GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS

Document content	Technical Specification	**Yes**
	Schedule of Technical Requirement	**Yes**
Description of item	FAILURE INDICATION CUM BRAKE APPLICATION (FIBA) DEVICE	
Remarks	1. Clause 6.1.4 & Para 3 of Annexure-B (Section-A) of this specification shall come under enforcement on 15.01.2024 onwards. Till implementation date of these clauses, functional test of FIBA device (Para 3 of Annexure-B) & resetting mechanism (Para 6.1.3) stipulated in STR no. RDSO/2015/CG/05 Rev. Nil with Amendment-1 shall be applicable. 2. Clause 7 (Section-B) of this specification shall come under enforcement on 15.06.2023 onwards. 3. Clause 3.2 (Section-B) of this specification shall come under enforcement on 15.09.2023 onwards.	

S. N.	**Month / Year of issue**	Revision/ Amendment	Page No	Reason For Amendment
1	September, 2015	Nil	-	-
2	October 2016	Amendment-1	5	To include the ISO Doc. No. QO-D-7.1.11 as new sub clause No. 1.3 under clause no.01 of scope
2	March 2023	Rev. 01	--	**Technical changes done and some new clauses incorporated.**

Issued By

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SPECIFICATION OF AIR SPRING FAILURE INDICATION CUM BRAKE APPLICATION (FIBA) DEVICE FOR AIR SPRING FITTED IN BG ICF, LHB, HYBRID, DOUBLE DECKER MAIN LINE COACHES AND MEMU/DEMU COACHES HAVING ICF OR LHB TYPE BOGIES OR ANY OTHER TYPE BOGIES FOR WHICH RDSO APPROVES APPLICABILITY OF THIS SPECIFICATION.

0.0 FOREWORD

0.1 This specification spells out the technical requirements of Air Spring Failure Indication Cum Brake Application (FIBA) Device for Air Spring fitted in BG ICF, LHB, Hybrid, double decker mainline coaches and MEMU/DEMU coaches having ICF or LHB type bogies or any other type bogies for which RDSO approves applicability of this specification.

0.2 This Schedule of specification is concerned with the Air Spring Failure Indication Cum Brake Application (FIBA) Device and details of the requirements and tests for the Air Spring Failure Indication Cum Brake Application (FIBA) Device.

0.3 This specification shall not be altered /modified or reproduced in any form without the written permission of the Director General (Carriage), RDSO, Lucknow.

0.4 Date of enforcement of this Specification of Air Suspension Control Equipment shall be as per remarks column of Ist page.

0.5 **Abbreviations**

STR	Schedule of Technical Requirements
IR	Indian Railways
FIBA device	Failure Indication Cum Brake Application device
IND	Indicator
PU	Production Unit
RDSO	Research Designs and Standards Organization, Lucknow

SECTION-A

1. SCOPE:

1.1. This section covers the technical requirements for the design, manufacture and supply of Air Spring Failure Indication Cum Brake Application (FIBA) Device for air spring fitted in BG ICF, LHB, Hybrid and Double Decker mainline coaches and MEMU/DEMU coaches having ICF or LHB type bogies or any other type bogies for which RDSO approves applicability of this specification. Scope of supply shall generally be as per clause 4 of this specification. However, if the supplier feels that certain additional items are necessary for improved working performance of the system, he may quote for the same. In any case, purchaser will be at liberty to buy all or part material from the offer.

1.2. Flexible hoses, Isolating Cock, Isolating cock with vent feature required for the fitment of Air Spring Failure Indication Cum Brake Application (FIBA) Device should be supplied as per RDSO's specification C-K407 (Latest Revision), ABR-02 and firm's approved drawings by RDSO. Indicator of FIBA device should be to RDSO STR no. RDSO/2011/CG-04 (Latest Rev.) The Air Spring Failure Indication Cum Brake Application (FIBA) Device should be compatible with the other items as described in the above specifications. The purchaser will be at liberty to buy any part or complete item as mentioned above and Air Spring Failure Indication Cum Brake Application (FIBA) Device to this specification from different sources of supply.

1.3. All the provisions contained in RDSO's ISO procedures laid down in Document No. QO-D-8.1-11 (latest) (titled "Vendor-Changes in approved status") and subsequent versions/ amendments thereof, shall be binding and applicable on the successful vendor/ vendors in the contacts floated by Railways to maintain quality of products supplied to Railways.

2. OPERATING CONDITIONS & FUNCTIONAL REQUIREMENT:

2.1. The Air Spring Failure Indication Cum Brake Application (FIBA) Device will be fitted in BG ICF, LHB, Hybrid, double Decker mainline coaches and MEMU/DEMU coaches having ICF or LHB type bogies or any other type bogies for which RDSO approves applicability of this specification having Air suspension in secondary stage.

2.2. The Pneumatic suspension system works under two different modes, one in the inflated condition and the other in deflated condition when there is no air cushion and load is directly transferred from the car body to the Emergency rubber spring (bumper) Under deflated condition of the air spring, the maximum permissible operating speed of the coach is restricted on account of inferior riding behavior.

2.3. Compressed air supply to the air spring assemblies shall be maintained through a compressor provided in the Locomotive though Feed Pipe. The Locomotive compressor charges the Feed pipe at 6 Kg/cm² and Brake Pipe at 5 Kg/cm². Provision of air drier may not exist/function in compressed air supply system of some Locomotives. Pneumatic circuit of Air Spring Failure Indication Cum Brake Application (FIBA) Device system is connected to air springs through pipelines. Internal air pressure of air springs may vary from tare to full load.

2.4. Each coach shall be fitted with four air spring assemblies (two per bogie). There will be one FIBA device per bogie. Each FIBA device (consisting 02 valves for sensing each Air spring by the respective valve) will monitor both the air springs of respective bogie. Each Air Spring shall be controlled by an independent leveling valve (4-point control system). Two air springs of the same bogie shall be connected through a duplex check valve set to act at a pressure differential of 1.5 ± 0.12 Kg/cm².

