTS, RESERVE APPARATUS & WEARING PIECES

- 6.1 The offer shall include recommended list of spare parts required for day-to-day maintenance of the brake equipment and spares in the form of kit for the various sub-assemblies for the maintenance at the time of POH. The list shall include the part number, quantity required and price of each component.
- 6.2 Firm shall ensure availability of all spares for a period of at least 10 years. This shall be irrespective of the fact whether the tenderer or his sub-contractor(s) have stopped manufacturing of the equipment to the design supplied to IR.
- 6.3 In order to ensure the highest availability and utilization of brake system, a certain number of standby units of principal assemblies are required. In addition, the firm may stock sufficient minor components and spares to meet renewal and replacement on account of wear or occasional failure, for a period of 5 years' service. Tenderer shall, therefore, submit a classified list of spares (unit exchange, spares & stage/normal maintenance) for each type of equipment of brake system, which he recommends for stocking.
- 6.4 The firm shall indicate in an itemized list, the life expectancy of components subjected to wear under Indian conditions.

7 AFTER SALES SERVICE

- 7.1 Firm may be required to send their technical expert during the installation and commissioning of their equipment on coach/coaches.
- 7.2 Firm shall also depute their technical expert on request by the Purchaser/RDSO to investigate and attend to specific problems that may come up during actual operation of disc brake system.
- 7.3 Firm shall associate with Indian Railways during the trials with disc brake system. It shall also undertake to modify the equipment supplied, if required as a result of trials.
- 7.4 Firm shall supply adequate nos. of copies (soft & hard copy both) of the Operation & Maintenance Manuals and Servicing Instructions of disc brake system to the PUs whenever requested. PU's will ensure that copies of these maintenance manuals are issued to respective Railways where the coaches were allotted. These should normally include:
- 7.4.1 Brief Details of functioning of each equipment.
- 7.4.2 Details of attention to be given during IOH/POH or any other schedule examination.
- 7.4.3 Test procedure and standards for various brake equipments on test bench as well as single coach/rake testing.
- 7.4.4 Details of gauges, jigs & fixtures, tools, machinery and plant for maintenance of brake equipment/system.
- 7.4.5 Typical defects and their remedial measures.
- 7.4.6 List of spares for day to day maintenance and at the time of IOH/POH in the form of periodic overhaul kit.
- 7.4.7 Maintenance standards including clearances and tolerances at various locations and permissible limits of wear for good service performance of equipments.

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7.4.8 Firm shall submit the frequency and detailed work content of various inspection/maintenance schedules necessary for maintenance of air brake system offered by him. Whether these requirements are time based or distance travelled based shall be indicated for each schedule.

8 TRAINING


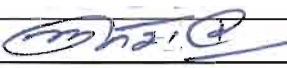

Manufacturer will organize free of cost Seminar/Workshops on Axle Mounted Disc Brake system once in a year in coaching having coach holding less than 50 and twice in a year in coaching depot having coach holding more than 50 at coaching depot/workshop where LHB coaches are being maintained.

PART-II: TECHNICAL REQUIREMENT

9 SCOPE OF SUPPLY

9.1 Scope of supply of axle mounted disc brake system & EP assist feature for all AC (EOG), AC (SG) & Non-AC(EOG) type of LHB design coaches shall cover the following equipments. It is the prerogative of purchaser to procure the system as complete set or in part:

S.N.	Description	Specification	Qty./coach	Remarks
1.	Brake Container Module	Appendix – A	1 Set	\$Max. BC pressure 3.0±0.1 Kg/cm ²
2.	Brake Cylinder (LH)	Appendix – B	4	Brake Caliper ratio is 2.17 for all EOG & SG Coaches except for the ACCN (SG). For ACCN (SG) coach Brake Caliper ratio is 2.48.
3.	Brake Cylinder (RH)	Appendix – B	4	
4.	Brake Caliper Assly. (LH)	Appendix – C	4	
5.	Brake Caliper Assly. (RH)	Appendix – C	4	
6.	Passenger Emergency Alarm Valve	Appendix – D	1	
7.	Passenger Emergency Alarm Pilot Valve with micro switch & indication Device	Appendix – D	*As reqd.	
8.	Brake Accelerator Valve	Appendix – E	1	
9.	Wheel Slide Protection Unit (WSP)	Appendix – F	1 Set	
10.	Brake Indicators	Appendix – G	4	
11.	Cut off angle cock 1-1/4"	Appendix – D of spec 02-ABR-02	4	
12.	Reducing Bush 1-1/4x1"	-	4	

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13.	Hose coupling assembly for BP	Appendix – F of spec 02-ABR-02	2	Hose length 660+6 mm & Hose assembly 790+6 mm
14.	Hose Coupling Assembly for FP	Appendix – F of spec 02-ABR-02	2	Hose length 660+6 mm & Hose assembly 790+6 mm
15.	Hose Connection for Bogie	RDSO Drg. CG-19036 (Alt.-latest)	4	650 mm long#
16.	Hose connection for brake cylinders	RDSO Drg. CG-19037 (Alt.-latest)	8	500 mm long#
17.	Isolating cock 1"	--	2	#
18.	EP Assist Equipment	Appendix-H	–	@
19.	Laptop with installed software and connecting cable	Appendix-I	On supply of every 25 brake system or part thereof	

(\$): DV with Relay valve should have provision for pressure adjustment.

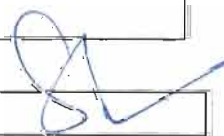
(*): Quantity may vary for different types of coaches.

(#): As per approved OEM drawing.

(@): Items may be procured with/without AMDBS. However, EP assist equipments will be compatible with brake system of same make.

- 9.2 Scope of supply of axle mounted disc brake system & EP assist feature for LHB type Power Car and SLR coaches shall cover the following equipment. It is the prerogative of purchaser to procure the system as complete set or in part:

S.N.	Description	Specification	Qty./coach	Remarks
1.	Brake Container Module	Appendix – A	1 Set	\$Max. BC pressure 3.0+0.1 Kg/cm ²
2.	Brake Cylinder (LH)	Appendix – B	2	
3.	Brake Cylinder (RH)	Appendix – B	4	
4.	Brake Cylinder (LH) with Hand Brake Arrangement	Appendix – B	2	
5.	Brake Caliper Assly. (LH)	Appendix – C	4	Brake Caliper ratio is 2.48 for Power Car and SLR
6.	Brake Caliper Assly. (RH)	Appendix – C	4	
7.	Passenger Emergency Alarm Valve	Appendix – D	1	
8.	Passenger Emergency Alarm Pilot Valve with micro switch & indication Device	Appendix – D	*As reqd.	

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9.	Brake Accelerator Valve	Appendix – E	1	
10.	Wheel Slide Protection Unit (WSP)	Appendix – F	1 Set	
11.	Brake Indicators	Appendix – G	6	
12.	Cut off angle cock 1-1/4"	Appendix – D of spec 02-ABR-02	4	
13.	Reducing Bush 1-1/4x1"	-	4	
14.	Hose coupling assembly for BP	Appendix – F of spec 02-ABR-02	2	Hose length 660 \pm 6 mm & Hose assembly 790 \pm 6 mm
15.	Hose Coupling Assembly for FP	Appendix – F of spec 02-ABR-02	2	Hose length 660 \pm 6 mm & Hose assembly 790 \pm 6 mm
16.	Hose Connection for Bogie	RDSO Drg. CG-19036 (Alt.-latest)	4	650 mm long#
17.	Hose Connection for brake cylinders	RDSO Drg. CG-19037 (Alt.-latest)	8	500 mm long#
18.	Isolating cock 1"	-	2	#
19.	Guard's emergency Brake Valves	-	1	#
20.	Pressure Gauges for Brake Pipe	Appendix – H of spec 02-ABR-02	1	
21.	Pressure Gauges for Feed Pipe	Appendix – H of spec 02-ABR-02	1	
22.	Pressure Gauges for Brake Cylinder	Appendix – H of spec 02-ABR-02	1	
23.	Flex ball Cable – Long G=4024mm	-	1	#
24.	Flex ball Cable – Short G=2333mm	-	1	#
25.	Flex ball Cable – Coach G=2197mm	-	2	#
26.	Roller operated Cam valve	-	1	#
27.	EP Assist Equipment	Appendix-H	--	(@)
28.	Laptop with installed software and connecting cable	Appendix-I	On supply of every 25 brake system or part thereof	

(\$): DV with Relay valve should have provision for pressure adjustment.

(*): Quantity may vary for different types of coaches.

(#): As per approved OEM drawing.

(@): Items may be procured with/without AMDBS. However, EP assist equipments will be compatible with brake system of same make.

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9.3 Scope of supply of Axle mounted Disc brake system for LHB type Double Decker Coaches shall cover the following equipment. It is the prerogative of purchaser to procure the system as complete set or in part:

S.No.	Description	Specification	Qty./coach	Remarks
1.	BP Panel Assembly	Appendix – A	1 Set	\$Max BC pressure 3.8±0.1 Kg/cm ²
2.	FP Panel Assembly	Appendix – A	1 Set	
3.	Auxiliary reservoir – 125ltr with drain cock (for brake system)	Appendix – A	1	
4.	Auxiliary reservoir – 75ltr with drain cock (for CDTs)	Appendix – A	1	
5.	Control reservoir – 6 ltr.	Appendix - A	1	
6.	Strap for 125 ltr reservoir	Appendix - A	1	
7.	Strap for 75 ltr reservoir	Appendix - A	1	
8.	Brake Cylinder (LH)	Appendix – B	4	Brake Caliper ratio is 2.48
9.	Brake Cylinder (RH)	Appendix – B	4	
10.	Brake Caliper Assly. (LH)	Appendix – C	4	
11.	Brake Caliper Assly. (RH)	Appendix – C	4	
12.	Passenger Emergency Alarm Valve	Appendix – D	1	
13.	Passenger Emergency Alarm Pilot Valve with micro switch & indication Device	Appendix – D	*As reqd.	
14.	Brake Accelerator Valve	Appendix – E	1	
15.	Wheel Slide Protection Unit (WSP)	Appendix – F	1 Set	
16.	Brake Indicators	Appendix – G	4	
17.	Cut off angle cock 1-1/4"	Appendix – D of spec 02-ABR-02	4	
18.	Reducing Bush 1-1/4x1"	-	4	
19.	Hose coupling assembly for BP	Appendix – F of spec 02-ABR-02	2	Hose length 660±6 mm & Hose assembly 790±6 mm
20.	Hose Coupling Assembly for FP	Appendix – F of spec 02-ABR-02	2	Hose length 660±6 mm & Hose assembly 790±6 mm
21.	Hose Connection for Bogie	RDSO Drg. CG-19036 (Alt.-latest)	4	650mm long#
22.	Hose Connection for brake cylinders	RDSO Drg. CG-19037 (Alt.-latest)	8	500 mm long#
23.	Isolating cock 1"		2	#
24.	EP Assist Equipment	Appendix-H	-	(@)
25.	Laptop with installed software and connecting cable	Appendix-I	On supply of every 25 brake system or part thereof	

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(\$): DV with Relay valve should have provision for pressure adjustment.

(*): Quantity may vary for different types of coaches.

(#): As per approved OEM drawing.



(@): Items may be procured with/without AMDBS. However, EP assist equipments will be compatible with brake system of same make.

10 PERFORMANCE REQUIREMENTS

- 10.1 The brake system shall be twin pipe graduated release type and its performance shall conform to the latest revision of UIC Specification 540 and 547.
- 10.2 The brake equipment shall give a trouble free service for a period of minimum six years from the date of commission or date of placement in service, whichever is later, with maintenance as per OEMs recommendation.
- 10.3 It shall be possible to obtain atleast 10% reduction in full service braking distance at a speed of 160kmph (on rake with at least 18 coaches comprising of two nos. of Power Car/Guard Van type coaches), during brake application on a straight and level track with EP brakes in both loco & coaches are in working condition as compared to full service braking distance with EP brakes in non-working condition.
- 10.4 The brake system must allow safe running of the train down the longest and steepest gradient as indicated in Annexure-I and it shall be possible to control the speed at operating speed levels permitted on this gradient.
- 10.5 The brake system shall have ability to stop the train in emergency (quick acting) and full service application without affecting stability of the train during braking.
- 10.6 The brake system shall have stopping ability from a speed after continuous braking for prolonged time during downhill travel.
- 10.7 The brake system shall give satisfactory performance under wet conditions also.
- 10.8 The permitted variation in BC pressure from Distributor Valve between two major schedules will be ± 0.2 kg/cm² for the specified values as mentioned in the specification on account of manufacturer.

11 DESIGN REQUIREMENTS

- 11.1 The Axle Mounted Disc Brake & EP Assist feature offered by the firm shall be compatible with the existing brake system being used for LHB/FIAT design coaches.
- 11.2 The disc brake equipments shall be designed and constructed in such a way that in normal conditions of use and vibrations, to which it may be subjected to, should not cause its premature failure or in any way affect the functional efficiency.
- 11.3 Design of the disc brake equipments shall be such that the performance of the system is not adversely affected under extreme positions of wheel and suspension movements under maximum wear conditions.
- 11.4 The disc brake system shall be of proven design, which has worked successfully in India or International Railway Passenger trains in similar operating conditions. Copies of UIC approval wherever applicable shall be submitted by the firm along with the offer.

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- 11.5 Equipments should be designed in such a way that it has minimum wear and tear and maintenance possibility.
- 11.6 Each Power Car/SLR/Guard Van/Parcel Van type shall be provided with Flex Ball type parking brakes system having accommodation in Guard's compartment. Parking brakes should brake atleast one bogie (minimum two axle). Parking Brake system shall be latest Proven Design and shall be capable of holding train on steepest and longest down gradient of 1%, when applied from two Power Car/SLR/Guard Van/Parcel Van type coaches. Firm shall submit detailed calculation in this regard.

12 SUBMISSION OF TECHNICAL DOCUMENTS

- 12.1 Firm shall submit the following technical documents/details for axle mounted disc brake equipment at the time of registration to RDSO:
- 12.1.1 Schematic diagram for the pneumatic systems.
- 12.1.2 Descriptive literature explaining the systems.
- 12.1.3 Descriptive literature explaining the individual equipment used in the system.
- 12.1.4 Layout dispositions of all the components/equipments on bogie, underframe and body.
- 12.1.5 QAP for manufacture and supply of Axle Mounted Disc Brake System. The 'Quality Assurance Plan' shall be prepared in accordance with the guidelines given in relevant ISO document of RDSO.
- 12.1.6 Operation and maintenance manual covering instructions, maintenance schedule & list of spares required for all individual items.
- 12.1.7 The complete set of drawings in A1/A2 size for each item of disc brake equipment which shall contain details regarding material specification, dimensions, estimated weight, testing parameters, reference to manufacturing/original collaborator's drawing etc.
- 12.1.8 Electrical wiring diagram.
- 12.1.9 Electrical power requirement i.e. voltage, current (AC/DC) for WSP.
- 12.1.10 Thermal loading details and calculations with the use of disc brakes.
- 12.1.11 Instantaneous/average co-efficient of friction for disc pads for a speed up to 200kmph under different brake pad pressures (should be as per relevant UIC).
- 12.1.12 Braking distance calculations (with & without EP assist feature) at 160kmph (as applicable) as per the rake configuration given in Annexure-I.

13 APPROVAL OF DRAWING

- 13.1 The design/drawing of the disc brake equipment shall be developed based on the technical and performance requirements given in this specification and sound engineering practice. The entire drawing shall be submitted by the firm with technical data and calculations to RDSO for approval.
- 13.2 The drawing shall be developed in SI units.
- 13.3 Material grade/specifications for each component shall be indicated on the relevant drawings of the firm and the firm shall supply copies of translation in English of such specifications/drawings other than Indian standard specifications to purchaser/RDSO.

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13.4 Approval of the design means the approval of the general design features. Notwithstanding the approval, the contractor will be wholly responsible for the performance of the disc brake equipment as well as individual components offered.

13.5 Further changes/modifications in the disc brake equipment may be called for with a view to achieve standardization and interchangeability. Firm shall be obliged to incorporate necessary changes in the design of his equipment for this purpose.

14 MANUFACTURE

14.1 Brake Equipments shall be strictly manufactured as per drawing and specification submitted by the manufacturer.

14.2 Equipments to be supplied shall be free from injurious defects that may impair their strength. Contractor shall also ensure that all items are adequately treated and painted (excluding flange faces) to prevent corrosion.

14.3 All parts of brake system shall be given suitable anti-corrosive treatment and painted with two coats of paints with colours as specified by IR before supply (if required). The surface of light alloy castings shall be anodized.

15 INSPECTION

15.1 The complete brake equipment to be supplied by the firm shall be inspected and accepted by the inspecting authority nominated by the purchaser in the supplier's plant. The cost shall be borne by contractor.

15.2 During Prototype development the firm shall offers at least one sets of complete Axle Mounted Disc Brake & EP assist feature equipments to carry out the following test/check:

15.2.1 Checking of dimensions & tolerances, interchangeability of components and general workmanship.

15.2.2 Performance testing of disc brake equipments.

15.3 Contractor shall be responsible for the proper functioning of the disc brake equipment, as per procedure laid down to be mutually agreed to between the contractor and Purchaser.




15.4 Inspection authority shall have access to all detailed manufacturing/original collaborator's drawings for all items of equipment. Contractor shall be obliged to table these drawings as and when called for.

15.5 The inspection authority may deviate from the agreed procedure if and when found necessary to reassure that the material is being furnished in accordance with these specifications. In this regard the contractor shall not be entitled to object on any ground whatsoever on the nature and procedure of testing that may be followed by the inspecting authority.

15.6 During the fabrication, subsequent inspection visit, the brake supplier shall allow IR inspection authority for inspection.

16 FIELD TRIAL

16.1 The disc brake equipments shall be subjected to field trials on minimum 18 coaches (Preferably 1 rake) for a period of minimum 12 months.