2.5. To meet the requirement of a fool proof arrangement in the suspension design, FIBA device connected with each air spring has been fitted in air spring fitted coaches. FIBA device will send a message to the crew of the train in the event of air spring failure (which will ultimately demand a reduction in the operating speed) by way of brake application and physical indication (**Hissing Sound and color change of indicator from green to red in affected coach).** Failure of Air Spring is possible due to the likely hood of spring damage, possibility of air supply failure or due to sudden rupture or bursting of bellows of air springs due to any reason.

2.6. The basic principle in this arrangement is to actuate the application of brakes in the event of air spring failure, which will immediately reduce the speed of the train and ultimately cause the train to stop. Indicators of respective failed air spring will turn to red and hissing sound will blow to indicate the location. The train is checked by the engine crew and after taking necessary action, train is allowed to move in the event of failure of the air spring at prescribed speed.

3. ENVIRONMENTALCONDITIONS:

3.1. Air Spring Failure Indication cum Brake Application (FIBA) Device shall be subjected to following environmental conditions.

Max. Ambient Temperature under sun	:	60°C.
Ambient temperature	:	-10° to 45°C in shade.
Average relative humidity	:	70% to 90%,(100% for several days)
Rainfall	:	Fairly heavy, maximum being 200 mm in 24 hours, typical to the coastal areas.
Atmosphere	:	Dusty with salt laden air for several months of the year.

3.2. Air Spring Failure Indication Cum Brake Application (FIBA) Device system may also come in contact with the following, during coach maintenance operation:

- Chemical products (like cleaning compound of coach cleaning)
- Cotton waste smeared with oil and paint etc.
- Disinfectants.
- Oils & lubricants used in coach bogies.

3.3 It shall be ensured & verified that all Failure Indication Cum Brake Application (FIBA) Device offered by the firm are suitable for performing satisfactorily under above environmental condition (Para 3.1 & 3.2).

4. SCOPE OFSUPPLY:

4.1. Two Nos. (02) Nos. FIBA devices will be required per coach i.e. one number will be required per bogie. Scope of supply of each FIBA device shall cover the following items: -

S. N.	Item	Quantity
1	Air Spring Failure Indication Cum Brake Application (FIBA) Device	1
2	Indicator	2
3	Hose connection 3/4" BSPX550 mm with both end rubber washers	2
4	Isolating cock (OLP type) 20 mm bore for BP/ Isolating cock without vent hole with end fitting (For LHB & Double Decker Coaches fitted with FIAT bogies)	1
5	Isolating cock 20mm bore with vent hole/ Isolating cock with vent hole with end fitting (For LHB & Double Decker Coaches fitted with FIAT bogies)**	2
6	Two way centrifugal dirt collector (20mm bore) as per RDSO Sketch 97005 (latest)	1
7	Nut bolts/fasteners with locking washer for mounting of FIBA device and Indicators	*01 set

*One set shall mean total nut bolts/fasteners with locking washer required for mounting of 01 FIBA device and 02 Indicators for each bogie.

**While fitment of Isolating cock with vent feature, it should be ensured that direction of draining of cock is towards FIBA device.

4.2. It is prerogative of purchaser to procure the FIBA device only or FIBA device along with associated items.

4.3. Any other item, which in the view of the supplier is considered essential for operation or enhances the performance of the system, may also be offered.

5. PARTICULAR REQUIREMENTSFOR VENDOR REGISTRATION:

5.1. Vendors willing to supply Air Spring Failure Indication Cum Brake Application (FIBA) Device for the use of Indian Railways shall register themselves with RDSO. All relevant documents like Vendor Approval guidelines & Application form, latest version of all specifications and drawings are provided on RDSO websites. The firm shall follow the latest vendor approval guidelines for registration with RDSO.

5.2. The firm should possess ISO: 9001 certificate for his works address, covering the items for which he seeks registration with RDSO.

5.3. The firm shall have adequate infrastructures for manufacturing, testing and quality control requirements of FIBA device as stipulated in Section – B of this specification. This will be verified by the RDSO official at the time of registration of the firm.

5.4. Special Conditions:

5.4.1 **Air** Spring Failure Indication Cum Brake Application (FIBA) Device vendors shall be recognized on the basis of their FIBA design. Company shall have the facilities for designing the Air Spring Failure Indication Cum Brake Application (FIBA) Device and the necessary infrastructure to carry out detailed type tests at their own facility.

5.4.2 Since Air Spring Failure Indication Cum Brake Application (FIBA) Device are a safety related air spring failure indication element, in-service trials shall be necessary for each design before full clearance is given for inclusion of name of firm in 'List of RDSO vendors for developmental orders' for manufacture and supply of FIBA device.

5.4.3 The Air Spring Failure Indication Cum Brake Application (FIBA) Device of a particular design shall be subjected to field trials on a minimum of ten coach sets for one year on IR's system to monitor the service performance prior to inclusion of name of firm in 'List of RDSO vendors for developmental orders' for manufacture and supply of FIBA device. For this purpose, limited trial order for more than ten coach sets may be given to such vendor to monitor the service performance of equipment supplied by their firm.

5.4.4 In case of any failure during field trials attributable to poor design, manufacturing process or material, the field trials shall be repeated with modified/updated design, manufacturing process or material after successful type testing afresh by RDSO official at firm premises. The vendor has to submit the fresh drawing and modified QAP for approval.

5.4.5 After completion of service trial period, one sample of the Air Spring Failure Indication Cum Brake Application (FIBA) Device shall be subjected to the tests laid down at para 11.2.2. In case these values are beyond permissible limits, the FIBA design shall be deemed to have failed the service trials.

5.4.6 After satisfactory performance of the service trials and successful test as per Para 11.2.2, the FIBA design may be considered for regular service on Indian Railways and firm may be given status of 'RDSO Vendor for Developmental order'.

5.4.7 A Vendor shall be considered eligible for up gradation to status of 'Approved Vendor' on completing successful supply of a minimum of 500 coach sets of the particular type of FIBA device as per latest ISO guideline of RDSO.

5.4.8 After type tests of a particular design are approved by RDSO, vendors shall ensure that Air Spring Failure Indication Cum Brake Application (FIBA) Device to the particular specification are supplied with components manufactured from the sources as indicated at the time of design approval and used for type testing. However, in case of change of sub vendor or source of supply for manufacturing of FIBA device components, the firm shall get approval of their modified QAP form RDSO before manufacturing and supply of FIBA device.

5.4.9 The type test shall be witnessed by authorized representative of RDSO at firm premises at the time of design approval of the vendor at their own test facility.

Any additional tests if considered necessary shall also be arranged by vendor free of cost. All necessary arrangements for witnessing the type test of Air Spring Failure Indication Cum Brake Application (FIBA) Device at firm's premises shall be done by the vendor. RDSO reserves the right to witness the type test again if changes in approved design/drawings are carried out which are likely to alter design / performance characteristics of the Air Spring Failure Indication Cum Brake Application (FIBA) Device.

5.4.10 Design of the FIBA Device shall be validated by suitable software prior to prototype sample manufacturing. Detailed simulation model with pneumatic air flow & valve operations shall be witnessed by RDSO officials during Capability Assessment /Quality audit/any failure analysis/performance approval.

5.4.11 In case design of critical component is changed, fresh type test and service trial shall be required. However, service trials can be dispensed with by RDSO considering the reasons for change and extent of modification.

5.4.12 Firm should have a system to identify root cause of problem occurred during service & for taking corrective action in this regard.

5.4.13 In case, source of any component of Air Spring Failure Indication Cum Brake Application (FIBA) Device is changed or any additional new source is introduced, the firm shall get approval of modified QAP form RDSO before manufacturing and supply of FIBA device. The vendor should provide the detailed information of the source changed/ additional source introduced along with the documentary evidences for the record of this office. Firm shall validate the source in all respects i.e. material, manufacturing process, quality control and inspection & testing etc. to conform to originally approved design and process. Compliance to all obligations including guarantee/warrantee (as per para. 8 of Section -A) shall remain the responsibility of vendor.

6 TECHNICALREQURIEMENTS:

6.1 General technical requirement:

General technical requirement of FIBA device shall be as under:

6.1.1 In no case it shall allow to flow the air supply from feed pipe or air spring system to brake pipe to avoid the influence or overcharging in brake pipe.

6.1.2 All Failure Indication Cum Brake Application device & its indicators shall be able to work under pressure between 1.0 Kg/cm2 to 10.0 Kg/cm2 & 0.5 Kg/cm2 to 10.0 Kg/cm2 respectively. The Failure Indication Cum Brake Application device & its indicators used in the IR coaches shall conform to IEC 61373 for shocks and vibrations as specified on the basis of the location and mounting of the equipment & the same shall be verified by the firm at its own facility/any NABL approved lab. The tests shall also cover Endurance test included herein.

6.1.3 A device to emit hissing sound at a constant sound level irrespective of the pressure of compressed air in the bellow after the rupture has taken place.

6.1.4 Indication devices/ Indicators, to be fixed one on each side of each bogie i.e 4 indicators per coach near turn under and mounted on under frame of the coach to change color from green to red till either FIBA device is reset manually (by resetting mechanism (knob/push) after the ruptured bellow/any other cause of actuation of FIBA is attended properly or FIBA device is reset manually (by resetting mechanism (knob/push) provided on FIBA device) after closing the Isolating Cock provided in BP line to FIBA. Port diameter indicator will be 1/4". The resetting mechanism of FIBA device shall be maximum two knob/push type mechanism i.e. one for each air spring or one for entire bogie.

6.1.5 An isolating cock of 20 mm inlet and outlet ports to isolate the BP branch pipe connected to each Air Spring failure indication device as per RDSO drawing no.CG K-9132 of latest alteration.

6.1.6 It shall have two isolating cocks of 20 mm inlet and outlet ports with vent feature for quick discharge of the air from pipe line of FIBA device as per RDSO drawing no.CG K-9132 of latest alteration.

6.1.7 Two *such* equipment sets with four indicators are required per coach to indicate the condition of two sets of adjacent bellows in both the bogies.

6.1.8 The equipment shall sense the air springs pressure from both of the adjacent air springs of same bogie and move to apply brake in complete train if compressed air pressure of respective air springs is less than $1 \pm 0.1 Kg/Cm^2$.

6.1.9 In addition to initiating brake in the complete train, it also shall actuate a hissing sound of 90 ± 5decibel intensity (measured approximately at 3-meter distance from actuated FIBA device) with steady pitch to attract the attention of the crew who walks along the train investigating the defect. It shall also not be such as to cause panic to the passengers traveling in the coach. In parallel, the equipment actuates a color change in the side mounted colour indicators from Green to red to quickly catch the eye of the driver. It shall be covered properly by a suitable transparent sheet to protect the same from dust, dirt and water etc.

6.1.10 It shall be possible to fit the FIBA device on the existing twin pipe graduated release air brake system provided with air suspension system of the vehicle without having to make any major modification in piping. The pipeline required for FIBA system shall be laid separately.

6.1.11 When any of the four bellows in a coach ruptures, the Air Spring failure indication Device monitoring that particular bogie with the ruptured bellow alone shall actuate. FIBA device in the other bogie and also in the other coaches shall not actuate.

6.1.12 It shall be possible to use the same Air Spring Failure Indication Cum Brake Application (FIBA) Device in the air brake system and air suspension system of LHB, Hybrid and ICF design coaches with pneumatic brake.