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- 16.2 In case of any modifications carried out by the registered suppliers in the items viz. Brake container module, Distributor Valve, Emergency Brake Accelerator Valve, Passenger Emergency Alarm Valve (PEAV), Passenger Emergency Alarm Signal Device (PEASD), Brake Cylinder, Brake Caliper assembly & Wheel Slide Protection of AMDBS & EP assist feature, the design will be validated in RDSO test lab, thereafter subjected to field trial of 6 months (minimum).
- 16.3 Any modifications found necessary as a result of these tests/trial or further service trials shall be carried out by the manufacturer at their own cost in the coaches in a manner approved by the purchaser/RDSO. All key and manufacturing drawings incorporating the modifications shall be submitted to RDSO for final approval.
- 16.4 After the satisfactory performance of the field trials, the firm may be considered for approval.

17 MARKING

Identification codes (manufacturer's name / trade mark), month/week & year of manufacture and serial number is to be applied to main equipment and subcomponents in a minute, clearly recognizable way; (Plate, label, or stamped, laser marking) to avoid mixing and for settling down warranty claim.

18 PACKING

- 18.1 Supplier shall ensure that all outer parts and exposed threaded portions of the various items of axle mounted disc brake system are suitably covered with protection caps to prevent ingress of foreign matter / damage to threads during handling and storage.
- 18.2 Supplier shall also ensure that all items of disc brake equipment in an assembled condition are adequately packed before dispatch to prevent damage in transporting, handling and storage. The safe transportation shall be the responsibility of manufacturer.

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APPENDIX -A

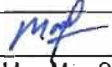

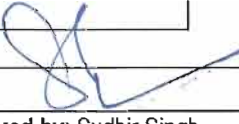
Specification for Brake Container Module for AMDBS & EPA feature for LHB type coaches**1 SCOPE**

This specification covers the technical requirements related to the performance, inspection and testing of Brake Container Module for axle mounted disc brake system of LHB type coaches and does not include other necessary provisions of the contract.

2 EQUIPMENT DESIGN

- 2.1 The brake container module for AC - Non AC (EOG), AC (SG) and Power Car shall be mounted on the underframe of the vehicle near sidewall using a cradle frame made of stainless steel to AISI 304. Dimensions shown in Drawing No. 110113.0.09.110.001 At-D shall be referred to for envelope size of the equipment including brake control panel. Broad dimension & location of sub-equipment of brake panel shall be as per RDSO drawing no.CG-18088 (Alt.-latest).
- 2.2 The brake container module for AC-Non AC (EOG), AC (SG) and Power Car shall consist of the following components:

S.N.	Description	Qty. /Set	Remarks
I.	Brake Frame	1	
II.	Brake Control Panel	1	
III.	Distributor Valve	1	As per RDSO spec. C-K209/UIC-540 (Appendix-A)
IV.	Control Reservoir 6 ltr.(Min.)	1	
V.	Control Reservoir 5 ltr.(Min.)	1	For Hand Brake only
VI.	Air Filter for BP & FP	2	
VII.	Isolating Cock without vent	2	
VIII.	Isolating Cock with vent	2	
IX.	Check valve	2	
X.	Check valve	1	For Power Car only
XI.	Test Point – BP & FP	2	
XII.	Pressure Gauge for Brake Cylinder (BC) Pressure having dial size of 2 inches with mechanical isolation on 1/4" BSPT for mounting with least count of 0.2 kg/cm ²	1	Appendix – H of spec 02-ABR-02
XIII.	Pressure Gauge for Control Reservoir (CR) Pressure having dial size of 2 inches with mechanical isolation on 1/4" BSPT for mounting with least count of 0.2 kg/cm ²	1	Appendix – H of spec 02-ABR-02

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XIV.	Pressure switch mounting assembly (in FP line)	1	(1.3 Kg/cm ² falling pressure and 1.8 Kg/cm ² rising pressure)
XV.	Pressure switch	1	
XVI.	Auxiliary reservoir – 125ltr.(Min.) with drain cock (for brake system)	1	
XVII.	Auxiliary reservoir – 75ltr. with drain cock (for CDTs)	1	

2.3 For Double Decker coaches, the brake control panel shall be designed suiting to the space availability. Preferably the reservoirs are to be accommodated in the diamond area whose approach shall be from inside of the coach. Brake Panel shall be made of split type to accommodate outside the diamond area leaving and adequate safe margin from bogie as 200mm and 235mm ground clearance. The mounting frame of control panels and reservoirs shall be stainless steel to AISI 304. RCF Drg. No. DD11235 and Body shell Drg. No. DD10250 shall be referred for envelope size of the Panels and reservoirs. Mounting accessories such as belts etc. for reservoirs and control panels shall be in the scope of the equipment supplier.

2.4 The brake control equipment on underframe for Double Decker Coaches shall consist of the following components:

S.N.	Description	Qty. /Set	Remarks
I.	BP Panel assembly	1	
II.	FP Panel assembly	1	
III.	Distributor Valve	1	As per RDSO spec. C-K209/UIC-540 (Appendix-A)
IV.	Control Reservoir 6 ltr.(Min.)	1	
V.	Air Filter for BP & FP	2	
VI.	Isolating Cock without vent	2	
VII.	Isolating Cock with vent	2	
VIII.	Check valve	2	
IX.	Test Point – BP, FP, BC & CR	4	
X.	Pressure switch mounting assembly (in FP line)	1	
XI.	Pressure switch (1.3 Kg/cm ² falling pressure and 1.8 Kg/cm ² rising pressure)	1	
XII.	Auxiliary reservoir – 125 ltr.(Min.) with drain cock (for brake system)	1	
XIII.	Auxiliary reservoir – 75 ltr. with drain cock (for CDTs)	1	
XIV.	Strap for 125 ltr. (Min.) reservoir	1	
XV.	Strap for 75 ltr. reservoir	1	

2.5 The brake control panel shall be made of Aluminum Alloy/Stainless steel to AISI 304 with fittings on specified location.

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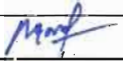
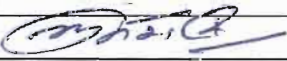
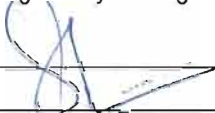
- 2.6 All the accessories to be mounted on brake control panel shall be of panel mounted type so that they can be easily mounted and removed from the panel.
- 2.7 The brake container module shall be protected against track stone hitting, dust, rain and salt-water influences.
- 2.8 Sizes of pipes as shown in Alstom Drawing Nos. 1 10113.0.09.100.002 Alt-D, 1 10113.0.09.100.003 Alt-B, 1 10113.0.09.100.004 Alt-C and 1 10113.0.09.100.005 Alt-C for various connections shall be used. These drawing are only for the purpose of guidance with regard to size of pipes.
- 2.9 The distributor valve (DV) shall be mounted on the panel through intermediate piece with isolating cock which shall form part of the DV or intermediate piece or could be directly mounted on the panel.
- 2.10 The various pipe connections should as far as possible be located on top of the brake panel.
- 2.11 The weight of brake panel with and without components shall be indicated.
- 2.12 The layout of the various apparatus etc. on the brake panel shall be finalized in consultation with the RDSO.
- 2.13 Test points shall be provided on the brake control panel to measure pressures of brake cylinder, auxiliary reservoir, control reservoir and brake pipe.
- 2.14 The material of all reservoirs/pressure tanks shall be of stainless steel to AISI 304.
- 2.15 The cradle shall be made of stainless steel to AISI 304 with wire-mesh of stainless steel at the bottom. All the critical Isolating cocks at front location in the control panel shall be covered with Stainless Steel mesh with sliding door arrangements to prevent their operation by unauthorized persons.
- 2.16 The control panels shall be designed and constructed in such a way that in normal conditions of use and vibrations, to which it may be subjected to, should not cause its premature failure or in any way affect the functional efficiency.
- 2.17 The manufacturer shall either fix a name plate or engrave below every fitting on control panel which should last as long as the control panel.

3 MECHANICAL INTERFACES

- 3.1 All piping of underframe to Brake Control Panel & Air suspension control panel shall be of ferrule type.
- 3.2 The supplier specifies the single weights (which can be summarized appropriately) of all components of the brake control panel to be mounted to the car body in order to guarantee the mechanical strength of the connecting points.
- 3.3 The supplier shall guarantee all internal interfaces of the brake equipment.
- 3.4 If the components included in the scope of delivery of the brake supplier are to be connected with the brake pipes of the car body and/or the bogie, they are to be suitable for ferrule type connections.

4 MANUFACTURE

- 4.1 Brake container module shall be manufactured as per drawing and specification submitted by the manufacturer.
- 4.2 Equipment to be supplied shall be free from injurious defects that may impair their strength. The firm shall also ensure that all items are adequately treated and painted (excluding flange faces) to prevent corrosion.
- 4.3 All parts of Brake Container Module shall be given suitable anti-corrosive treatment if required, painted with two coats of paints with colors as specified by IR before supply. The surface of light alloy castings shall be anodized.

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5 PURCHASE INSPECTION

- 5.1 The purchase inspection shall be carried out at the firm's premises who are cleared for the regular manufacture and registered with the RDSO for manufacture and supply of Brake container module.
- 5.2 The inspecting authority shall make audit checks of the manufacturing procedure/"Internal Quality Assurance System" to ensure that the brake container module offered for inspection is manufactured strictly as per "Internal Quality Assurance System" and the manufacturer has carried out all the tests/inspection during manufacturing stage to ensure that brake container module offered are strictly to the specification and drawings. During such audit checks the Inspection Authority shall also see from the records of 'Internal Quality Assurance' that the Raw material used for the manufacture of brake container module is as per specification laid down.
- 5.3 Inspection Authority will ensure that each Distributor Valve has been tested by the manufacturer as per clause 7.2 of the RDSO specification C-K209 before fitment on the brake control panel. Manufacturer shall have to maintain the internal tests record and submit against the Inspection Authority at the time of inspection.
- 5.4 Inspection Authority will ensure that each Brake container module has been tested by the manufacturer as per clause 6.0 of this specification. Manufacturer shall have to maintain the internal tests record and submit against the Inspection Authority.
- 5.5 The Inspection Authority shall conduct the following checks/tests of the Brake container from a lot of 50 coach set or part thereof.
- 5.5.1 2% or minimum two numbers Brake container module picked up at random shall be checked for dimensions and tolerances, interchangeability of components, general workmanship and surface finish as per RDSO approved drawings.
- 5.5.2 10% or minimum two numbers Brake container module picked up at random shall be subjected to performance tests as given at clause 6.0
- 5.6 In case the samples picked up fails in any of the tests/checks indicated at clause 5.5.1 & 5.5.2, the entire lot of the brake container module shall be rejected by the Inspecting Authority.
- 5.7 Inspecting authority shall have access to all detailed manufacturing / original collaborator's drawings for all items of equipment. The firm shall be obliged to provide these drawings as and when called for.
- 5.8 The inspecting authority may deviate from the agreed procedure if and when found necessary to re-assure that the material is being furnished in accordance with these specifications. In this regard the manufacturer shall not be entitled to object on any ground whatsoever on the nature and procedure of testing that may be followed by the inspecting authority.
- 5.9 During the fabrication, subsequent inspection visit, the brake supplier shall allow IR Inspection Authority for Inspection.

6 PERFORMANCE TESTS

- 6.1 The Brake container shall be mounted on the test bench and tested for the following features. All the test shall be conducted with twin pipe system except the test mentioned at S.No.6.1.2 which shall be carried out with single pipe system.

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S.N.	Check	Specified Values	As Observed
6.1.1	Leakage Test for Brake Control Panel Assembly Leakage from mounting of sub-assemblies and components at air pressure of 10 Kg/cm ²	No leakage	
6.1.2	Charging Time (with single pipe only) a) Time for auxiliary reservoir (AR) pressure to rise from 0 to 4.8 kg/cm ² . b) Time for Control reservoir (CR) pressure to rise from 0 to 4.8 kg/cm ² .	- -	
6.1.3	Leakage from mounting of sub- assemblies during I) Release II) Service Application Iii) Emergency	No leakage No leakage No leakage	
6.1.4	Full Service Application & Release i) BC Filling time from 0 to #2.8 kg/cm ² under service application with eight brake cylinders of 255 mm dia. ii) BC Release time from *3.0±0.1 to 0.4 kg/cm ² after service application with eight brake cylinders of 255 mm dia. iii) Maximum Brake Cylinder pressure	3 - 5 Sec 15 - 20 Sec *3.0 ± 0.1 kg/cm ²	
6.1.5	Emergency Application & Release i) BC Filling time from 0 to #2.8 kg/cm ² under emergency application with eight brake cylinders of 255 mm dia. ii) BC Release time from *3.0±0.1 to 0.4 kg/cm ² after emergency application with eight brake cylinders of 255 mm dia. iii) Maximum Brake Cylinder pressure	3 - 5 Sec 15 - 20 Sec *3.0 ± 0.1 kg/cm ²	
6.1.6	Graduated Application & Release Test i) Brake Cylinder pressure attained when Brake pipe pressure is reduced in steps (at least seven steps). ii) Brake Cylinder pressure attained when Brake pipe pressure is increase in steps (at least seven steps). iii) Brake pipe pressure when cylinder pressure is 0.4 kg/cm ² .	- - 4.85 kg/cm ² (Approx.)	
6.1.7	Sensitivity Test Response of brakes when Brake pipe (BP) pressure is reduced at a rate of 0.6 kg/cm ² in six seconds when BP is isolated from main reservoir.	Brake should apply within 6 Sec	
6.1.8	Insensitivity Test Response of brakes when Brake pipe (BP) pressure is reduced at a rate of 0.3 kg/cm ² in 60 seconds when BP is isolated from main reservoir.	Brake should not apply	
6.1.9	Refeeding Test Response of valve when Brake cylinder pressure is slowly exhausted by 2mm choke	Refeeding should be available	

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6.1.10	Over Charge Protection Test Overcharge Brake Pipe (BP) to 6 kg/cm ² after full service application	Control Reservoir pressure Should not rise within 10 sec.	
6.1.11	Bogie Isolation Test for Brake control panel Increase the BC pressure to *3.0±0.1 kg/cm ² in 3-5 sec. i) Turn the first bogie Isolation Cock to close position. BC1 Pressure Gauge should show zero pressure. ii) Turn the second bogie Isolation Cock to close position. BC2 Pressure Gauge should show zero pressure. iii) Turn the first bogie Isolation Cock to open position. BC1 Pressure Gauge should show *3.0±0.1 kg/cm ² pressure. iv) Turn the second bogie Isolation Cock to open position. BC2 Pressure Gauge should show *3.0±0.1 kg/cm ² pressure.	OK OK OK OK	
6.1.13	Toilet Cock Isolation Test Open cock for toilet on panel. Check the pressure gauge for pressure	It should show 6Kg/cm ²	
6.1.14	Quick Release Valve Test Automatic exhausting of Brake Cylinder and Control reservoir test of quick release valve	@CR & BC pressure should automatically exhaust to zero	
6.1.15	Hand Brake Cock Isolation & Reservoir Leakage Test (In Power Car only) Check leakage from the connection on reservoir	No leakage	

(#): For Double Decker Coach BC filling time shall be recorded from 0 to 3.6 kg/cm²

(*): For Double Decker Coach max BC pressure shall be 3.8 kg/cm²

(@): In case of any ambiguity regarding parameters above, provisions mentioned in relevant UIC shall be used for guidance.

Note:- Specified values of test Indicated at clause 6.1.2(a), 6.1.2(b) & 6.1.6 (i) & (ii) shall be furnished by the manufacturer and approved by RDSO.

6.2 Testing of Auxiliary Reservoir of 125ltrs (Min.) and 75ltrs shall be carried out as per Clause 7.0 of Appendix-C of 02-ABR-02.

6.3 The purchaser/Inspection Authority may specify any other test to satisfy himself for the performance of the requirements and manufacturer shall assist for conduct of these tests.

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APPENDIX- B

Specification for Brake Cylinder for AMDBS & EPA feature for LHB type coaches**1. SCOPE**

This specification covers the technical requirements related to performance, Inspection and testing of Brake Cylinder to be used for Axle Mounted Disc Brake system of LHB type coaches and does not include other necessary provisions of the contract.

2. EQUIPMENT DESIGN

- 2.1 The brake cylinder with automatic wear adjustment serves in the operation of the brake clasp of the disc brake.
- 2.2 The brake cylinder shall be built with a compact, simple method and small dimensions. It is suitable for installation in brake caliper for axle mounted brake discs.
- 2.3 The main characteristic of the cylinder is the built-in power controlled wear adjustment mechanism. It acts as a single-acting play regulator and performs unaffected by the spring-action elongation of the brake caliper, which is dependent on brake power. During the braking process, the regulator quickly and automatically corrects the play in the brake shoe, which has been enlarged due to wear, in the entire area of adjustment.
- 2.4 Play in the brake cylinder remains constant. The piston stroke remains largely constant. Manual regulation of the brake cylinder/brake caliper is not required.
- 2.5 The brake cylinder shall be provided with a spindle release device, which allows, simple replacement of the used brake linings.
- 2.6 Basic parameters of the brake cylinder shall be as under:
- | | |
|------------------|------------------------|
| Piston Strokes | 21 mm (max.) |
| Slack capacity | 120 mm (min.) |
| Cylinder size | 10" |
| Max. BC pressure | 3.9 Kg/cm ² |
- 2.7 Air connection to brake cylinder shall be through 15 mm diameter pipe.
- 2.8 All parts of brake cylinder shall be design for fatigue strength (with the exception of parts subject to wear).
- 2.9 A minimum true specific weight for the brake cylinder is of great importance.
- 2.10 The weight of brake cylinder must be evident on the drawing.
- 2.11 A drop in pressure in the service brakes shall not exceed 0.1 Kg/cm² within 10 minutes.
- 2.12 All moveable parts (such as spindles) are to be provided with an appropriate protective covering. If bellows are used, they must be heat and flame resistant.
- 2.13 The functioning of the brake cylinders must be guaranteed against wear, corrosion and leakage. The permissible limits for wear, corrosion and leakage are to be specified by the supplier.
- 2.14 The brake cylinder is to be protected from water infiltration due to splashing of water in rainy seasons or water wash of the coach at station/sick line.