6.1.13 It shall be possible to retrofit the equipment even on the existing vehicles having Air suspension if desired.

6.1.14 The FIBA Device shall not need any electrical connections.

6.1.15 Once brake application is initiated by the Air Spring failure indication Device, the brake application shall remain in effect until the driver or the railway staff has located the defect on the coach and isolated FIBA from brake pipe system or defect is rectified and system has been re adjusted for further use.

6.1.16 It shall be possible to reset the brake application by the driver so that the journey can be resumed at a restricted speed.

6.1.17 However, the visual indication shall not be possible to be suppressed automatically either without proper rectification of the deflated air spring or by resetting the FIBA device by resetting mechanism (knob/push) provided on FIBA device

6.1.18 Maintenance/attending staff shall be able to reset the audiovisual indication to normal condition even without repairing/replacing the defective bellows.

6.1.19 The visual indication devices shall stay in actuated condition at even as low pressure as 0.3 Kg/cm^2.

6.1.20 The equipment shall be designed to withstand maximum vibrations as in existing Railway system without loosing its efficiencies. Complete unit shall be protected from all possible damages and theft etc. It shall be as compact and light weight as possible for ease in mounting at the appropriate location. In case, FIBA design of any vendor requires mesh type front cover for protection against miscreant/damage, the front cover design shall be approved by RDSO so as to ensure that different design do not create confusion in field.

6.1.21 The equipment shall perform satisfactorily at various bellow pressures from tare to max loaded condition. The design shall be maintenance friendly and if any assistance is required during warrantee/ Guarantee period, firm shall facilitate free of cost online health check or personal visit to site as desired by the user.

6.1.22 The performance of Air Spring failure indication Device shall remain unchanged in the air brake system and air suspension system supplied by any approved manufacturer.

6.1.23 The specifications for air spring assembly can be referred to in RDSO specification no. RDSO/2020/CG-01, for air spring control equipment C K-407 and other air brake system/equipment 02-ABR-02, (With Latest amendment).

6.1.24 Air Spring failure indication Device shall in no way interfere /alter the performance of the twin pipe graduated release air brake system and the air spring control system of the coach. Normal braking performance shall not be affected.

6.1.25 Weight of FIBA device with cover and mounting bracket shall not exceed 16 Kg (approx.).

6.1.26 Design of FIBA Devices & its indicators should be dust & moisture proof.

6.1.27 Critical internal parts of FIBA & its indicators should be made of stainless steel/brass/rubber/Aluminum Alloy/suitable polymer or any other material (with approval of RDSO)

6.1.28 Critical items such as rubber items ('O' ring etc.), metal bonded items & springs should be procured from reputed supplier who are already manufacturing & supplying such items to pneumatic valves manufacturers or who have satisfactory performance records for manufacture and supply of such items for more than 5 years or who are already manufacturing & supplying such items to reputed manufacturers of Railway braking system for LHB, METRO coaches, Locomotives etc.

6.2 Space Constraints:

Air Spring Failure Indication cum Brake Application (FIBA) Device shall be within the space envelope shown in RDSO drawing no. CG-15078 (latest)

6.3 Pneumatic supply connection:

Pneumatic supply connection of Air Spring Failure Indication Cum Brake Application (FIBA) Device shall be as per schematic diagram of RDSO Drawing no. CG-K9132 (latest alteration).

6.4 Mounting arrangement:

Mounting arrangement of Air Spring Failure Indication Cum Brake Application (FIBA) Device shall be as per mounting interface and mounting holes of RDSO drawing no. CG-15078 (latest alteration).

6.5 Other Details:

Manifold/Valve body or body of the Air Spring Failure Indication Cum Brake Application (FIBA) Device and its Indicators shall be of AISI 304 stainless steel or Aluminum Alloy for corrosion resistance. FIBA device shall be anodized with natural or yellow colour however Indicators shall be painted grey. Other items of clause 4.1 excluding FIBA device, Indicators and fasteners shall also be corrosion resistant and shall be painted in red colour. The fasteners shall be of high tensile steel to IS: 2269 (ISO 898). Fasteners/ Nut bolt shall be strictly of TVS, Unbrako, LPS make or of make of RDSO Approved Vendor for "*axle end steel high tensile cap screws to be used in end holes of BG freight axles*" (Vendors for developmental orders in the vendor directory should not be considered). Details of requirement of fasteners are as follows: -

SN.	Item	FIBA	Indicators
1	Type, size & grade of bolt	High tensile hexagonal socket head cap bolt M16×50 long, IS:2269 (latest) class 10.9	High tensile hexagonal socket head cap bolt M10×40 long, IS:2269 (latest) class 10.9
	Type, size & grade of nut	Prevailing torque type hexagonal nut (with nonmetallic insert), M16: B, IS: 7002 (latest) class 10.	Prevailing torque type hexagonal nut (with nonmetallic insert), M10: B, IS: 7002 (latest) class 10.
	Type, size & grade of washer	Spring washer IS: 3063 (latest), nominal size 16	Spring washer IS: 3063 (latest), nominal size 10
	Surface finish of fasteners	All fasteners (bolt,nut & washer) shall be either " zinc electroplated to A3L finish of IS:1367 (part-11)" or Geomet 500A.	

7 SUBMISSION OFTECHNICAL DOCUMENTS:

7.1 Vendors desirous of seeking approval from RDSO for supply of material as per this specification, shall submit their proposal accompanied by the documents containing the following information to RDSO: -

7.1.1 Dimensional drawing of Air Spring Failure Indication Cum Brake Application (FIBA) Device.

7.1.2 Weight of one Air Spring Failure Indication Cum Brake Application (FIBA) Device and Indicator respectively.

7.1.3 Whether proposed Air Spring Failure Indication Cum Brake Application (FIBA) Device is being used by any other rail-road system? If yes, details regarding quantity, type of stock, max. operating speed, type of service, average annual running kilometers, life cycle obtained by the user rail-road and maintenance cycle followed by them shall be furnished.

7.1.4 Content of indigenous and imported items in offered Air Spring Failure Indication Cum Brake Application (FIBA) Device.

7.1.5 Expected life cycle in operating and environmental conditions enumerated in clause 2 & 3.

7.1.6 A write-up giving broadly the maintenance requirements on time/distance basis along with the facilities that would be needed for proper maintenance/upkeep of the offered Air Spring Failure Indication Cum Brake Application (FIBA)Device.

7.1.7 A detailed write-up giving the details of "Quality Assurance System" being followed for manufacture of the offered items; and

7.1.8 Details of manufacturing and testing facilities available with the manufacturer.

7.2 The information as received above shall be used for preliminary evaluation of the firm's capability in meeting with the requirements of this specification.

7.3 The firm shall be required to submit a Type Test Report of a proposed design after the preliminary evaluation carried out as per para 7.2 is found satisfactory. Type Test Report shall be complying with Annexure "A" of this specification.

7.4 RDSO reserves complete right in granting approval or otherwise to a firm.

8 GUARANTEE:

8.1 Complete Air Spring Failure Indication Cum Brake Application (FIBA) Device shall be guaranteed for satisfactory performance for a minimum period of 60 months from the date of actual commission in bogies or 72 months from the date of supply whichever is earlier (subject to the conditions that proper over hauling and proper instructions are followed during POH as instructed by the OEM). Satisfactory performance for this purpose means that complete Air Spring Failure Indication Cum Brake Application (FIBA) Device or any of its part shall neither show any kind of deterioration which is likely to render it unserviceable nor lose its characteristics as stipulated in this specification, during the guarantee period for reasons attributable to manufacturing/design defects.

8.2 In the event of 'non-satisfactory performance' of any of the items as indicated above, supplier will have to replace the same at his own expense without levying any cost involved in transportation, handling and replacement of such items on the Purchaser.

9 PROTOTYPE INSPECTION

9.1 The manufacturer shall offer at least 2 Nos. Prototype Failure Indication Cum Brake Application (FIBA) Device & 04 Nos. Prototype Indicators with isolating cock & Hose pipe, the necessary testing according to Para 11.2 of Section-A and Annexure – A of this specification shall be carried out on prototype sample.

9.2 The Prototype inspection of FIBA device shall be carried out by RDSO official at manufacturer's premises. The manufacturer shall provide, without extra charges material, tools and any other assistance, which may consider necessary for any test, examination and dimensional checking.

9.3 After prototype clearance, the FIBA device shall be subjected to field trial as per Para 5.4.3 of Section A of this specification.

10 INSTALLATION, COMMISSIONING & MAINTENANCE:

10.1 On placement of order by a Zonal Railway/PU, supplier whose equipment will be purchased for the "First Time" for installation on the coaches, shall have to depute his representative at his own expense to associate with the purchaser in installation and commissioning of the equipment on the first five coaches.

10.2 With every order for supply of the Air Spring Failure Indication Cum Brake Application (FIBA) Device, the supplier shall have to supply maintenance instructions in the form of one booklet (hard copy on need basis) and one soft copy on Email.

10.3 The vendor shall arrange training session for Railways for maintenance of FIBA device of their make.

10.4 Maintenance booklet supplied by the supplier shall cover the following aspects in detail:

10.4.1 Specification of the Air Spring Failure Indication Cum Brake Application (FIBA) Device.

10.4.2 Working principle based on the actual construction.

10.4.3 Constructional details giving sketches, drawings and photographs etc. identifying various items and their part numbers etc. for easy identification.

10.4.4 Procedure for dismantling using sequential steps with the help of sketches.

10.4.5 Procedure for assembly, using sequential steps with the help of sketches.

10.4.6 Jigs, tools, other materials and details of special set-ups etc., necessary for item 4 & 5 above.

10.4.7 Testing procedures and facilities required along with their details.

10.4.8 Details of prevention maintenance kit, required for periodical preventive maintenance of Air Spring Failure Indication Cum Brake Application (FIBA) Device as recommended by the supplier.

10.4.9 Comprehensive details containing legible sectional views of defects normally observed or may happen on FIBA device with clear remarks whether the defect is rejectable or non-rejectable.

10.4.10 List of other defects and their remedies.

10.4.11 Periodicity for various scheduled maintenance activities on time and distance basis.

10.4.12 Trouble shooting sheets along with sheets indicating Do's and Don'ts for maintenance officials.

11 PURCHASE INSPECTION AND TESTING:

11.1 General requirements:

Purchase inspection shall be done at the premises of the manufacturer by a representative of the Research Designs and Standards Organization or an agency authorized by RDSO. The supplier shall have to arrange for the following and associate with the same:

11.1.1 Access to all records considered relevant for such activity by inspecting officials.

11.1.2 Questioning of relevant personnel engaged in production, testing and quality checking activities etc. or related issues.

11.1.3 Any other check considered necessary by the inspecting party.

11.1.4 The inspecting official shall carry out purchase inspection as per inspection check sheet attached at Annexure "B" of this specification.

11.1.5 The supplier should have credentials of supply of FIBA device and other items as laid down in clause 4 of this specification and will be fully responsible for the delivery of accessories such as Isolating Cock (OLP Type) 20 mm bore, Isolating Cock 20 mm bore with vent hole, Hose Connection and Hardware etc., within the time schedule included in the purchase order.

11.1.6 Item no.3, 4, 5 & 6 of Para 4.1 to be purchased from RDSO/ICF/RCF/MCF registered sources for similar items (isolating cock or hose pipe/connection) and these item to be inspected as per their (RDSO/ICF/RCF/MCF) check sheets and respective specification for similar items (isolating cock/hose pipe). Inspection Certificate of the same should be available at the time of inspection of FIBA device and Indicator. Purchaser can procure suitable fittings and hardware's in deviation of item no. 4 & 5 under clause 4.1 from the sources developed by RDSO/RCF/ICF/MCF as per their requirement based on the type of joint (single ferrule/double ferrule/Flange joint) used in pneumatic suspension. In case of such deviation, inspection requirement/procedure along with check sheet if required shall be provided by the purchaser for such item covered by deviation. These item may be manufactured by the vendor with prior approval of Carriage Directorate, if it is found that sufficient registered sources for similar items (isolating cock, hose pipe/connection) are not available in vendor directory of ICF/MCF/RCF/RDSO. Item at S. No. 7 may be purchased on WTC/RITES/Third party Inspection as per applicability.