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- 2.15 For brake lining replacement, an easy-operated release device is to be provided for the wear adjustment mechanism.
- 2.16 The return device must be easily accessible.
- 2.17 The type of release must be evident on the drawing.
- 2.18 It must not be possible for the release device to release unintentionally, such as from vibrations or blows.
- 2.19 Even when used in a counter-clockwise manner (wrong direction of turn), no damage should be caused to the return device.

3. DIMENSIONS AND TOLERANCES




- 3.1 For all coaches, brake cylinder shall come within the space as shown in FIAT-SIG Drawing No. 1268820 and for one bogie of power car and second class luggage cum guard coach FIAT-SIG drawing no. 1272116 will be applicable.
- 3.2 Fixing arrangement of calipers with brake cylinder piston and brake cylinder body shall be as per RCF Drg. No. MI000524. Tenderer may please take note of the fixing hole size etc. as shown in this drawing.
- 3.3 The dimensions and tolerances of Brake cylinder shall be as indicated in the RDSO/OEMs approved drawings.
- 3.4 Discrepancies in dimensions if noticed shall be brought to the notice of RDSO at the developmental stage and sorted out.

4. MANUFACTURE

- 4.1 Brake Cylinder shall be manufactured as per drawing and specification submitted by the manufacturer.
- 4.2 Brake cylinder to be supplied shall be free from injurious defects that may impair their strength. The firm shall also ensure that all items are adequately treated and painted to prevent corrosion.
- 4.3 All parts of Brake Cylinder shall be painted with two coats of paints in grey or black colours or as specified by IR before supply. The surface of light alloy castings shall be anodized.

5. PURCHASE INSPECTION

- 5.1 The purchase inspection shall be carried out at the premises of manufacturers who are cleared for the regular manufacture of Brake cylinder. The following procedure shall be followed for the purchase inspection: -
- 5.1.1 The Inspecting authority shall make audit checks of the manufacturing procedure/"Internal Quality Assurance System" to ensure that the brake cylinder offered for inspection is manufactured strictly as per "Internal Quality Assurance System" and the manufacturer has carried out all the tests/inspection during manufacturing stage to ensure that brake cylinder offered are strictly to the specification. During such audit checks the Inspecting Authority shall also see from the records of 'Internal Quality Assurance' that the Raw Material used for the manufacture of brake cylinder is as per specification laid down.
- 5.1.2 The Inspecting Authority shall conduct the following checks from a lot of not more than 50 Nos.
- 5.1.2.1 Two percent brake cylinder picked up at random shall be checked for dimensions with respect to assembly drawing.

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- 5.1.2.2 Two percent or minimum one brake cylinder shall be dismantled and dimensions and general workmanship of each component checked as per RDSO approved drawings.
- 5.1.2.3 Ten percent brake cylinder picked up at random shall be subjected to tests as given at clause 6.1 of this specification.
- 5.1.2.4 Two piston packing per every contract shall be tested for conformity with UIC code 831-R. In case piston packing is imported from OEM, test certificate should be produced.
- 5.1.3 In case the samples picked up fail in any of the tests/checks indicated in clause 5.1.2.1 to 5.1.2.3 the reasons for such failure shall be identified. The Inspecting Authority shall verify the reasons by conducting audit check on 'Internal Quality Assurance System'. If it is found that such failures are due to non-implementation of 'Internal Quality Assurance System' the entire lot of brake cylinders shall be rejected. In case the failures are on account of reasons other than non-implementation of 'Internal Quality Assurance System' the manufacturers may re-offer the lot after rectifying the defects. However, in such cases, double the quantity of the samples shall be picked up and tests/checks conducted as clause 5.1.2.1 to 5.1.2.4. In case the samples again fail in any of the tests/checks the entire lot shall be rejected.

6. TESTS

6.1 Leakage & Function Test for Brake Cylinder complete

- The brake cylinder shall be mounted on the fixture to limit the piston stroke to 21mm. Apply 0.7 kg/cm² air pressure and observe the leakage is not exceeded 0.1 kg/cm² in 10 minutes.
- Adjust the piston stroke to 21 mm and apply 3.8 kg/cm² air pressure and observe the leakage is not exceeded 0.1 kg/cm² in 10 minutes.

Signature			
Name & Designation	Prepared by: Man Singh Meena JE/Carriage	Checked by: Mahesh SSE/Carriage	Approved by: Sudhir Singh Director/Carriage

APPENDIX- C

Specification for Brake Caliper Assembly for AMDBS & EPA feature for LHB type coaches

1. SCOPE

This specification covers the technical requirements related to performance, Inspection and testing of Brake Caliper Assembly for Axle Mounted Disc Brake system of LHB type coaches and does not include other necessary provisions of the contract.

2. EQUIPMENT DESIGN

- 2.1 The Brake Caliper serves in the transmission of power from the brake cylinder to the brake disc for certain braking processes and powers.
- 2.2 The Brake Caliper is built with a compact, simple method and to be designed so as to provide simple assembly and disassembly, in particular of the brake linings as well as bolts and sockets.
- 2.3 The Brake Caliper is connected with spring action to the bogie structure over the caliper yoke support and drag link support.
- 2.4 A minimum true specific weight for the Brake Caliper is of great importance.
- 2.5 All parts shall be designed for fatigue strength.
- 2.6 All hinged supports and exposed parts are to be provided with lubricant or appropriate corrosion protection.
- 2.7 Stainless steel pins with non-metallic self-lubricating property bushes, which have long life are to be used in brake calipers for better operation & maintainability where applicable.
- 2.8 For reasons of weight, brake levers for calipers without locking brakes have been built in a lighter version, possible due to the absence of interfering force. An exchange of the two brake calipers must be prevented with a simple construction measure.
- 2.9 The forces and loads are evident on the braking calculation.
- 2.10 The kinematic movements of the brake lining with respect to the brake disc must be examined by the manufacturer for all operational instances. Floatation of the brake caliper must be guaranteed for all operational conditions.
- 2.11 Brake Calipers shall give effective brake radius of 247 mm with lever ratio of 2.17 per disc for all types of coaches except for Generator/Power Car/SLR/Guard Van/Parcel Van type and Double Decker coaches for which caliper ratio is to be 2.48.
- 2.12 Brake Calipers shall be suitable for operation with brake cylinders as specified in Appendix-B.
- 2.13 The brake Pad holder is designed for the installation of the brake Pad according to UIC 541-3.
- 2.14 The brake Pad holder is provided with a simple, safe device for Pad arrest and Pad replacement.
- 2.15 The size of the brake Pad holder is evident on the braking calculation.
- 2.16 If special Pads are used, confusions with normal Pads are to be excluded by using simple constructive measures.

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3. DIMENSIONS AND TOLERANCES

3.1 Manufacturer shall ensure that Brake caliper assembly offered by them shall be suitable for mounting in space as shown in RCF Drawing No. 1268820, 1272112 and 1272116 (Power car) and shall be able to be mounted on mounting brackets and hole sizes shown in these drawings including Bogie frame drawing No. 1267401 201 version-04.

3.2 Brake caliper assembly shall be suitable for fitting UIC type 200x2 cm² brake pads of thickness 35 mm.

4. MANUFACTURE

4.1 Brake caliper assembly shall be manufactured as per drawing and specification submitted by the OEMs/Collaborator.

4.2 Brake caliper assembly to be supplied shall be free from injurious defects that may impair their strength. The firm shall also ensure that all items are adequately treated and painted (excluding flange faces) to prevent corrosion.

4.3 All parts of Brake Caliper assembly shall be painted in grey or black colors with two coats of paints or as specified by IR before supply.

4.4 All hinged supports and exposed parts are to be provided with lubricant or appropriate corrosion prevention.

5. PURCHASE INSPECTION

5.1 The purchase inspection shall be carried out at the premises of the manufactures who are cleared for the regular manufacture of Brake Caliper assembly and registered with RDSO. The following procedure shall be followed: -

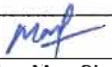
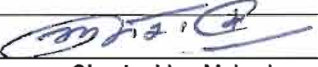
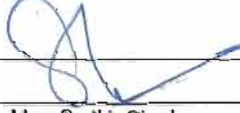
5.2 The Inspecting Authority shall make audit checks of the manufacturing procedure 'Internal Quality Assurance System' to ensure to that the Brake Caliper assembly offered for inspection is manufactured strictly as per 'Internal Quality Assurance System' and the manufacturer has carried out all the tests inspection during manufacturing stage to ensure that the Brake Caliper assembly as well as their components are manufactured strictly to the specification/drawing and quality standard of the collaborator. During audit checks the inspection Authority shall see from the records of 'Internal Quality Assurance' that the Raw material used for the manufacture of Brake Caliper assembly is as per specification laid down.

5.3 Inspection Authority will ensure that each Brake Caliper Assembly has been tested by the manufacturer as per clause 6.0 of this specification. Manufacturer shall have to maintain the internal tests record and submit against the Inspection Authority.

5.4 The Inspection Authority shall conduct the following checks/tests of the Brake Caliper from a lot of 100 Nos. or part thereof.

5.4.1 2% or minimum two numbers Brake Caliper Assembly picked up at random shall be checked for dimensions and tolerances, interchangeability of components, general workmanship and surface finish as per RDSO approved drawings.

5.4.2 10% or minimum five numbers Brake Caliper Assembly picked up at random shall be subjected to tests as given at clause 6.0

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- 5.5 In case the samples picked up fails in any of the tests/checks indicated at clause 5.4.1 & 5.4.2, the entire lot of the Brake Caliper assembly shall be rejected by the Inspecting Authority.
- 5.6 Inspecting authority shall have access to all detailed manufacturing / original collaborator's drawings for all items of equipment. The firm shall be obliged to show these drawings as and when called for.
- 5.7 The inspecting authority may deviate from the agreed procedure if and when found necessary to re-assure that the material is being furnished in accordance with these specifications. In this regard the manufacturer shall not be entitled to object on any ground whatsoever on the nature and procedure of testing that may be followed by the inspecting authority.
- 5.8 During the fabrication, subsequent inspection visit, the brake supplier shall allow IR Inspection Authority for Inspection.

6. TESTS

6.1 Torque Test

- 6.1.1 Check the tightening torque of nut on hanging link, pad holder, Bridge Piece, Brake lever and Hex head screw with the torque wrench. The tightening torque should not be less than the value as specified in drawing/specification approved by RDSO.

Signature			
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APPENDIX- D

Specification for Passenger Emergency Alarm system for AMDBS & EPA feature for LHB type coaches

1. SCOPE


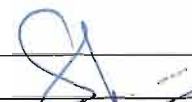
This specification covers the technical requirements related to performance, Inspection and testing of Passenger Emergency alarm system for LHB type coaches and does not include other necessary provisions of the contract.

2. EQUIPMENT DESIGN

- 2.1 Design of the passenger emergency alarm system for LHB type coaches shall conform to UIC 541-1 & UIC 543.
- 2.2 Passenger Emergency Brake Valve is to be directly connected to the Brake Pipe.
- 2.3 Passenger Emergency Brake valve is to be operated through the emergency brake pull box.
- 2.4 The design of the passenger alarm system shall be such that as the handle of passenger emergency brake pull box is moved the air pressure in brake pipe will be exhausted via large orifice (at least 19mm diameter cross section) of passenger emergency Brake valve.
- 2.5 Emergency Brake valve must be designed in such a way that, when the alarm signal is triggered, the pressure in the train pipe falls rapidly to 2 Kg/cm² (+0/-0.5 Kg/cm²) and remains at that level thereafter.
- 2.6 There should be provision of an Isolating cock on branch pipe connecting to Brake Pipe to the Passenger Emergency Valve.
- 2.7 Passenger emergency alarm system shall be reset by a guard's key. The guard's key for passenger emergency alarm resetting shall be 8mm square.
- 2.8 The alarm signal resetting device must be placed inside the vehicle and easy to operate from there. It must be designed in such a way that passengers are not able to activate it.
- 2.9 Each passenger emergency pull box shall be provided with pilot valve and micro switch & indication LED.
- 2.10 The electrical wiring with standardized color coding (indicated below) and 'Push Wire single pole Wago connectors' to be used in Passenger Emergency Alarm Pull Box.

S.N.	Wire	Color
1	Positive (+ve)	Red
2	Negative (-ve)	Black
3	Return (Common)	Blue

- 2.11 Positive and negative wires should be separated in the PEASD (Passenger Emergency Alarm Signal Device) in separate standard make conduits.

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3. PURCHASE INSPECTION

3.1 The purchase inspection shall be carried out at the premises of the manufactures who are cleared for the regular manufacture of Passenger Emergency Brake Valve and Passenger Emergency Alarm Pull Box and registered with RDSO. The following procedure shall be followed:

3.1.1 The Inspecting Authority shall make audit checks of the manufacturing procedure 'Internal Quality Assurance System' to ensure to that the Passenger Emergency Brake Valve and Passenger Emergency Alarm Pull Box offered for inspection is manufactured strictly as per 'Internal Quality Assurance System' and the manufacturer has carried out all the tests inspection during manufacturing stage to ensure that the Passenger Emergency Brake Valve and Passenger Emergency Alarm Pull Box are manufactured strictly to the specification /drawing and quality standard of the collaborator.

3.2 After having satisfied about the quality standards, 10% of each lot of 100 Passenger Emergency Brake Valve and Passenger Emergency Alarm Pull Box shall be tested as per procedure given in clause 4.

4. TESTS

4.1 PASSENGER EMERGENCY BRAKE VALVE

4.1.1 The valve is tested on the test bench by connecting the portion provided for brake pipe side and the outlet portion should be connected to PEAPB or a pipe line with isolating cock with suitable choke provided. Charge the valve to a pressure of 10kg/cm² (± 0.2 kg/cm²). There should not be any leakage if checked with soap water.

4.1.2 Now exhaust the outlet portion through PEAPB or Isolating cock, the air should start escaping through the large orifice (at least 19mm diameter) provided on the valve. The pressure should not fall below 2Kg/cm² (± 0.5 Kg/cm²) and remains at that level thereafter.

4.2 PASSENGER EMERGENCY ALARM PULL BOX (PEAPB)

4.2.1 The Passenger Emergency Alarm Pull Box is tested on the test bench. Apply air at a pressure of 10 kg/cm² through the portion provided for the connection to PEAPB and check for the leakage with soap water.

4.2.2 Now pull the alarm handle of this valve. The air should start escaping through the exhaust provided in the pilot valve.

4.2.3 Check for resetting of alarm signal device by alarm valve reset key.

4.2.4 The PEAPB shall be tested for type tests (for reliability of electronic items as per RDSO spec. ELRS/SPEC/SI/0015) & routine tests (like IR, HV, over voltage protection, burn in tests for electrical items including connecting cables etc.).

4.2.5 For safety of the electrical wire cables in pull box and to avoid damage during fitment, the following points must be ensured-

- Length of cable to be kept approx. 25mm.
- Provision of WAGO type connector similar to WAGO Part No. 224-101
- Ferrule No. for easy identification of wires.
- Heat Shrinkable sleeve over wires to protect it from external damage.

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Name & Designation	Prepared by: Man Singh Meena JE/Carriage	Checked by: Mahesh SSE/Carriage	Approved by: Sudhir Singh Director/Carriage

APPENDIX- E

Specification for Emergency Brake Accelerator Valve for AMDBS & EPA feature for LHB type coaches

1. SCOPE

This specification covers the technical requirements related to performance, Inspection and testing of Emergency Brake Accelerator Valve for LHB type coaches and does not include other necessary provisions of the contract.

2. EQUIPMENT DESIGN

- 2.1 The emergency brake accelerator valve is mounted into the brake pipe.
- 2.2 The emergency brake accelerator valve sense the fast pressure reduction of brake pipe in emergency brake application and vents the brake pipe via large orifice. This causes an equal brake pressure reduction speed over the whole train in the brake pipe.
- 2.3 The emergency brake accelerator will stop to vent the brake pipe between pressure of 2.5 and 1.5Kg/cm².

3. DIMENSIONS AND TOLERANCE

- 3.1 The mounting arrangement of emergency brake accelerator valve in LHB coach underframe shall be as per Alstom Drawing No.1 10113.0.09.100.004. Tenderer may please take note of the fixing holes size etc. as shown in this drawing. Dimensions of the equipment should within space envelope shown in above drawing.

4. PURCHASE INSPECTION

- 4.1 The purchase inspection shall be carried out at the premises of the manufactures who are cleared for the regular manufacture of Emergency Brake Accelerator Valve and registered with RDSO. The following procedure shall be followed:
 - 4.1.1 The Inspecting Authority shall make audit checks of the manufacturing procedure 'Internal Quality Assurance System' to ensure to that the Brake Accelerator Valve offered for inspection is manufactured strictly as per 'Internal Quality Assurance System' and the manufacturer has carried out all the tests inspection during manufacturing stage to ensure that the Emergency Brake Accelerator Valve as well as their components are manufactured strictly to the specification /drawing and quality standard of the collaborator.
 - 4.1.2 After having satisfied about the quality standards, 10% of each lot of 100 Brake Accelerator Valve shall be tested as per procedure given in Clause 5.

5. TESTS

5.1 Leakage Testing

- 5.1.1 The emergency brake accelerator valve is tested on the test bench. Charge the valve to a pressure of 10kg/cm²(± 0.2 kg/cm²). There should not be any leakage in vent hole if checked with soap water.

5.2 Functional Testing

5.2.1 Insensitivity Test

- 5.2.1.1 BP pressure to be reduced at the rate from 5.0 to 3.2 Kg/cm² in 6sec, the air should not start escaping through the exhaust provided on the valve.

5.2.2 Sensitivity Test

- 5.2.2.1 BP pressure to be reduced at the rate from 5.0 to 3.2 Kg/cm² in 3sec, the air should start escaping through the exhaust provided on the valve.