11.1.7 The supplier shall be fully responsible for successful running of the system.

11.1.8 The performance of equipment should be equally good for tare and loaded condition.

11.2 **Inspection and testing of Air Spring Failure Indication Cum Brake Application (FIBA) Device:**

11.2.1 Dimensional check:

Item	Reference Documents
Air Spring Failure Indication Cum Brake Application (FIBA) Device	As per Firm's assembly drawing approved by RDSO, Clause 1 of ANNEXURE-B & technical requirements of clause 6 of this specification.
Indicator of FIBA device	

- Tightening torque for fasteners must be mentioned in drawing.
- Dimension tolerance for other than specified dimension should be as per IS 2102 (Part-I) (medium).

11.2.2 Functional test of the FIBA device:

Functional test of FIBA device shall be carried out as per ANNEXURE- B of this specification. Functional testing of Indicators of FIBA device shall also be carried out as per clause 4 of ANNEXURE-B. Indicative pneumatic circuit diagram for FIBA Test Bench is given at ANNEXURE – III.

Leak test of Air Spring Failure Indication Cum Brake Application (FIBA) Device shall be carried out as follows-

- Install the Air Spring Failure Indication Cum Brake Application (FIBA) Device at test bench.
- Gradually raise the air pressure to 2 kg/cm^2 and thoroughly check the air leakage from FIBA device with the help of liquid soap solution.
- Gradually raise the air pressure to 10kg/cm^2

There should be no leakage from any joint, port or FIBA device. Repeat the same procedure for leakage testing of Indicator.

11.3 10% samples of the lot or a minimum 10 samples shall be picked up randomly for dimensional check.

11.4 For other specified inspections a given in clause 11.2.2 of this specification, samples shall be picked up randomly as under:

Lot size upto	10	25	50	75	100
No of samples	2	3	4	5	6

For lot sizes more than 100, 6% of the samples shall be picked up randomly for the above inspections.

11.5 In case any picked up sample fails, manufacturer/supplier shall re-offer, rectifying the defects. However, in such cases, double the quantity of samples shall be picked up and shall be checked for dimension and other specified testing. In case anyone sample fails again, the entire lot shall be rejected.

Signature			
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12 MARKING:

Every item of the Air Spring Failure Indication Cum Brake Application (FIBA) Device shall be legibly marked by engraving/laser marking/using punching/Casting/Name plate or any other permanent & legible marking approved by RDSO to indicate the following:

1) Manufacturer's initials.
2) Month and year of manufacture.
3) Identification marks, i.e. Part Number, Batch Number, etc.

- Ports of FIBA devices shall also be marked i.e. B1, B2, BP &IND etc. by embossing.
- FIBA Resetting Instruction must be displayed properly on FIBA device (near to re-setting mechanism) duly approved by RDSO.
- Due to similarity of indicators of FIBA with brake systems indicators "FIBA" shall be marked on FIBA indicators in more than 20 mm letter.

13. PACKING:

13.1 The Air Spring Failure Indication Cum Brake Application (FIBA) Device shall be suitably packed along with its loose parts and exposed threaded portion, to protect against any damage that may occur during transit and handling. The threaded and other ports of the FIBA device shall be suitably covered with a plastic/rubber cap to prevent ingress of dust or foreign material in the FIBA device and Indicator.

13.2 Packing arrangement should be approved by RDSO/ICF/RCF/MCF & shall be included in QAP.

14. GENERAL:

14.1 RDSO may draw samples for quality check to test any property mentioned in this specification at its discretion at the time of time of purchase inspection. The vendor shall arrange testing of these samples at a reputed outside laboratory as decided between RDSO and the vendor. The testing charges should be borne by the vendor.

14.2 RDSO reserve the right to modify any clause of this specification as per requirement of Indian Railways.

14.3 Additional information if required may be obtained from the office of the Director General (Carriage), RDSO, Manak Nagar, Lucknow –226011.

14.4 Manufactures and purchaser should follow the Make in India policy.

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Signature			
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Annexure – A

REQUIREMENTS OF TYPE TEST REPORT

The type test report of Air Spring Failure Indication Cum Brake Application (FIBA) Device & indicator shall consist of the following, clearly represented by graphs as well as in tabulation forms, with detailed test procedures and their results: -

1) **MATERIAL TESTS**

Material test report (supported by standard test specifications). Material test of FIBA device & indicator including rubber part shall be carried out in ISO and NABL approved lab for confirmation of properties of materials as per approved QAP and drawings of the firm. Testing shall be done as per ASTM/IS/EN/UIC standard.

2) **ENDURANCE TEST OF AIR SPRING FAILURE INDICATION CUM BRAKE APPLICATION (FIBA) DEVICE:**

a) The endurance test is conducted to assess suitability of the Air Spring Failure Indication Cum Brake Application (FIBA) Device provided at secondary stage suspension in coach bogie by simulating service condition.

b) FIBA device shall be tested for 10000 actuation cycle for each valve from 6 Kg/cm^2 in air spring/reservoir. Actuation pressure of both side FIBA valves shall be recorded continuously for first 100 cycles and afterward at every 10^{th} cycles for each Valve. Actuation pressure of FIBA valves shall be within specified limit.

c) Endurance testing of one number Indicator shall be conducted as per para 6.3.11 of EN 15220 (latest).

d) The test on Air Spring Failure Indication Cum Brake Application (FIBA) Device shall be conducted only when the results of functionality test are obtained and found satisfactory.

3) High pressure & functional test of FIBA device shall be done after endurance test, as per para 3 of Annexure- "B" of this specification & test result should be satisfactory.

4) Any other test felt necessary by the manufacturer.

5) Leak test of Air Spring Failure Indication Cum Brake Application (FIBA) Device as detailed at para 11.2.2 of this specification.

6) Tolerance in different dimensions of Air Spring Failure Indication Cum Brake Application (FIBA) Device for machined parts should be as per IS 2102 (Part -I) (m). However, for other components manufactured by different process, respective IS to be followed duly mentioned in Type Test Report and drawing.

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ANNEXURE - B

CHECKSHEET FOR INSPECTION OF AIR SPRING FAILURE INDICATION CUM BRAKEAPPLICATION DEVICE

As per inspection and testing Clause no.11

1. Dimensional Check (10% of the Lot Qty.)

S.N.	Particulars		Unit	Specified	Observed		Remarks
Sample No.							
1.	Length of FIBA Device		mm	As per approved drawing			
2.	Height of FIBA Device		mm				
3.	Thickness of FIBA Device without bkt.		mm				
4.	Thickness of FIBA Device with bkt.		mm				
5.	Port diameter and thread of FIBA device:	BP		3/4"BSPP			
		B1		3/4"BSPP			
		B2		3/4"BSPP			
		IND		¼" BSPP			
6.	Mounting bkt hole pitch of FIBA device		mm	134±0.5			
7.	Dia. of mounting bkt. Holes of FIBA Device	Hole 1	mm	18±0.5			
		Hole 2	mm	18±0.5			
		Hole 3		18±0.5			
8.	Weight of FIBA device with bkt		Kg	As per approved drawing			
9.	Height of indicator		mm	As per approved drawing			
10.	Width of indicator		mm				
11.	Thickness of indicator		mm				
12.	Total Height of indicator		mm				
13.	Inlet port dia of indicator		mm	1/4" BSPP			
14.	Indicators Mounting holes dia.		mm	11.5±0.5			
15.	Indicator Mounting holes pitch		mm	124±0.5			
16.	Weight of indicator		Kg	As per approved drawing			

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2. **Leak Test of FIBA Device**: As per Clause 11.2.2 of section A.

3. **Functional test of FIBA device**:

S. No.	Test and testing procedure	Standard	Results of FIBA device sample obtained	
			S. No..... Mfgdt.....	S. No..... Mfgdt.....
1.	**Initial Charging:** i) Ensure that all Isolating cocks and cut of angle cocks in supply line should be in open condition. Other end cut of angle cocks and drain cocks provided on test bench should be in closed position. ii) Charge the FP line at 6.0 Kg/Cm^2 and BP line at 5.0 Kg/Cm^2.	--------- FP= 6 ± 0.1Kg/Cm^2 BP= 5 ± 0.1Kg/Cm^2		
2.	Leak **Test:** Check for any leakage in FIBA device & pipe lines. No leakage is permitted in FIBA device and through its joint. Total leakage in system should not be more than 0.2 Kg/Cm^2 in 60 sec.	Leak test within limit.		
3.	High Pressure Test: Charge FP and BP up to 10.0 Kg/Cm2.	i) No leakage in FIBA device Valve ii) FIBA device should not operate. iii) No damage in FIBA device or circuit.		
4.	**A) Functional Test at 2.0 Kg/Cm^2 (Tare Pressure)** Charge the FP at 2.0 Kg/Cm^2 Pressure and BP at 5.0 Kg/Cm^2. Open the ½" drain cock to drain the air pressure of one side air spring/40L/60L auxiliary reservoir. Repeat the process for other side air spring.	i) Pressure in respective gauge start falling & FIBA device actuate when respective gauge pressure becomes less than 1±0.1 Kg/Cm^2. ii) BP pressure starts venting gradually and settles at 3.4**±0.1**Kg/Cm^2. iii) Both indicators should be red. iv) Hissing sound of 90±5 db should blow.		

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BP Isolation: (Brake release and suppression of hissing sound /Hissing sound along Indicators) Close the Isolating cock provided before FIBA device in BP line.	i) BP pressure exhaust, through FIBA device exhaust port stops and BP pressure rises to 5±0.1 Kg/Cm^2. ii) Hissing sound stops. iii) Both indicators show red.					
Suppression of Indicator: Reset the FIBA device by knob/push mechanism.	Both indicators of FIBA device should turn to green from red.					
B) Functional Test at 5.0 Kg/Cm^2: Charge the FP at 5.0 Kg/Cm^2 Pressure and BP at 5.0 Kg/Cm^2. Open the ½" drain cock to drain the air pressure of one side air spring/40L/60L auxiliary reservoir. Repeat the process for other side air spring.	i) Pressure in respective gauge start falling & FIBA device actuate when respective gauge pressure becomes less than 1±0.1 Kg/Cm^2. ii) BP pressure starts venting gradually and settles at 3.4±0.1Kg/Cm^2. iii) Both indicators should be red. iv) Hissing sound of 90± 5db should blow.					
BP Isolation: (Brake release and suppression of hissing sound /Hissing sound along Indicators) Close the Isolating cock provided before FIBA device in BP line.	i) BP pressure exhaust, through FIBA device exhaust port stops and BP pressure rises to 5±0.1 Kg/Cm^2. ii) Hissing sound stops. iii) Both indicators show red.					
Suppression of Indicator: Reset the FIBA device by knob/push mechanism.	Both indicators of FIBA device should turn to green from red.					
C) Functional Test at 6.0 Kg/Cm^2: Charge the FP at 6.0 Kg/Cm^2 Pressure and BP at 5.0 Kg/Cm^2. Open the ½" drain cock to drain the air pressure of one side air spring/40L/60L auxiliary reservoir. Repeat the process for other side air spring	i) Pressure in respective gauge start falling & FIBA device actuate when respective gauge pressure becomes less than 1±0.1 Kg/Cm^2. ii) BP pressure starts venting gradually and settles at 3.4**±0.1**Kg/Cm^2. iii) Both indicators should be red. iv) Hissing sound of 90± 5db should blow.					