Signature			
Name & Designation	Prepared by: Man Singh Meena JE/Carriage	Checked by: Mahesh SSE/Carriage	Approved by: Sudhir Singh Director/Carriage

APPENDIX- F

Specification for Wheel Slide Protection Unit AMDBS & EPA feature for LHB type Coaches**1. SCOPE**

This specification covers the technical requirements related to Wheel slide protection Unit (WSP) used on Axle Mounted Disc Brake system for LHB type coaches and associated components (Dump Valve, Speed Sensor, Phonic Wheel, Junction Boxes etc.) and does not include other necessary provisions of the contract.

2. PARTICULAR REQUIREMENT

- 2.1 The WSP Unit is to be approved by UIC and is to meet the corresponding requirements especially UIC 541-05.
- 2.2 The WSP Unit shall retain full functionality, regardless of the braking force requested, up to a speed 20% greater than the maximum running speed of the vehicle for which it is designed.
- 2.3 The WSP Unit shall function reliably from maximum speed to a minimum speed of approx. 5 Km/h.
- 2.4 The WSP Unit shall function reliably independent of the moving direction.
- 2.5 The WSP Unit shall have provision for automatically switch on and switch off for electrical supply to WSP Unit on receiving an electrical signal from pressure switch mounted in FP line in Brake Control Panel when the coaches are not in use.
- 2.6 The WSP Unit shall have additional output lines for attachment of speedometer, vacuum toilet system and door sub-systems.
- 2.7 The WSP shall so vary the braking force as to make maximum use of available adhesion and improve it by providing controlled wheel slide.
- 2.8 The WSP Unit is to guarantee a sufficient and safe operation. Moreover, a failure of the WSP Unit should not have any influence on the braking function of this vehicle or of the whole train set.

3. EQUIPMENT DESIGN

- 3.1 The WSP unit shall consist of the following components:
 - 3.1.1 Microprocessor-based control unit (1 pc) consisting of the following
 - I. Power Supply
 - II. Control Unit
 - III. Micro processor
 - IV. Input/Output
 - 3.1.2 Speed sensors (with cable of suitable length) with integrated amplifier (4 Pc) and mounting bracket
 - 3.1.3 Connector Plug (1set)
 - 3.1.4 Anti-Skid Valve / Dump Valve (4 Pc)
 - 3.1.5 Junction boxes with mil-grade connectors & plugs for speed sensors and Dump valves (4 pcs)

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- 3.1.6 Housing (4 pcs)
- 3.1.7 Phonic Wheels (4 pcs) with M8 bolts to IS:1364 Pt.III clause 10.9 and washers to IS:3063 type B.
- 3.1.8 Cable for complete wiring of WSP system.
- 3.1.9 Pressure switch (1 pc) 1.3/1.8 Kg/cm² in FP line (if necessary to switch on/off the WSP depending on the pressure).
- 3.2 The WSP Unit should have sturdy design, long maintenance intervals and easy to repair.
- 3.3 The WSP Unit has to work axle-selective, that means it has to be a four-axle/four channel configuration.
- 3.4 It is to be ensured, that manual correction for wheel diameter is not required by WSP.
- 3.5 The microprocessor wheel slide protection shall have additional module for kilometre performance. So that total kilometre earned by the coach (WSP unit) can be recorded and it can be correlated with the Error Code.
- 3.6 The microprocessor unit housing shall have a standard 19" rack for the minimal execution. Supplier shall indicate maximum temperature and humidity for safe working of his equipment. The unit is proposed to be mounted in non-air conditioned area of the coaches.
- 3.7 WSP software for downloading WSP fault and event logged data shall be provided free of cost by the firm to the user Railways i.e., coaching depots and workshops in sufficient numbers as demanded. Fault data can be downloaded to any Windows laptop/computer using Ethernet cables with RJ45 (on laptop side) to M12 connectors (on panel side). WSP software should have suitable user friendly interface and should store at least the following data w.r.t. time and date for minimum period of three months.

a) WSP errors/faults as per Standard errors codes given below:

Error Description	Error Code
Speed Sensor Failure (Open/Short Circuit) Axle 1, Axle 2, Axle 3 & Axle 4	0011, 0021, 0031 & 0041
Speed Sensor Failure (Gap/Frequency) Axle 1, Axle 2, Axle 3 & Axle 4	0012, 0022, 0032 & 0042
Dump Valve Failure (Short Circuit) Axle 1, Axle 2, Axle 3 & Axle 4	0013, 0023, 0033 & 0043
Dump Valve Failure (Open Circuit) Axle 1, Axle 2, Axle 3 & Axle 4	0014, 0024, 0034 & 0044
Transient Error	0095
O.K.	0099

- b) Dump valve activities with date & time in a customized time period (like in a month, quarterly, yearly etc.); Axle number and reference speed/speed of all four axles.
- c) There shall be provision of continuous recording and storage of speed of all the four axles for minimum 10,000 kms. The sampling rate of data recording should be 100 ms with continuous recording of minimum 30 minutes.

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- 3.8 Supply voltage to microprocessor rack shall be 110V DC nominal.
- 3.9 The supply of the microprocessor shall switch-off automatically after a certain period of time when the vehicle is not in use.
- 3.10 There shall be a dedicated switch/single operation push button for self-test of WSP health and further simple scrolling switch to view the errors including transient errors.
- 3.11 There shall be standard colour codes (indicated below) of wire as standardised by RDSO for easy identification. Also proper ferrule marking to be provided as per approved numbering plan.

S.N.	Wire	Color	Item
1	Positive (+ve)	Red	Speed Sensor
2	Negative (-ve)	Black	
3	Signal	White	
4	Holding	Yellow	Dump Valve
5	Exhaust	Grey	
6	Return (Common)	Green	

- 3.12 Wheel slide protection system shall employ phonic wheel of 80 teeth fitted on to Security disc to FIAT-SIG Drg. No. 1902094 ver-04 on the one end of each axle as shown in FIAT-SIG drawing No. 1268823 ver-02. For the purpose of standardization and enabling physical interfacing with the bearings, it is desirable that the phonic wheel should be as per Parizzi Drawing No. V12014.
- 3.13 Axle box mounted speed sensor (one for each axle) shall be employed as a transmitter and shall fulfil the requirements of this specification. In order to achieve physical interfacing of speed sensor with front cover of axle box and phonic wheel, the sensor shall be fitted in the front cover as per FIAT-SIG Drawing no. 1902713 ver-06 and 1902714 ver-07. The tenderer shall ensure that a gap of 0.9 to 1.4mm between phonic wheel and speed sensor shall be maintained for proper functioning of the wheel slide protection system.
- 3.14 The speed sensor should have the following characteristics:
- Protection against mechanical damage.
 - Resistance to corrosion.
 - Durable and maintenance free.
 - Protection against HF interference.
 - Temperature range from -5 deg. C to + 60 deg. C.
 - Protection on all input and output against reverse polarity, and short circuit connection.
 - Constant output signal, when stationary for functional diagnosis.
 - Permissible insulation test voltage of 1500 VAC and 50 Hz for one minute.
 - Blank flange with cover.

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3.15 The WSP wiring layout & Junction Boxes shall be as per RDSO drawing no. CG-18246 & CG-19005 with latest alterations.

3.16 Design & Wiring scheme for Junction Boxes (as approved by the PUs/RDSO) shall be used.

4. ENVIRONMENTAL AND AMBIENT CONDITIONS

4.1 Environmental and Ambient Conditions for the WSP Unit

4.1.1 Climatic Conditions

4.1.1.1 All materials selected must withstand these external influences during their lifetime without any restrictions on their function and safety.

4.1.2 Protection against Corrosion

4.1.2.1 Due to the climatic conditions defined above, protection against corrosion as well as an anticorrosive design and material selection are of special importance for the parts and components of the WSP Unit and must be realized accordingly. All WSP components to be arranged in the vehicle's underframe are to be painted completely. The following coats of paint have been provided (colours may change).

- Anticorrosive primer beige-red RAL 3012, epoxy metal primer with hardener approved by DBI, layer thickness 60 µm.
- Intermediate coat: sand yellow RAL 1002, PUR priming paint with normal hardener, layer thickness 60 µm.
- Top coat quartz grey RAL 7039, PUR varnish paint with normal hardener, layer thickness 60 µm.

4.1.2.2 Before painting, the inspection addresses with the company labels are to be covered. Bolts, slide surfaces, threaded spindles; valves, etc. are not to be painted. If necessary, the inner walls of the WSP Unit components are to be molatened with corrosion protection oil.

4.1.3 Energy Supply for Electrical/Electronic Components of the WSP Equipment

4.1.3.1 For the energy supply of electrical and electronic components of the WSP Unit a 110 V direct current voltage is available in the vehicles.

4.1.4 Mechanical Strength Requirements

4.1.4.1 All components of the WSP Unit are to be designed according to the mechanical strength requirements stipulated in UIC 566. If required corresponding proofs are to be submitted.

4.1.5 Service Life

4.1.5.1 The coaches manufactured by Indian Railways are designated for a service life of 35 years. The WSP Unit is to be developed and designed accordingly. The supplier should specify the recommended maintenance schedules/practices clearly to achieve the desired life.

4.1.6 Reliability

4.1.6.1 The reliability of the WSP Unit or the parts and components included in the supplier's scope of delivery is to guarantee a mileage of 200,000 km without any failures. The conditions for proving a trouble free mileage are to be coordinated with LHB. The design of all parts has to guarantee that under normal

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operating conditions a mileage of 1,000,000 km will be reached without any replacements. The supplier should specify the recommended maintenance schedules/practices clearly to achieve the desired life.

4.1.7 Design Suitable for Easy Maintenance

The design of the WSP Unit is to allow an easy maintenance.

4.1.8 Environmental and Ambient Conditions caused by the WSP Unit

4.1.8.1 Environmental Acceptability

When selecting the materials, the general aspects of environmental acceptability, the degradability of the materials used without residues, if possible, or the later recycling are to be taken into consideration.

4.1.8.2 Electromagnetic Compatibility

The legal rules concerning the protection requirements for the EMC of electrical parts and components within the scope of supply of the WSP Unit supplier are to be considered and corresponding proofs are to be submitted.

5. DESIGN DOCUMENTS

5.1 The following documentations for the development and design of the WSP Unit are to be prepared by the supplier:

- A set of drawings consisting of drawings and parts lists, including block diagrams, pneumatic flow charts and wiring schemes, list of operating subassemblies etc. (for documentation of electrical and pneumatic components).
- A description of the WSP Unit incl. the description of diagnostics
- An operation and maintenance manual
- A list of spare parts.

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Name & Designation	Prepared by: Man Singh Meena JE/Carriage	Checked by: Mahesh SSE/Carriage	Approved by: Sudhir Singh Director/Carriage

APPENDIX- G

Specification for Brake Indicators for AMDBS & EPA feature for LHB type coaches

1. SCOPE

This specification covers the technical requirements related to performance, Inspection and testing of Brake Indicators for Axle Mounted Disc Brake system for LHB type coaches and does not include other necessary provisions of the contract.

2. EQUIPMENT DESIGN

2.1 The design of the brake indicators shall be of UIC Pattern.

3. PURCHASE INSPECTION

3.1 The purchase inspection shall be carried out at the premises of the manufactures who are cleared for the regular manufacture of Brake Indicators and registered with RDSO. The following procedure shall be followed: -

3.1.1 The Inspecting Authority shall make audit checks of the manufacturing procedure 'Internal Quality Assurance System' to ensure to that the Brake Indicators offered for inspection is manufactured strictly as per 'Internal Quality Assurance System' and the manufacturer has carried out all the tests inspection during manufacturing stage to ensure that the Brake Indicators as well as their components are manufactured strictly to the specification / drawing and quality standard of the collaborator.

3.1.2 After having satisfied about the quality standards, 10% of each lot of 100 Brake Indicators shall be tested as per procedure given in clause 4.

4. TESTS

4.1 Leakage Test

4.1.1 Apply a pressure of 10kg/cm² (± 0.2 kg/cm²). There should not be any leakage if checked with soap water.

4.2 Functional Test

4.2.1 Apply a pressure of 0.5 to 0.6 Kg/cm². Red colours should appears in Window of indicator.

4.2.2 Now release the pressure to 0 kg/cm². Green colours should appears in Window of indicator.

Signature			
Name & Designation	Prepared by: Man Singh Meena JE/Carriage	Checked by: Mahesh SSE/Carriage	Approved by: Sudhir Singh Director/Carriage

APPENDIX-H

Specification for EP assist equipments for AMDBS & EPA feature for LHB type coaches

- EP Assist Brake System should conform to UIC 541-5 so as to meet the latest provision of relevant UIC specification for "Passenger Train" application. The proposed EP Assist System when used along with this basic system shall enable performance of the whole system in conformity of relevant UIC specification.
- Design of EP Assist System shall permit the fitment of disc brakes and WSP system in the brake system, without affecting the functionality of the existing brake system.
- Design of EP Assist System shall be such that in the event of EP 'OFF' or its failure, the braking system of the train should not remain totally inoperative and the brake system shall work as ordinary twin pipe graduated release type of air-brake system without deteriorating its limitations & performance.
- With the proposed EP assist it shall be possible to attach few more coaches without EP assist feature brake system at the rear end of the train formation having coaches fitted with EP assist brake system and such attachment shall be possible without significant change in braking distance of the train and generation of excessive inter coupler forces at any location during compressed air brake application in entire rake.
- The EP Assist Brake System equipment includes:
- 1 Scope of supply for EP assist feature on Axle mounted Disc brake system for LHB Coaches shall cover the following equipments. It is the prerogative of purchaser to procure the system as complete set or in part:

S.N.	Description	Qty. per coach	Remarks
1.	EP Assist Brake Equipments		
	Set of Magnet valves for distributor valve	1 Set	To be as per UIC-541-5
	@Brake Test Boxes	2	
	Junction Boxes	3	
	UIC couplers	4 sockets & 2 plugs	
	Cables for connecting:		
	• Middle junction to brake test boxes	2	To be as per UIC-541-5
	• Middle junction to EP assist magnet valves	1	
	• End junction box to dummy socket	2	
	• End junction box to UIC socket	2	
	• End junction box to UIC plug	2	
	• Middle junction box to end junction box	2	
2.	Mounting bracket	1 Set	

(@):- Brake Test boxes should be provided with indicator which shall be required for checking the connectivity of EP assist brake system.

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- 5.2 Electro-pneumatic module with application and release magnet valves. The equipment to be fitted on coaches shall perform satisfactorily in the voltage range of 50V to 137V DC. Supplier will include protection against sudden variation in voltage like surge in EP assisted brake system devices design itself.
- 5.3 Minimum 9 core cable according to UIC-541-5 should be used between the junction boxes and inter coach connections.
- 5.4 Cable for connection of electro pneumatic magnet valves on DV and middle junction box to brake test box with indicator.
- 5.5 Brake test box to be provided on both sides of each coach as per UIC guidelines for testing of EP assist feature in the rake.
6. The inspection of above EP brake equipment's should be carried out as per respective internal test schemes of the firm which have to be submitted by them for RDSO approval.
7. Firm should offer UIC standard couplers (with pilot contact/micro-switch type) from the UIC approved sources mentioned in Appendix-L of UIC 541-5.
8. A wiring scheme for the EP assist system between locomotive & coaches and at the coach level is given as a reference in Annexure-III.

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APPENDIX-I

Laptop Specification for Downloading and Analysing of WSP data LHB Brake System:

The minimum required parameters for the laptop are given below: -

S.N.	Description	Required Parameter
1.	Processor Make	Intel
2.	Processor Description	Intel Core i5
3.	Processor Generation	11
4.	Type of RAM	DDR4
5.	RAM Size (GB)	8 GB
6.	Type of drives used	HDD
7.	HDD Capacity	500 GB
8.	Operating System	Window 10 Home
9.	Wireless Connectivity	Yes
10.	Display Size (Inch)	14 Inch
11.	On Site OEM Warranty	3 Years

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ANNEXURE-I

1. OVERALL DIMENSIONS OF COACH

1.1	Gauge	1676 mm
1.2	Length over coach body	23540 mm
1.3	Length over buffer	24000 mm
1.4	Width over body	3250 mm
1.5	Buffer centres	1956 mm
1.6	Maximum distance between wheel	12340 mm
1.7	a. Maximum operating speed [AC(EOG) & Generator Car]	160 kmph
	b. Maximum operating speed [AC (SG)& Non-AC]	120 kmph
1.8	a. Maximum test speed [AC(EOG) & Generator Car]	180 kmph
	b. Maximum test speed [AC (SG)& Non-AC]	140 kmph
1.9	Wheel diameter	New 915 mm Worn 845 mm
1.10	Wheel base	2560 mm
1.11	Minimum clearance above rail level	91 mm under loaded and worn condition
1.12	Maximum bogie rotation & swing	3.5°, 82 mm

2. RAKE COMPOSITION:

2.1	For speed 160 kmph (EOG type)	
2.1.1	Generator car cum luggage & brake van (Power Car)	2
2.1.2	AC first class	2
2.1.3	AC chair car	14
2.2	For Speed 120 kmph (SG type)	
2.2.1	AC-three tier (SG)	3
2.2.2	AC -2 tier (SG)	2
2.2.3	AC 1st (SG)	1
2.2.4	SLR	2
2.2.5	SCN	10
2.2.6	GS	4

3. TENTATIVE TARE AND GROSS WEIGHT OF COACHES (Tonnes)

3.1 For Speed 160 kmph (EOG type)

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	COACH TYPE	TARE	GROSS
3.1.1	Generator car cum luggage & brake van	53.2	56.6
3.1.2	AC first class (EOG)	41.0	48.3
3.1.3	AC chair car(EOG)	40.9	48.9
3.1.4	AC Ist Sleeper	43.0	47.8
3.1.5	AC-3T (EOG)	46.5	54.5
3.1.6	AC-2T (EOG)	43.0	50.4
3.1.7	AC Hot Buffet Car	40.9	48.9

3.2 For Speed 120 kmph (SG type)

	COACH TYPE	TARE	GROSS
3.2.1	AC Three tier (SG)	50.50	58.50
3.2.2	AC Two tier(SG)	48.00	55.04
3.2.3	AC-Ist (SG)	45.90	50.70
3.2.4	SLR	35.40	44.50
3.2.5	SCN	36.28	42.91
3.2.6	GS	35.29	50.49

4. LOCO PARTICULARS

4.1	Length of Loco	19974 mm
4.2	Gross mass	113 t
4.3	Horse power	3600

(Multiple consists of two locos may be used for 18 coach train haulage).

5. ENVIRONMENTAL CONDITIONS

5.1	Maximum temperature under sun	70 deg. C
5.2	Maximum temperature under shade	45 deg. C
5.3	Minimum temperature	-10 deg. C
5.4	Altitude	Sea level to 1776 meter
5.5	Humidity	100% saturation during rainy Season
5.6	Rain falls	Fairly heavy
5.7	Atmosphere during hot weather	Extremely dusty and desert terrain in certain areas

Environment: Coaches shall be working in coastal area with salt laden and corrosive atmosphere.

6. TRACK PARAMETERS

6.1	Maximum gradient	1:37
6.2	Sharpest curvature	145.83 m radius
6.3	Max. super elevation	185 mm

7. INTERFACES OF THE BRAKE SYSTEM

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7.1 Mechanical interfaces

- 7.1.1 The supplier specifies the interfaces of all brake components with the car-body or with the bogie thus allowing the design of the corresponding mounting parts.
- 7.1.2 The supplier of the brake system specifies the single connecting points of the parts and components at the car-body or at the bogie as well as their position. Moreover, the supplier has to specify corresponding requirements or restrictions.
- 7.1.3 The supplier specifies the single weights (which can be summarized appropriately) of all components of the brake system to be mounted to the vehicles in order to guarantee the mechanical strength of the connecting points.
- 7.1.4 The supplier guarantees all internal interfaces of the brake system (car-body equipment/bogie equipment/wheel slide protection equipment).
- 7.1.5 If the components included in the scope of delivery of the brake supplier are to be connected with the brake pipes of the car-body and/or the bogie, they are to be suitable for ferrule connections. Ferrule connections type B are used (Ferrule are made of stainless steel, screwed connections are made of galvanized steel, the car-body pipes are made of stainless steel).

7.2 Electrical interfaces

- 7.2.1 In order to guarantee an easy exchangeability, the single electrical/electronic parts of the brake control system are to be connected by means of plug in connectors, if possible. The plug in connections and the mating connectors for connecting the electrical/electronic components are to be delivered by the supplier of the brake system.
- 7.2.2 The supplier of the brake system defines the connection of the brake control system to the vehicle's energy supply system. The power consumption and the requirements on the energies to be supplies are to be specified (e.g. voltage tolerances, ripple etc.).

7.3 Pneumatic interfaces

- 7.3.1 The hose coupling heads of the pneumatic system have to correspond to those of the existing vehicles.
- 7.3.2 The supplier defines the requirements of the pneumatic brake system on the components generating the compressed air under the aspect of a steady readiness for braking or the corresponding safety.

7.4 Interfaces with the wheel slide protection unit

- 7.4.1 The interfaces with the wheel slide protection are technically to be coordinated according to the integration of the wheel-slide protection into the brake system of the brake supplier. As far as known, these interfaces are situated at the pressure switches 1.3/1.8 Kg/cm² in FP line (functional and electric interface) and at the valves of the wheel slide protection (functional and pneumatic interface).

7.5 List of Applicable Drawings

S.No.	Drawing No.	Description
1.	LW02100 (RCF)	Axles for FIAT Bogies
2.	LW03002 (RCF)	Bogie Frame Assembly with air spring
3.	DD11235 (RCF)	Underframe complete for Double Decker

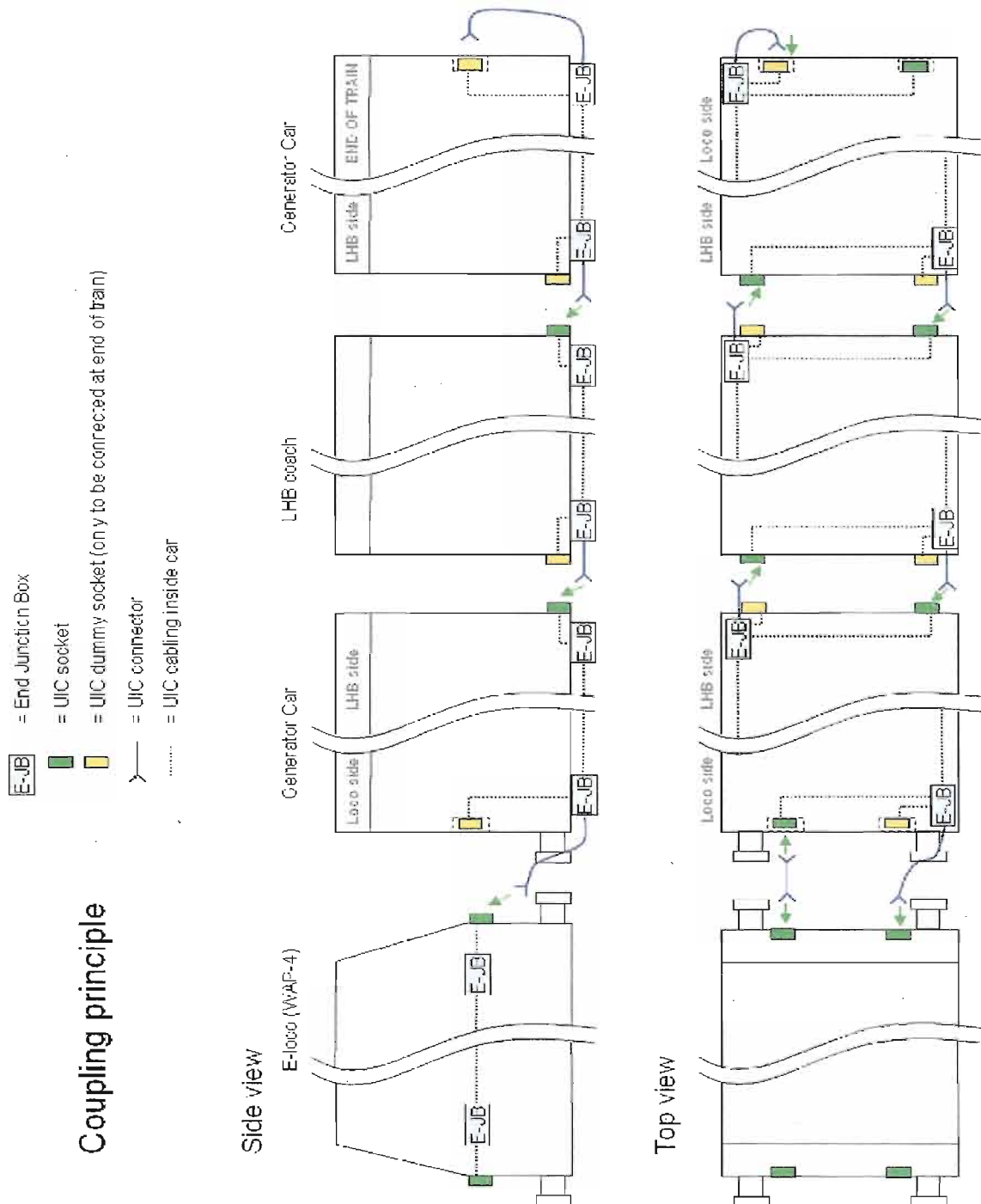
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4.	DD10250 (RCF)	Body Shell assembly for Double Decker Coach
5.	MI000524 (RCF)	Axle Mounted Brake Cylinder
6.	MI001696 (RCF)	DV port hole location on brake control panel
7.	LD36001	Layout of air brake on underframe for Double Decker
8.	1 10113.0.09.100.002 (Alstom)	Compressed air brake mounting NPP end
9.	1 10113.0.09.100.003 (Alstom)	Compressed air brake mounting PP middle
10.	1 10113.0.09.100.004 (Alstom)	Compressed air brake mounting NPP middle
11.	1 10113.0.09.100.005 (Alstom)	Compressed air brake mounting PP end
12.	1272112 (FIAT-SIG)	Brake equipments
13.	1902094 (FIAT-SIG)	Securing Disc
14.	1902713 (FIAT-SIG)	Axle end cover
15.	1902714 (FIAT-SIG)	Axle end cover
16.	V12014 (PARIZZI)	Frequency Generator (Toothed wheel)

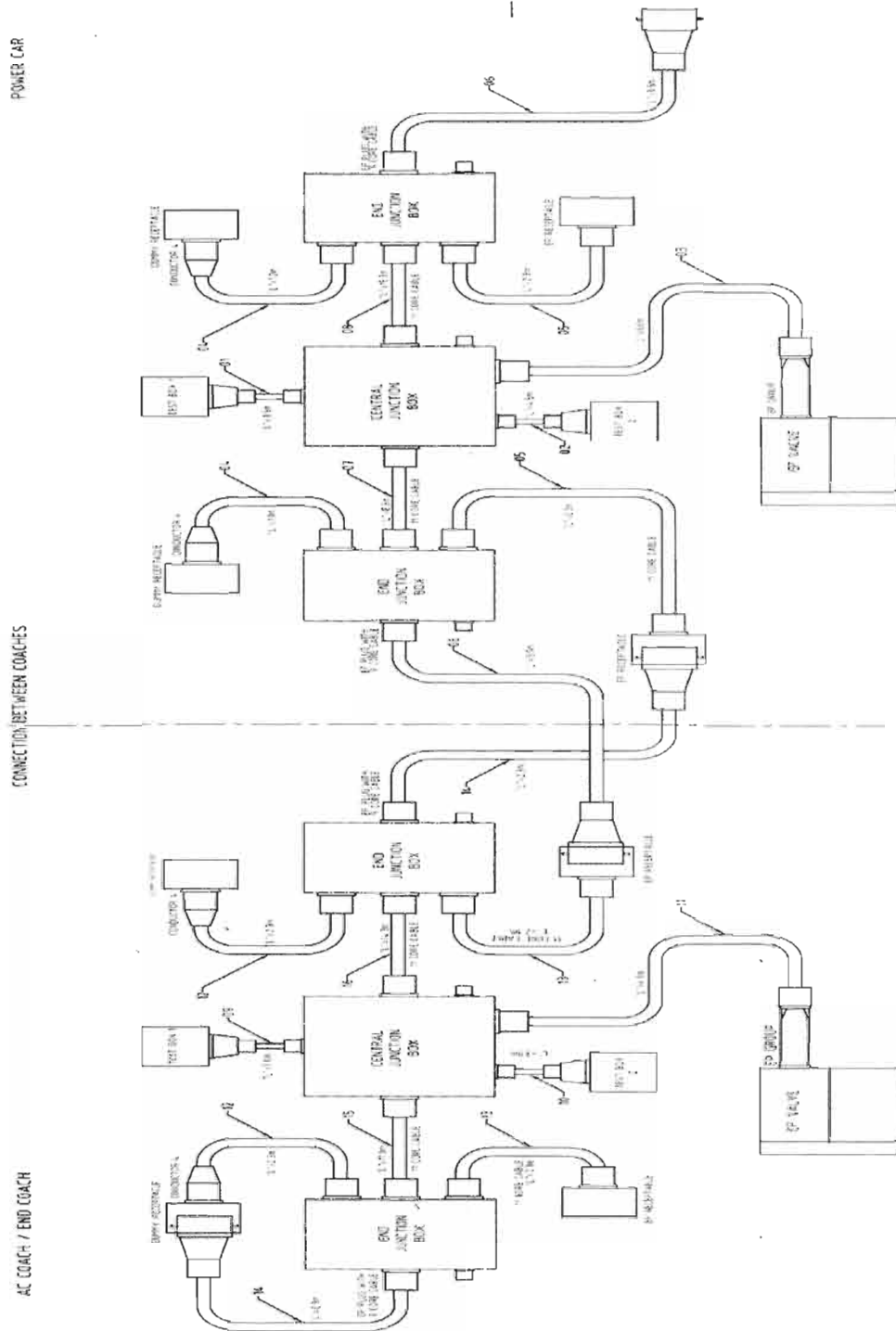
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Annexure-II

EP ASSIST WIRING SCHEME BETWEEN LOCOMOTIVE & COACHES



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Annexure-III**EP ASSIST WIRING SCHEME AT COACH LEVEL (INDICATIVE)**

Signature			
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Annexure-IV

SCHEDULE OF TECHNICAL REQUIREMENTS

INFRASTRUCTURE & TESTING FACILITIES REQUIRED FOR MANUFACTURE OF AXLE MOUNTED DISC BRAKE & EP ASSIST BRAKE SYSTEM FOR LHB TYPE BG MAINLINE COACHES.

1.0 SCOPE

- 1.1 This section covers the infrastructural requirements for manufacture of Axle Mounted Disc Brake & EP Assist Brake System for LHB type BG mainline coaches.

2.0 REQUIREMENTS

- 2.1 All vendors seeking registration with approving authority must fulfil the requirements of this schedule.
- 2.2 The firm should have adequate plant, machinery and manufacturing capacity for manufacture and supply of Axle Mounted Disc Brake & EP Assist Brake System for LHB type BG mainline coaches within the delivery schedule.

3.0 PLANT, MACHINERY AND INFRASTRUCTURE REQUIREMENTS

- 3.1 The Manufacturer shall have adequate space and covered area with cemented floor to accommodate the following and for smooth logistics:
- a) Damp-free place for storage of raw materials.
 - b) Adequate manufacturing area.
 - c) Finishing, Assembly and Inspection area.
 - d) Storing and dispatch of finished products.

4.0 TESTING FACILITIES

The manufacturer shall have the test benches/equipment of following items to test the products as per the requirements of the specification, installed in a workstation.

4.1 Test benches/equipment of following items are required:

S.N.	Description	Specification
1.	Brake Container Module	Appendix-A
2.	Brake Cylinder	Appendix-B
3.	Brake Caliper unit (including torque testing arrangement)	Appendix-C
4.	Passenger Emergency Alarm Valve (PEAV)	Appendix-D
5.	Passenger Emergency Alarm Pilot Valve with micro switch & indication Device	Appendix-D
6.	Emergency brake accelerator valve	Appendix-E
7.	Wheel Slide Protection Unit (WSP)	Appendix-F
8.	Pressure Switch	Appendix-F

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9.	Dump Valve	Appendix-F
10.	Speed Sensors	Appendix-F
11.	Brake Indicator	Appendix-G
12.	EP Assist Unit	Appendix-H
13.	Guard Emergency brake valves	-
14.	Roller operated Cam valve	-
15.	Isolating cocks	-
16.	Distributor Valve	As per CK-209

4.1.1 In addition to above machines, the standards room/Inspection should also have a minimum of two nos. of the following instruments:

- Surface Plate/Table for measurement Components.
- Vernier Caliper with digital indicator.
- Sufficient no. of gauges for measuring critical dimensions as defined in the QAP. One should be preserved as a master gauge set, one should be used in Standard room and two should be for regular use on shop floor.
- Digital Surface finish tester.
- Digital Vernier type height gauges.
- Measurement steel tape.
- Feeler gauge sets.

5.0 QUALITY CONTROL REQUIREMENTS

- The firm must ensure that proper analysis is being done on regular basis to study the rejections at various internal stages and this analysis is well documented.
- Records for traceability of product/parts thereof from raw material up to finished stage should be available.
- There should exist a quality manual of the firm indicating the extent of control for production and testing.
- Documented system for calibration of testing & measuring equipment and records thereof.

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INDIAN RAILWAYS



सत्यमेव जयते



Document content	Technical Specification-	Yes
	Schedule of Technical Requirement	No
Description of item	NON-ASBESTOS BASED ORGANIC BRAKE PADS FOR LHB TYPE COACHES EQUIPPED WITH AXLE MOUNTED BRAKE DISC AND VANDE BHARAT TRAIN SET INCLUDING EMU-US & MEMU-US COACHES EQUIPPED WITH WHEEL MOUNTED BRAKE DISC ON INDIAN RAILWAYS	
Remarks	Nil	


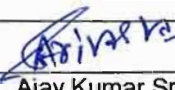
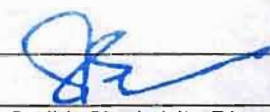
S. No.	Month/Year of Issue	Revision/ Amendment	Page No.	Reason for Amendment
1.	Jan, 2014	First Issue	-	-
2.	September, 2016	Amendment-1	3	To include the ISO Doc. No. September, 2016 Amendment-1 3 00-0-7.1-1 1, New sub clause No.1.2 added under clause no. 1 of Scope.
3.	April, 2023	Revision-1	8,9,10 & 11	To improve clarity with focus on functional requirements for enhancing indigenous vendor base.
4	Dec 2023	Revision -2	All	In reference to Railway Board letter no. 2023/M(W)/II/509/3 dated 07.08.2023 Brake Pad for Vande Bharat type coaches included.

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Research Designs and Standards Organization
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Ref: CG-WI-4.2.1-1 Ver.3.1	Page 3 of 28	Latest (Rev/Amend) issue: Dec 2023	No.RDSO/2013/CG-01 -(Rev.2)
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SPECIFICATION FOR NON-ASBESTOS BASED ORGANIC BRAKE PADS FOR LHB TYPE COACHES EQUIPPED WITH AXLE MOUNTED BRAKE DISC AND VANDE BHARAT TRAIN SET INCLUDING EMU-US & MEMU-US CAR EQUIPPED WITH WHEEL MOUNTED BRAKE DISC ON INDIAN RAILWAYS

1.0 FOREWORD


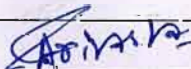

- 1.1 This specification intended to covers the characteristics required for non-asbestos based organic brake pads of LHB type coaches equipped with Axle Mounted Brake Disc and Vande Bharat Train Set including EMU-US & MEMU-US Car equipped with Wheel Mounted Brake Disc on Indian Railways. The general features of LHB, Vande Bharat and EMU-US & MEMU-US type coaches are given in Appendix-I.
- 1.2 UIC Code 541-3 (latest) for 'Brakes – Disc brakes and their application – General conditions for the approval of brake pads' may be referred to in conjunction with this specification.
- 1.3 In the event of conflict between this specification and any other standards or specification quoted herein, the requirement of this specification shall prevail.
- 1.4 **General:**
- 1.4.1 Following shall be applicable when this item appears in RDSO's vendor directory:
"All the provisions contained in RDSO's ISO procedures laid down in Document No. QO-D-7.1-11 dated 07.07.2023 (titled "Vendor-Change in approved status") and subsequent versions/amendments thereof, shall be binding and applicable on the successful vendor/vendors in the contracts floated by Railways to maintain quality of products supplied to Railways."
- 1.4.2 The Govt. of India policy on 'Make in India' shall apply.

2.0 SCOPE

This specification covers the technical requirements related to manufacture, supply, inspection, testing and performance of non-asbestos based organic brake pads for LHB type coaches equipped with Axle Mounted Brake Disc and Vande Bharat Train Set including EMU-US & MEMU-US Car equipped with Wheel Mounted Brake Disc on Indian Railways and does not include all the necessary provisions of the contracts.

3.0 GENERAL REQUIREMENTS

- 3.1 The composition brake pads made of organic materials work on cast iron/steel friction discs which are fitted to the axle/wheel of the wheel set.
- 3.2 This specification defines the necessary characteristics required of non-asbestos based organic brake pads, whose average coefficient of friction is 0.35:

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- 3.3 The composition of the material and the manufacturing process for series production of brake pads must always conform to that of the prototype brake pads for which approval has been given.
- 3.4 The use of asbestos and other fibers harmful to health is prohibited.
- 3.5 The use of lead and zinc in the metal state or in the form of compounds is not recommended. Use of other substances of any composition, which could cause a risk to health and the environment in the form of dust, fibers, particles or gas released during use of the composite brake pads, is not recommended.

PPM level of these compounds if present in traces should be below the OSHA or ROHS or REACH guidelines.

- 3.6 The composition of the material from which the brake pads are made shall be so selected, that the best compromise is obtained between:

- the frictional properties,
- the wear and the life of the pads and
- the aggressiveness against the brake disc.

- 3.7 The different constituents must be evenly distributed in the mass of the material. The material must be free from lumps, blowholes and other defects.

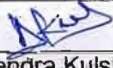
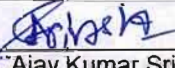
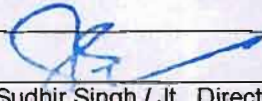
- 3.8 The characteristics laid down in this specification must be maintained for the complete usable thickness of brake pads.

4.0 FRICTIONAL REQUIREMENTS

- 4.1 As far as possible the co-efficient of friction shall be independent of the extent to which the pads are bedding-in, the specific pressure, the temperature and the weather effects. The frictional requirements for brake pads to be used in LHB and Vande Bharat type coaches are described in the test programmes given in Appendix – IV, V and VI. The permissible coefficients of friction are described in Appendix- III.

- 4.2 The tolerance bands for the instantaneous (μ_a) and average coefficient of friction (μ_m) on a dry disc shall be as per Appendix-III. At least 80% of the mean co-efficient of friction values must lie within the band.

- 4.3 The average values of mean coefficients of friction at a speed of 120 km/h at the highest contact force shall not vary more than 10% upwards or 5% downwards from the nominal coefficient of friction given in Appendix III. At speeds above 120 km/h, the average values of these mean coefficients of friction shall not vary more than 10 % upwards or 10 % downwards from the nominal.

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Typical values of tolerances for Instantaneous coefficient of friction

Speed (km/h)	Lowest μ	Highest μ
0	0.280	0.460
140	0.280	0.420
200	0.250	0.420

Typical values of tolerances for Mean coefficient of friction

Speed (km/h)	Lowest μ	Nominal μ	Highest μ
0	0.310	0.350	0.420
140	0.310	0.350	0.390
200	0.270	0.310	0.390

4.4 Criteria for bedding brake applications

The mean coefficient of friction of the bedded state shall be defined as the average of measured mean coefficient of friction of the last 5 braking stops carried out during the bedding section.

During the bedding-in phase, the mean coefficients of friction shall not exceed the following variations from the nominal value of the bedded state:

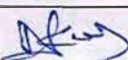
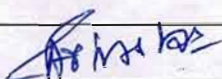

- $\pm 30\%$ from the 11th bedding-in brake application until 30 % of the bedding-in is finished.
- $\pm 15\%$ during the rest of the bedding-in process.

4.5 The coefficient of friction under severe winter conditions can be evaluated by the application of Appendix-VI.

The mean coefficients of friction of wet brake applications with the highest clamp force in the test programme Appendix-VI (simulation of severe winter conditions) should not be less than the value $\mu_m = 0.150$. For the remaining brake applications the absolute value should not be less than $\mu_m = 0.100$.

4.6 In wet conditions, with the highest contact pressure of test scheme given in Appendix-V, the average coefficient of friction must not vary – all other things are equal - by more than $\pm 15\%$ compared with the average coefficient of friction obtained during braking under dry conditions. The average coefficient of friction of the other brake applications to a stand of this test scheme (Appendix-V) shall not under run the absolute value of $\mu_m = 0.25$ under otherwise similar conditions.

4.7 Drag braking followed directly by a braking to a stop gives rise to particularly high temperature. Even at this temperature ($\geq 140^\circ\text{C}$), maximum of 400°C on the opposed rubbing surface, the average coefficient of friction under otherwise similar conditions may not vary by more than $\pm 15\%$ from the average of brake applications initiated from the cold ($\leq 60^\circ\text{C}$) and dry condition.

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- 4.8 During continuous brake applications, the coefficient of friction shall stay inside the band defined by $\mu_{min} = 0.250$ and $\mu_{max} = 0.500$ during the entire braking time. The coefficient of friction shall not vary more than 0.05 during any minute
- 4.9 During the tests on the friction test bench, no combustion phenomena, blistering, exudation of bonding material, continuous squealing, strong odour, excessive smoke or other defects should be observed on the brake pads.
- 4.10 The wear on the brake pads should be uniformly distributed over the entire depth of the pad. It should be as low as possible and be largely independent of the type of brake load application. The average wear value found by weighing should not exceed 0.55 cc/MJ.
- 4.11 The average wear rate recorded during dynamometer testing at RDSO on prototype brake pads for which approval has been given will form the basis for further quality checks. The wear rate in subsequent dynamometer testing should not be more than 20% higher than the wear rate of prototype brake pad (not exceeding 0.55cc/MJ in any case) for which approval has been given. The manufacturers will specify the wear rate in their QAP as obtained in prototype approval test, for use during any quality checks.


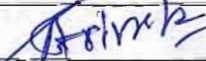

5.0 GEOMETRICAL CHARACTERISTICS

- 5.1 Organic brake pads (two half) are used with thicknesses of 24 or 35 mm. The controlling dimension of a brake pad half with a rubbing area of 200 cm² shall conform to the requirements given in Appendix-II.
- 5.2 The design of the brake pads must enable them to wear uniformly to a frictional material thickness of 5 mm including carrier plate, without the reinforcement, if fitted, coming into contact with the brake disc.
- 5.3 The brake pads shall be affixed to the vehicle by pushing them into a dovetail shaped cut out in the brake pad holder and locking them in. The design of the dovetail section is shown in Appendix-II.
- 5.4 The brake pads shall not deform under the effect of heat or humidity so that they can no longer be fitted or removed.
- 5.5 In no case may the arrangement of the rubbing parts cause the pad to overlap the outer or inner diameter of the rubbing ring when the vehicle has average spring deflection.

6.0 MECHANICAL, PHYSICAL AND CHEMICAL FEATURES

6.1 Manufacturer's Product Specification:

- 6.1.1 The manufacturer of organic brake pads shall submit a product specification, on which sufficient mechanical, physical and chemical characteristics (i.e. density, hardness, compression modulus, cross braking strength, acetone extract, ash content and flammability, thermal conductivity and water absorption etc.) are given, so that by quality testing or subsequent inspections it is possible to check that these characteristics have not changed and the brake pad actually conforms to the approved brake pads. The value

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of density, hardness, compression modulus, cross braking strength, acetone extract, ash content and flammability shall be given for acceptance purpose and specified in their QAP. The test procedure for these properties shall be as per Appendix – VII of the specification.

6.2 Mechanical Requirements

6.2.1 When delivered and up to the assembly on the vehicle (after holding in stores) the frictional material must be sufficiently homogeneous that its assembly, as well as its use up to the wear limit, is neither affected by defects (craters, bubbles, cracks, etc.), which could cause brittleness, nor by any deformation or cracking. Consequently, a loss of rubbing elements or parts of the rubbing material on the track should be prevented.

6.2.2 The method of bonding the frictional material to the carrier plate is left to the manufacturer. This shall be done in such a way that the operating forces that occur during service can be withstood.

6.3 Thermal Requirement:

6.3.1 The frictional material shall not cause any thermal damage on the brake disc (burn marks and thermally initiated cracks, which can lead to fracture of the disc). Also the adjacent rubbing surface shall not be attacked nor should it tend to form metallic inclusions.

6.3.2 The brake pad shall withstand the thermal loading within the limits of the test scheme without burning, melting, or forming large deposits on the brake disc or wearing unusually quickly.

6.3.3 The brake pads in service should give least/controlled smoke emission and should not give away unpleasant burning odour.

6.3.4 The frictional material shall be able to withstand a temperature of **400°C**, without worsening of its properties, measured on the rubbing surfaces of the brake pads.

7.0 MARKING

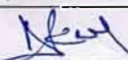
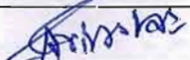

7.1.1 On the back of each part of an approved brake pad, there shall be following marking:

- Manufacturer's name / short name
- Week/month & Year of manufacture
- Pad-abbreviation (material)
- Condemning limit
- Type designation of brake pad i.e. "UIC-xx"- to indicate "UIC-42" for a type 4.2 pad.

These marks shall preferably be stamped, engraved or punched and shall be so applied, that each pad can still be identified even after it has work to its condemning limit.

8.0 Process of Approval-

8.1 Categories of Manufacturers/Vendors/Firms

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8.1.1 Firms having UIC approved brake pads.

8.1.2 Firms already manufacturing friction materials for Indian Railway.

8.1.3 Firms not having experience of manufacturing friction materials.

8.2 Conditions for compliance

8.2(a) The manufacturer will submit the following-

- The detailed drawings made in accordance with the Appendix-II.
- The dynamometer test results as per Test Scheme given in Appendix- IV, V and VI.
- The product specification, specifying the acceptance value and test reports of physical, mechanical and chemical characteristics as given in para 8.6.1.
- The details of requisite manufacturing and testing facilities including full scale rail dynamometer.

8.2 (b) A supplier / manufacturer whose organic brake pads are approved in International traffic (for passenger coaches for maximum speed of 200 Kmph) as per regulations of UIC 541-3 OR will submit the following details in addition to as mentioned in para (8.2 (a))-


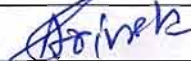

- A copy of valid UIC approval certificate issued to their firm for manufacture and supply of that particular type of organic brake pads.
- The list of past supplies of particular brake pads made by them to different rail road.
- If UIC approved firm has an Indian agent, a copy of memorandum of understanding (MOU) jointly signed by the Indian agent authorized to import particular type of brake pads for Indian Railways.

8.2 (c) Additional requirements for the manufacturers under category 8.1.3

- Must have technical collaboration with a reputed manufacturer who has experience in manufacturing and supplying of rail road organic brake pads for passenger coaches up to maximum speed of 200 kmph.
- Submit a copy of memorandum of understanding (MOU) jointly signed by the supplier and collaborator. Authenticity of MOU of Collaborator will be verified by RDSO at initial level before acceptance of application.
- Submit the list of past supplies and their satisfactory performance by the collaborator to different rail road along with specifications followed for manufacture of brake pads for last three years.
- The manufacturer shall furnish collaborator's detailed information including type and acceptance test report as per Test Scheme given in Appendix- IV, V and VI other details in accordance with Clause No. 6.1.1.

8.3 PROTO TYPE TESTING

- Supplier will submit 5 pairs (5 LH & 5 RH) of brake pads for testing on RDSO's own brake dynamometer as per test scheme given in Appendix – V, VI and VII. The average wear value found by weighing should not exceed the value specified in clause 4.10. The brake pads tested on the dynamometer must meet the requirements concerning friction and temperature given in clause 4.0 of this specification.

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- ii. Product shall be tested for physical, mechanical and chemical characteristics mentioned in para 8.6.1.

8.4 FIELD TRIAL

After prototype approval, the field trial shall be carried out on 1000 pair (1000 LH & 1000 RH) brake pads which shall undergo the field trials for nine months or 1,50,000 km whichever is earlier. Field trial will be carried out on LHB and Vande Bharat type coaches as the case may be. The field trials shall be monitored by RDSO.

Parameters to be monitored in field trial-

- Performance of the brake pads esp. its possible deleterious effects on brake disc.
- Wear rate of Brake pad.
- Physical condition of brake pad i.e. crack, broken etc.

Note-. In case of UIC approved manufacturer at least 500 Pairs (500 LH & 500 RH) of brake pads shall undergo field trial for six months or 1,00,000 Km whichever is earlier. However the field trial may be dispensed with, at the discretion of RDSO.

Detailed field trial scheme shall be issued by RDSO separately.

- 8.5 Based on technical evaluation and successful field trial results, further action will be taken for approval of the firm.


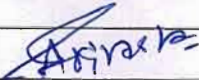
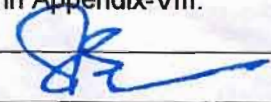
8.6 For supplier/manufacturers already cleared for supply

- 8.6.1 The supplier shall get his Quality Assurance Plan approved by RDSO before undertaking manufacture of the brake pad. The Quality Assurance plan must contain the details of process of manufacture, process controls, quality records maintained, specific wear rate and values of following characteristics.

- | | | |
|--|---|--|
| a) Density | : | Variation should be within ± 0.10 units |
| b) Ash content (in %) | : | Variation should be within $\pm 3\%$. |
| c) Acetone extract | : | Should be less than 3% |
| d) Hardness | : | To be within ± 10 Units. |
| e) Cross-breaking strength (Min.): | | |
| f) Compression modulus value : | | Range (Min. to Max.) |
| g) Flammability (Min.) : | | First smoke $>400^{\circ}\text{C}$, and ignition at $> 700^{\circ}\text{C}$ |
| h) Thermal conductivity (Min.) : | | |
| i) Water absorption (Max.) : | | |
| j) Weight loss in drag test (application no. 69-72) of appendix IV | | |

The base values of above parameter shall be taken as per the actual test results obtained on prototype brake pads for which type approval was given.

The location for taking test specimen from brake pad is given in Appendix-VIII.

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- 8.6.2 The supplier shall undertake full-scale dynamometer test on the brake pads under supply to Indian Railways as per test scheme given at Appendix- IV, V and VI. For this purpose requisite samples shall be picked up by RDSO/Inspecting Authority and the supplier shall arrange testing of the pads. To audit the quality control, RDSO at their discretion may pick up samples for dynamometer testing at RDSO/Lucknow.

The frequency of testing samples on dynamometer should be after manufacture of every 20,000 pairs of brake pads. The dynamometer test may be witnessed by inspecting official or authorized representative of IR. The weight loss during dynamometer testing must be witnessed by inspecting official.

The thermal conductivity and water absorption test to be carried out yearly. In case testing facilities are not available in firm premises, the test may be conducted in labs meeting accreditation criteria as detailed in RDSO ISO procedure.

- 8.6.3 In case dynamometer is under break down due to any of the reasons, the dynamometer testing shall be conducted at the collaborator plant or at RDSO. The manufacturer shall bear the testing charges in case pads are tested at RDSO.

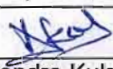
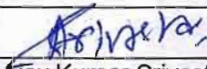
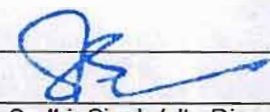
9.0 INSPECTION

- 9.1 The inspection of the brake pad shall be carried out by Indian Railways or their authorized representative at the premises of the supplier.

- 9.2 The inspection will be carried out as per the following procedure.

- i) Supplier to submit pre-inspection report for the lots offered for inspection as per the approved QAP of the firm.
- ii) Supplier to ensure traceability of each pad to it's parent mix batch number.
- iii) The Inspecting Authority shall inspect the quality records maintained by the supplier for the entire lot.
- iv) Each lot offered for inspection shall consist of 2000 numbers (1000 LH & 1000 RH) brake pads or part thereof and shall represent the mix batch numbers out of which these brake pads have been manufactured.
- v) 20 numbers of every offered lot of 2000 numbers (1000 LH & 1000 RH) brake pads are part thereof will be selected at random and checked for dimensional accuracy. Dimensions are to be checked as per approved drawing of manufacturer. However, it is to be ensured that pads from different mix batches will be taken up for inspection.
- viii) One brake pad selected at random from the above lot shall be tested as per Appendix- VII for the following characteristics. In case, two brake pads are selected for the test, then the test specimen for density, ash content, hardness, acetone extract, Hardness and compression modulus and shall be taken from the one pad and only the test for specimen for cross breaking strength and Flammability shall be taken from the another pad.

- a) Density
- b) Ash content
- c) Acetone extract
- d) Hardness

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- e) Cross-breaking strength
- f) Compression modulus value
- g) Flammability
- h) Any other test specified by RDSO

The pads shall be accepted based on acceptable readings given in the approved QAP of the supplier. The test methods are given in Appendix –VII.

- ix) One brake pad selected at random from the lot shall be subjected to any other test as decided by the manufacturer and RDSO.

- 9.3 The brake pads shall conform to the requirements mentioned in clause 9.2. Should any of the samples selected as per clause 9.2 fail to meet the requirements of any of the requirements, double the quantity of samples stipulated in clause-9.2 shall be selected for tests. Should any of the brake pads fail to meet the requirements of any of the tests on retesting, the entire quantity of brake pads offered for inspection shall be rejected and brake pads shall be rendered unserviceable.

10.0 TESTING FACILITIES

- 10.1 Supplier shall have adequate facilities for checking of brake pads according to dimensional tolerances shown on drawing.
- 10.2 The supplier shall have adequate facilities for determining the characteristics laid down in clause 9.2.
- 10.3 The supplier shall have in house full scale dynamometer facilities to test the brake pad as per test scheme laid down in Appendix- IV, V and VI. The brake pads tested on full-scale dynamometer shall meet the requirements given in clause 4.0.



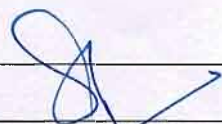
11.0 PACKING

The brake pads shall be securely packed in cardboard crates with enough cushions so that there is no damage to brake pads during transit.

12.0 WARRANTY

The composite brake pad will have warranty against any manufacturing defect noticed during the service before the condemning limit is reached or 24 months from the date of supply whichever is earlier. Manufacturer shall replace the defective brake pads within a month's time from the receipt of information from user railways without any cost.

Note: - The date of enforcement of the specification is 2 months from the date of issue of specification


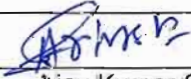

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Appendix – I

FEATURES OF COACHES

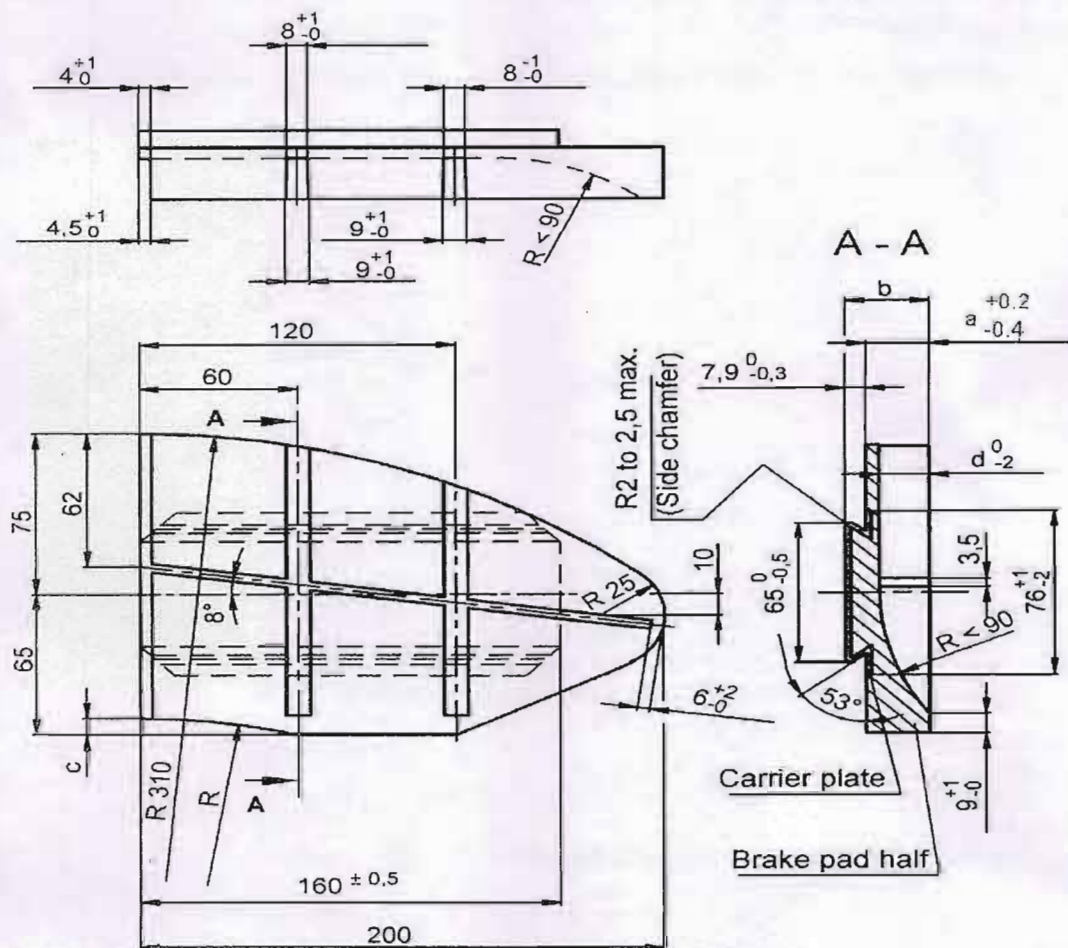
Sl.No.	Description		LHB Coaches	Vande Bharat Coaches	MEMU-US & EMU-US
1.	Maximum operating speed (kmph)		160	160	130
2.	Maximum deceleration		1.3 m/sec ²	1.1 m/sec ²	0.82 m/sec ²
3.	Type of brake system used		Disc brake system	Electro Pneumatic (EP) Wheel mounted disc Brake system	
4.	Max. axle load (t)		16.25	17.00	21
5.	No. of axles per coach		4	4	4
6.	Wheel dia (mm)	New	915+3/-0	952	
		Condemning	845	877	
7.	Type of brake disc used		Ø640 x 110 mm	Ø750 x 49 mm	
8.	Mean friction radius of brake disc		247 mm	305 mm	
9.	Material of brake disc used		Cast Iron	Cast Iron/Cast steel	
10.	No. of brake disc per coach		8 no.	8 set	
11.	Type of brake pads required		Non-Asbestos Organic Pad		
12.	No. of brake pads/holder		2 (1LH+1RH)		
13.	No. of brake pads/disc		4 (2 set)		
14.	Brake Pad Force (Max.)		42.1 KN	43.00 KN	37.8 KN

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Appendix – II

DRAWING OF BRAKE PAD HALF 200 cm² MADE OF ORGANIC MATERIALS

View B (right hand model)



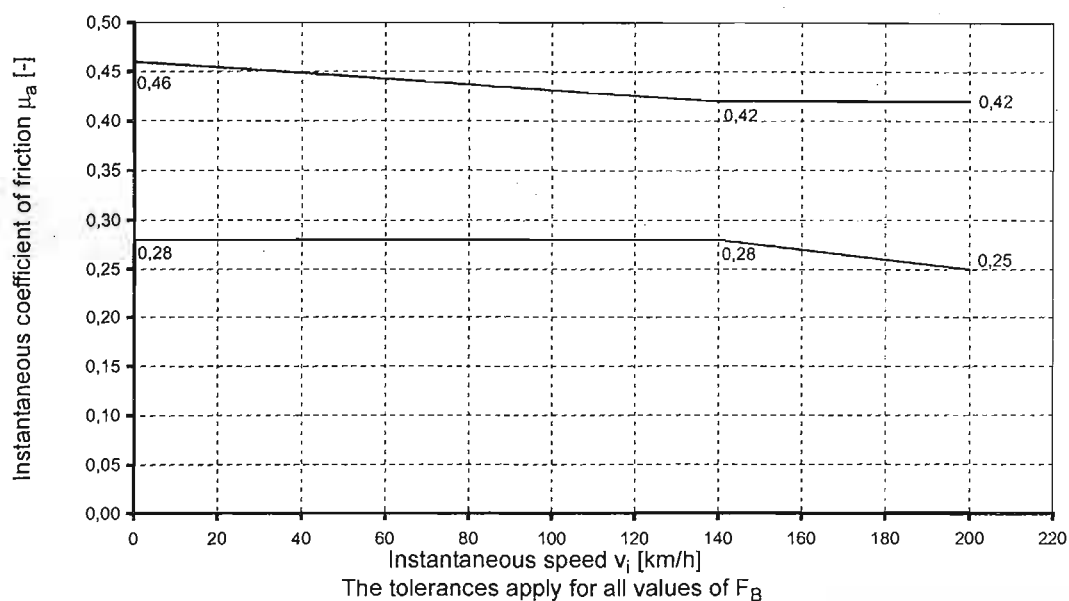
- Left hand model: same drawing but a mirror image.
- The pictorial display and the dimensions of the grooves are merely given as examples.
- For one piece pads (400 cm²), the two halves are joined together

a	b	d	C	R
24	31.9	19	7.5	232.5
35	42.9	30	7.5	232.5
24	31.9	19	15	240
35	42.9	30	15	240

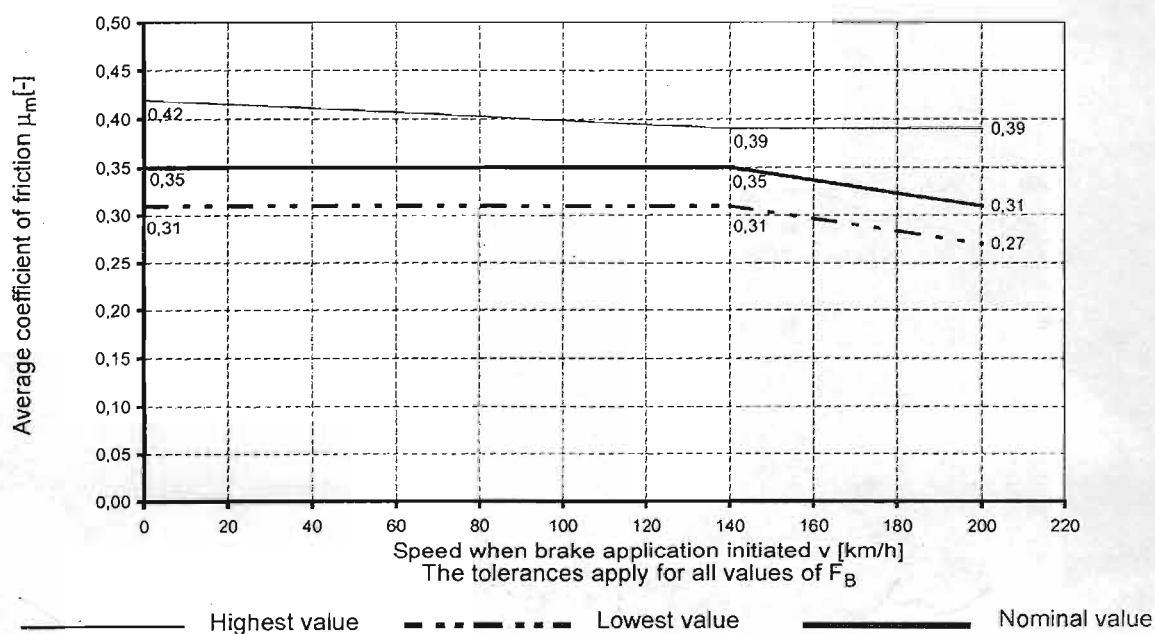
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Appendix – III

A) Instantaneous coefficient of friction

Tolerance for the instantaneous coefficient of friction (μ_a) with dry disc

B) Average coefficient of friction

Tolerance for the average coefficient of friction (μ_m) with dry disc


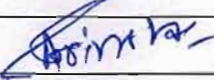

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Appendix – IV

TEST SCHEME FOR TYPE ACCEPTANCE TEST ON ORGANIC BRAKE PADS

1. Brake Pad half : Organic 200 cm²
2. Brake Disc : Ø640 x 110 mm for LHB, Ø 750 X49 mm for VB
3. Mass per brake disc : 6.7 t
4. Wheel Diameter : 890 mm

Brake application No.	Speed v (km/h)	Force applied F _B (kN)	Initial Temperature Θ ₀ °C	Remarks
R1 to Rx	120	28	20-100	x Brake applications to bed-in the brake pads up to at least 80% contact area. Weigh
1 19 37	50	28	50-60	Brake applications to a stop dry condition, after a cooling interval.
2 20 38	80	28	"	
3 21 39	120	28	"	
4 22 40	140	28	"	
5 23 41	160	28	"	
6 24 42	200	28	"	
7 25 43	50	16	"	
8 26 44	80	16	"	
9 27 45	120	16	"	
10 28 46	140	16	"	
11 29 47	160	16	"	
12 30 48	200	16	"	
13 31 49	50	40	"	
14 32 50	80	40	"	
15 33 51	120	40	"	
16 34 52	140	40	"	
17 35 53	160	40	"	
18 36 54	200	40	"	
55	140	40	140-150	Brake applications to a stop dry condition, after a cooling interval.
56	200	40	140-150	
57	80	40	210-220	
58	80	28	50-60	Brake applications to a stop dry, after a cooling interval. Weigh
59	80	40	"	
60 63 66	200	28	50-60	Brake applications to a stop dry, after a cooling interval, mass per disc m = 7.7 t or m = 6.2 t (see test condition for details). Weigh
61 64 67	200	16	"	
62 65 68	200	40	"	
69	50	-	20-30	Continuous brake application with dissipated load of 25 kW over 20 minutes. Brake application to a stop immediately after continuous braking.
70	50	28	"	

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71	80	-	-	Continuous brake application immediately afterwards without a cooling interval with dissipated power of 55 kW for 10 minutes. Brake application to a stop immediately after continuous braking. Weigh
72	80	28	-	
73	80	28	50-60	Brake applications to a stop after a cooling interval. dry
74	120	40	"	
75	200	28	"	
76	50	16	20-30	Brake applications to a stop after a cooling interval. wet
77	50	28	"	
78	80	28	"	
79	80	28	50-60	Brake applications to a stop after a cooling interval. dry
80	120	40	50-60	Brake applications to a stop after a cooling interval. dry
81	200	28	"	
82	30	28	≤30	Brake applications to a stop after a cooling interval. dry
83	30	28	"	
84	30	28	"	

Brake application time $t_s=4\pm0.2s$

Rotation and ventilation conditions

	Test bench speed (km/h)		Speed of the cooling air (km/h)	
	Dry	Wet	Dry	Wet
During the brake application	V	v	v/2	10
Between brake applications	100	50	80	10

Weighing

The pads shall be weighed after they have bedded-in and after brake applications No. 59, 68, 72 and 84.


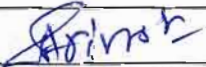

The actual wear of the pads shall be given for the brake applications No.1 to 59, 60 to 68 and 69 to 72.

The permissible wear of the pads for the brake applications No.1 to 84 is $0.55 \text{ cm}^3/\text{MJ}$.

Interruptions

During the tests, interruptions of up to 3 days before tests No.1, 19, 37, 60, 69 and 73 are allowed.

Temperatures

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During the brake applications care must always be taken to see that the starting temperature has fallen to the values given.

For the brake applications No.1, 19, 37, 60 and 73 a starting temperature between 20°C and 60°C is permissible.

The brake application to a stand which immediately follow continuous braking shall be carried out with the temperature which was produced at the end of this continuous braking (no cooling interval between tests No.69, 70 and 71). The continuous brake application No. 71, which follows the brake application to a stand No.70 shall be done immediately after this without a cooling interval.

If during the continuous braking arithmetic average of the brake disc temperature of the 6 measuring places reaches 375 °C, the braking shall be interrupted immediately (check of the coefficient of friction and the mechanical properties of the brake pads).

Conditions for the spraying with water

The brake applications under wet conditions shall be carried out with a water quantity of 25 l/h. During wet brake applications, the spraying of the brake discs during the cooling intervals between the tests No. 76 to 78 shall not be interrupted.

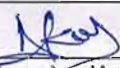
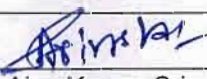

After brake application No. 75, the spraying shall only begin when the brake disc temperature has reached 80°C.

After brake application No. 78, the spraying shall be discontinued.

Further conditions

- The brake applications shall be carried out in the given sequence.
- The number of bedding-in brake applications necessary for the contact pattern of at least 80% (to remove all peaks) to be achieved shall be given in the test report.

For the exceptional case of the brake application No.60 to 68, masses and speed shall be so adjusted that in each case an energy of 11.9 MJ and 9.6 MJ is converted (in this case it is allowed to exceed the limit for the correction factor K).

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Appendix - V

TEST SCHEME FOR TYPE ACCEPTANCE TEST ON ORGANIC BRAKE PADS UNDER WET CONDITIONS

1. Brake Pad half : Organic 200 cm²
2. Brake Disc : Ø640 x 110 mm for LHB, Ø 750 X49 mm for VB
3. Mass per brake disc : 4.7 t
4. Wheel Diameter : 890 mm

Brake application No.	Speed v (km/h)	Force applied F _B (kN)	Initial Temperature Θ ₀ °C	Remarks
R1 to Rx	120	26	20-100	x Brake applications to bed-in the brake pads up to at least 85% contact area.
1 8	80	21	50-60	Brake applications to a stop dry, after a cooling interval.
2 9	120	16	"	
3 10	120	21	"	
4 11	140	21	"	
5 12	80	26	"	
6 13	120	26	"	
7 14	140	26	"	
15 22 29	80	21	20-30	Brake applications to a stop wet, after a cooling interval. Water quantity: 25 l/h
16 23 30	120	16	"	
17 24 31	120	21	"	
18 25 32	140	21	"	
19 26 33	80	26	"	
20 27 34	120	26	"	
21 28 35	140	26	"	

Brake application time $t_s=4\pm0.2s$


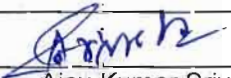
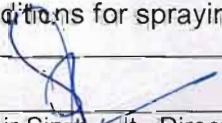
Rotation and ventilation conditions

	Test bench speed (km/h)		Speed of the cooling air (km/h)	
	Dry	Wet	Dry	Wet
During the brake application	V	v	v/2	10
Between brake applications	100	50	80	10

Interruptions

During the tests, interruptions of up to 3 days before tests No.1, 8 and 15 are allowed.

If there is an interruption before the test No.15, an identical brake application No.14 shall be carried out in addition outside the programme in order to observe the conditions for spraying

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water

Temperatures

During the brake applications care must always be taken to see that the starting temperature has fallen to the values given.

For the brake applications No.1 and 8 a starting temperature between 20°C and 60°C is permissible.


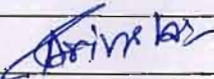

Conditions for the spraying with water

The brake applications under wet conditions shall be carried out with a water quantity of 25 l/h. During wet brake applications, the spraying of the brake discs during the cooling intervals between the tests No. 15 and 35 shall not be interrupted.

After brake application No. 15, the spraying shall only begin when the brake disc temperature has reached 80°C.

Further conditions

- The brake applications shall be carried out in the given sequence.
- The number of bedding-in brake applications necessary for the contact pattern of at least 85% to be achieved (all the projecting pad peaks) shall be given in the test report.

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Appendix - VI

TEST SCHEME FOR TYPE ACCEPTANCE TEST ON ORGANIC BRAKE PADS UNDER SEVERE WINTER CONDITIONS

1. Brake Pad half : Organic 200 cm²
2. Brake Disc: Ø640 x 110 mm for LHB, Ø 750 X49 mm for VB
3. Mass per brake disc : 4.2 t
4. Wheel Diameter : 890 mm

Brake application No.	Speed v (km/h)	Force applied F _B (kN)	Initial Temperature Θ ₀ °C	Remarks
R1 to Rx	120	25	20-100	x Brake applications to bed-in the brake pads up to at least 85% contact area, projecting pad peaks must be removed
1 7	80	25	50-60	Brake applications to a stop dry, after a cooling interval.
2 8	120	12		
3 9	120	25		
4 10	120	25		
5 11	80	12		
6 12	80	12		
13 19 25	80	25	15-20	Brake applications to a stop dry, after a cooling interval.
14 20 26	120	12		
15 21 27	120	25		
16 22 28	120	25		
17 23 29	80	12		
18 24 30	80	12		
31	80	25	50-60	Brake applications to a stop dry, after a cooling interval.
32	80	25		
33	80	25		
34	80	25		
35	80	25		
36	80	25	50-60	Brake applications to a stop wet, after a cooling interval.
37	80	25		
38	80	25		
39	80	25		
40	80	25		

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Appendix –VII**TEST METHODS**

(Test methods are based on and ORE Report B-126 / RP2 of Oct,1974)

Cutting of Specimen: The specimens for density, hardness, thermal conductivity, bending strength and Modulus of Elasticity shall be cut from the pre-determined location of brake pads as shown in Appendix – VII of this specification.

Conditioning of Specimen: All the specimens shall be conditioned prior to testing, in a room with controlled temperature of 20°C and relative humidity of 65%.

A MEASUREMENT OF DENSITYPreparation of Specimen:

Cut sample of 50 x 50mm from the location of brake pad as shown in Appendix-VII. The specimen intended for the hardness test may be used for measuring the density, before the hardness test is carried out. The specimen should be dried suitably to carry out the hardness test on the same specimen.

Test method:

Two methods are available for measuring the density:


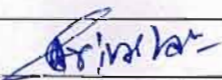

- 1 In first method, the specimen is weighed to an accuracy of 1mg and measured to an accuracy of 50 µm.
The density is obtained by the following formula:

$$\frac{\text{Mass of specimen (g)}}{\text{Volume of specimen (cm}^3\text{)}} = \text{Density (g/cm}^3\text{)}$$

- 2 In second method specimen is suspended by a thin thread from the hook to a weighing scale and its weight in air is measured to an accuracy of 1mg. The specimen is then freely suspended in water at a temperature between 18°C and 24°C and then weighed again. Before weighing, any air bubbles adhering to the specimen must be removed, which can be facilitated by adding a trace of detergent to the water. The density is then obtained by the following formula:

$$\frac{\text{Weight in air}}{\text{Weight in air- weight in water}} = \text{Specific gravity}$$

$$\text{Density} = \text{Specific Gravity} \times \text{Density of water i.e. 1g/cm}^3$$

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B HARDNESS TEST

Preparation of Specimens :

Cut sample of 50X50mm from the location of brake pad as shown in Appendix-VII and machining the back until the whole holding plate has been removed and a smooth surface parallel to the top side (braking side) obtained.

The specimen intended for the hardness test may be used for measuring the density, before the hardness test is carried out. The specimen should be dried suitably to carry out the hardness test on the same specimen.

After recording the 6 measurements on the upper surface (To preparation refer to paragraph 2) this surface is ground down 5mm parallel to the lower surface. A new series of hardness measurements is then obtained.

Test method:

The test is carried out in accordance with method A of standard ASTM D 785. For soft materials (<100HRX) a non-standard 19 mm ball is used in order to prevent wide scatter. The minimum (initial) load is 10kgf (98.0665N), the maximum (total) load is 60 kgf (588.399N).

The test scale is called "X"

For hardness values greater than 100HRX standard scale "R" is recommended.

a) Method A (scales "X" and "R")

After putting the specimen into position, the minimum load of 10 kg is applied and the small pointer is set to zero within 10 seconds.

The large pointer is set to (B) 30 on the red scale. Within 10 seconds, after the application of the minimum load and immediately after setting the dial, the minimum load of 10kgf (98.0665 N) is increased to maximum load of 60kgf (588.399N). The maximum load is then reduced to the minimum load after 15 seconds.




The Rockwell hardness HRX is read off on the red scale 15 seconds after the reduction of the maximum load.

The HRX hardness value is obtained as follows:

HRX value=130-penetration depth (scale divisions)

Note: If the depth of penetration exceeds 130 scale divisions (0.26mm), negative values are obtained

Number of measurements and calculation of hardness:

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12 measurements are to be obtained on the two surfaces. Six measurements are to be obtained from upper surface and six measurements are to be obtained 5mm below the original upper surface. The minimum distance between two penetrations or between one penetration and the edge of the specimen shall be 10mm. The arithmetical mean of these values is the surface hardness.

C ACETONE EXTRACTION TEST

The following materials and equipment are required:

- Pure acetone
- Apparatus for crushing the specimen into powder
- A sieve with a nominal mesh of 425 μm in accordance with ISO standard 565 (1)
- A sieve with a nominal mesh of 250 μm in accordance with ISO standard 565 (1)
- An analytical scale with an accuracy of 0.001g.
- A Soxhlet extraction apparatus, or other apparatus, which has been shown to produce similar results.
- A drying oven with air circulation adjustable to 50 ± 2 °C.

Specimen Preparation:

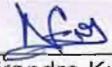
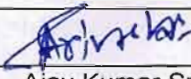
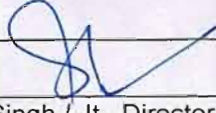
A specimen representative of the pad material is reduced to powder form by filing, milling, turning or boring, without excessively heating the material. The powder is then sieved, using the sieves described under c) and d) above, preserving for extraction only the matter having passed through sieve c) and retained by sieve d). Suitable precaution must also be taken to prevent the powdered specimen from absorbing moisture.

Test specimen to be prepared from the location of brake pad as shown in Appendix-VII.

Test Procedure:

Two portions of the sieved material must be tested. One specimen of approx 3g is weighed to an accuracy of 0.001g on calibrated filter paper with large pore size or in a thin extraction crucible. After covering the crucible, or the filter paper containing the specimen, so that none of the powder can escape, the specimen is placed into the siphon of the extraction apparatus. The condenser, siphon and flask, into which 200 ml of pure acetone has been filled, are then assembled. Heating is regulated so that siphoning occurs 20 to 30 times per hour and extraction is continued for at least 6 hours. At the end of this period the flask is withdrawn and the content is transferred to the smaller flask or a bowl having previously been weighed to an accuracy of 0.001 g. The empty flask is rinsed with approximately 20 ml acetone, which is then added to the extract.

The acetone is then evaporated by a suitable method, taking care that the temperature does not exceed 50 °C. The receptacle holding the residue is then placed into the oven, where it remains for 30 minutes at a temperature of 50 ± 2 °C. The receptacle is then removed from the oven, cooled in a drier to room temperature and weighed heating, cooling and weighing is repeated until a consistent mass is obtained, i.e. until the difference between two successive weightings does not exceed 0.003g.

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The specimen content of matter soluble in acetone is obtained in the form of a mass percentage by applying the following formula:

$$\frac{m1}{m0} \times 100$$

where:

m0- Mass of the test specimen in g,

m1- Mass of dry extract in g.

The arithmetical mean of the values obtained from the two portions of the test specimens is considered to be the specimen content of matter soluble in acetone.

The test report should present the following details:

- Reference to this method.
- Complete description of the specimen.
- Method used to reduce the block material into powder form.
- Content of matter soluble in acetone of each portion of the test specimen.
- Arithmetical mean of the results obtained from the two portions.
- Date of test.

D MODULUS OF ELASTICITY (COMPRESSION)

Test Specimen:

6 Nos. of test specimen to be prepared from the location of brake pad as shown in Appendix-VII.

Test Procedure:

The diameter and the height of the 6 specimens are measured to an accuracy of 10 µm.



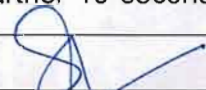
The specimens are submitted to a test on a Rockwell hardness tester, on which the ball has been replaced by a cylindrical mandrel of 13.3mm diameter.

The minimum (initial) load is 10kgf (98.0665N) and the maximum (total) load is 35 kgf (343.233N).

Before the test is started, the deflection of the test apparatus between minimum and maximum loads is measured without the test specimen.

The following test sequence is applied to each specimen.

The specimen is placed centrally underneath the mandrel, the minimum load is applied and the dial is again set to zero (black scale). The maximum load is then applied for 45 seconds, followed by an application of the minimum load for a further 10 seconds. The

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dial is again set to zero and the maximum load is applied again. The reading is taken, when after approximately 10 seconds the movement of the pointer suddenly slows down.

The deflection of the apparatus is then subtracted from this reading and the net deflection expressed in scale graduations is multiplied by two in order to obtain the depression Δh of the specimen in μm .

The modulus of elasticity E (mean value of the results obtained with the 6 specimens) is then calculated by the formula:

$$E = \frac{3.122 \times 10^5 \times h}{D^2 \times \Delta h} \text{ N/mm}^2$$

H = height of specimen (mm)

D = diameter of specimen (mm)

Δh = depression of specimen (μm)

E ASH CONTENT

Preparation of test specimen:

A specimen of fine particles of the brake pad is prepared by drilling out with 10mm dia. Drill bit without overheating. The drilling is done perpendicular to the working surface and the depth of the drilled holes shall not be more than 50% of the total pad thickness. Test specimen to be prepared from the location of brake pad as shown in Appendix-VII.

Apparatus:

1. Analytical Balance with an accuracy of 1mg.
2. Muffle furnace with pyrometric control to $\pm 50^\circ\text{C}$ with temperature to 1000°C
3. Crucible
4. Tongs
5. Desiccators


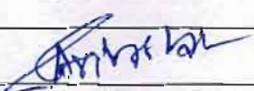

No. of tests: One

Procedure:

Weigh previously ignited and cooled empty crucible (without lid) and the record the weight W1. Load the drilled particles of 1gm in the pre-weighed crucible and weigh to an accuracy of $\pm 0.1\text{gm}$ (W2). The crucible containing the sample is placed in the muffle furnace at $825 \pm 5^\circ\text{C}$ and left for 2 hours. After ignition, the crucible shall be removed, cooled in a desiccators and weigh (W3). The ash content shall be calculated as follows,

$$\text{Ash Content in \%} = \frac{W3 - W1}{W2 - W1} \times 100$$

W1 = Weight of the crucible in gms

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W2 = Weight of the crucible and sample in gms

W3 = Weight of the crucible and sample (after ignition) in gms

F CROSS BREAKING STRENGTH

Test specimen: Size of the test specimen is 120mm x 15mm x 10mm. Test specimen to be prepared from **Blank Pad made from same batch.**

Apparatus:

1. Universal Testing machine (UTM)
2. Suitable Jig & fixture having supporting span of 100mm

No. of tests: One

Procedure: The test shall be carried out at room temperature. The top portion of the jig shall be placed in the adjustable crosshead of the Universal testing machine and lock in with the key. Place the bottom portion of the jig in the centre position of the UTM table and adjust the jig so that the top portion of the jig is aligned to the middle of the bottom portion of the jig. Place the specimen on the jig. Select load range of the UTM for testing the sample. Apply the load until the sample breaks. Read the load in kgf. Calculate the cross breaking strength of the specimen using the following equation,

$$\text{Cross breaking Strength} = 1.5 \times \frac{W \times L}{b \times d^2}$$

Where, W= Load in Kgf

L = 100 mm (Distance between jaws)

b = Width of the specimen (cm)

d = Thickness of the specimen (cm)

G FLAMMABILITY

Test specimen: Size of the test specimen is 20mm x 20mm x 35mm. Test specimen to be prepared from the location of brake pad as shown in Appendix-VII.


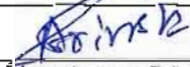

Apparatus:

1. Rotatable welding torch, Nozzle size ANME 5/64
2. Thermocouple connected with graph recorder
3. 500x500x10 mm thick steel plate, IS 2062 E250 grade
4. 2 Nos. Stop watch

No. of tests: One

Preparation of specimen: The test specimen is dried for 6 hrs at 105 °C, followed by cooling to room temperature in a desiccator where it is kept until tested.

Procedure: The test specimen is placed in the middle of a 500 x 500 x 10 mm thick steel plate, with the braking surface of the specimen in contact with the plate. A rotatable

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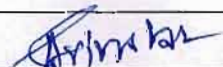

welding torch is then placed accurately beneath the center of the plate. A motorized system will rotate the welding torch in a 100 ± 5 mm diameter circle at the speed of 30 ± 2 rpm. Sample and sensor are to be placed on this circle at 10 mm distance apart. It must be ensured that the temperature of the surface is to be measured. The temperature of the plate is monitored using thermocouples connected to a graph plotter, and two stop watches are used for time recording. The times and temperature at which smoke is first given off and at which specimen ignition occurred are recorded, together with the time for which the specimen continued to burn after removal of source of heat and the temperature of the steel plate when specimen ceased to burn

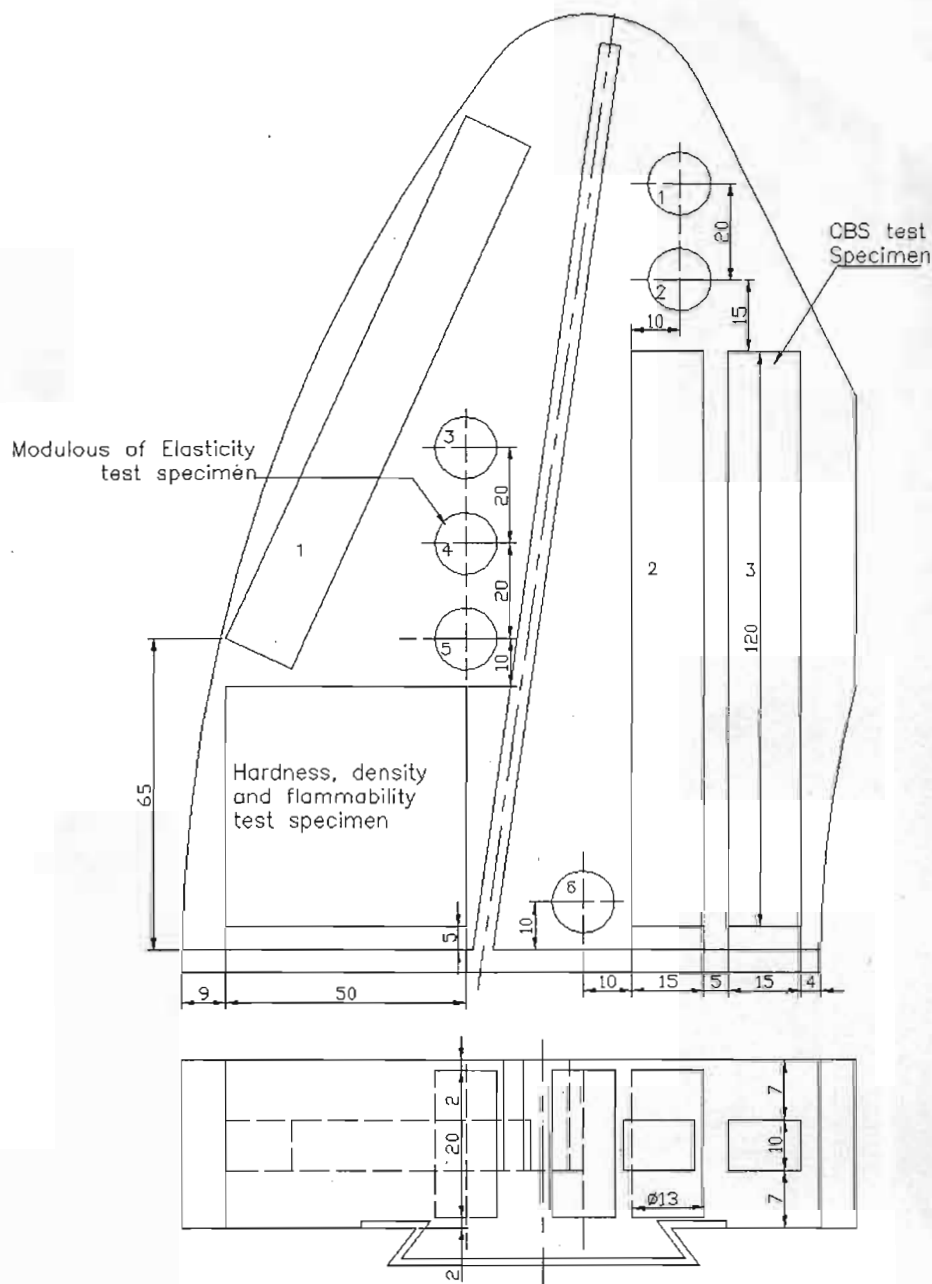
H THERMAL CONDUCTIVITY

Thermal conductivity Test shall be done in accordance to ASTM E-1530.

I WATER ABSORPTION

Water absorption test can be done in accordance to EN ISO 62

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Appendix – VIII**LOCATION, FORM AND DIMENSIONS OF TEST SPECIMENS**

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