Signature			
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5.	**BP Isolation: (Brake release and suppression of hissing sound /Hissing sound along Indicators)** Close the Isolating cock provided before FIBA device in BP line.	i) BP pressure exhaust, through FIBA device exhaust port stops and BP pressure rises to 5±0.1 Kg/Cm^2. ii) Hissing sound stops. iii) Both indicators show red.				
	Suppression of Indicator: Reset the FIBA device by knob/push mechanism.	Both indicators of FIBA device should turn to green from red.				
	Brake Pipe Variation Test: **Drop** Brake Pipe pressure from 5.0 Kg/Cm^2 to zero.	i) FIBA device should not actuate. ii) FP line pressure should not drop. iii) Both indicators should show green. iv) No Hissing sound.				
6.	**Charging Behaviour Test:** Charge BP prior to and observe the actuation behavior of FIBA Dev if actuated.	FIBA device should not actuate				
7.	**Resetting Behaviour Test:** i) Charge the system(FP)at 6.0±0.1 Kg/Cm^2 pressure. ii) Drop FP line pressure and actuate the respective FIBA Device. iii) Close the drain cock and raise FP line pressure of FIBA Device to again 6.0±0.1 Kg/Cm^2.	FIBA device should not reset automatically				

4. Testing of Indicator:

i) Leakage test:

Apply a pressure of 10 Kg/Cm^2. There should not be any leakage if checked with soap water.

ii) Functionality Test:

a) Apply a pressure of 0.5 to 0.6 Kg/Cm^2. Red colours should appear in window of Indicator. Movement of piston of Indicator shall be smooth and steady.

b) Now release the pressure to 0 Kg/Cm^2. green colours should appear in window of Indicator.

c) Piston of indicator should move smoothly and piston should not be sticky. Indicator shall be air tight and water resistant.

Signature			
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SECTION-B (SCHEDULE OF TECHNICAL REQUIREMENTS)

INFRASTRUCTURE & FACILITIES REQUIRED FOR MANUFACTURE & TESTING OF AIR SPRING FAILURE INDICATION CUM BRAKE APPLICATION (FIBA) DEVICE & its Indicators.

1.0 SCOPE

1.1. This Section covers the infrastructural requirements for manufacture and supply of Air Spring Failure Indication Cum Brake Application (FIBA) Device for air Spring fitted in BG ICF, LHB, Hybrid, double decker mainline coaches and MEMU/DEMU coaches having ICF or LHB type bogies or any other type bogies for which RDSO approves applicability of this STR.

2.0 REQUIREMENTS

2.1 All vendors seeking registration with RDSO shall comply all requirements mentioned below.

3.0 PLANT, MACHINERY AND INFRASTRUCTURE REQUIREMENTS

3.1 The Manufacturer shall have adequate space and covered area with proper 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, Rejection and Inspection area.
d) Storing and dispatch of finished products.
e) Assembly & testing area should be dust, moisture & temperature controlled.

3.2 The Manufacturer must have UIC approval of at least one pneumatic system/valve/equipment, else manufacturer must have in-house (or at allied/sister concern) manufacturing (primarily machining) and assembly facilities, for proper quality control, as follows: -

SN.	Item	Requirement
1	Failure Indication cum Break Application Device (FIBA)	At least machining, assembly & testing should be in-house.
2	Indicators	At least machining, assembly & testing should be in-house.
For better quality control, machining shall be done on CNC/NC machine.		

4.0 TESTING FACILITIES

4.1 The Manufacturer shall have at least following testing equipment/facility with controlled temperature and humidity:

a) Test Bench for Functional Testing of FIBA Device: Min. 01 Nos.
b) Endurance Test setup: Min. 01 Nos.
c) Audio meter: Min. 01 Nos.
d) Digital Vernier Caliper (500mm): Min. 01 Nos.
e) Dial Gauge: Min. 01 Nos.
f) Micrometer: Min. 01 Nos.

g) Measuring tapes (3 mtr): Min. 01 Nos.
h) Thread Plug Gauge: Min. 02 Sets
i) Steel Scale: Min. 02 Nos.
j) Digital Weigh scale (20 Kg): Min. 01 Nos.
k) Stop watch: Min. 01 Nos.
l) Surface table: Min. 01 No.
m) Radius gauges: Min. 01 Set
n) Vibration testing machine for compliance of para 6.1.2 of this specification (In-house/at NABL approved lab).
o) Any other essential measuring equipment's for dimensional & functional test for compliance of this specification.

5.0 QUALITY CONTROL REQUIREMENTS

5.1 The firm should have acquired ISO:9000 series certification for the product for which an approval is sought.

5.2 The Vendor shall have a well-documented 'Internal Quality Assurance System' to ensure sustained quality of product being manufactured. The Quality Assurance System' shall generally cover the following: -

5.2.1 System to ensure that correct raw material is being used.

5.2.2 System to ensure that components having manufacturing defects are identified and destroyed so that such components are not used during assembly of air spring.

5.2.3 System to ensure that bought out components are strictly as per requirements laid down in the specification /drawing.

5.2.4 System to maintain strict control of dimensions and workmanship of components and assembled product.

5.2.5 System to test and establish that the Air Spring Failure Indication Cum Brake Application (FIBA) Device manufactured by the firm meets all the requirements laid down in specification / drawing.

5.2.6 System of periodical calibration of equipments/gauges to ensure accuracy of product.

5.2.7 System to ensure cleaning & removal of dust/rust and moisture by dry air.

5.2.8 System to ensure traceability at least up to guarantee period.

5.3 Quality manual of the firm for ISO:9000 should clearly indicate at any stage the control over manufacturing and testing of the railway product.

5.4 The firm should submit the Quality Assurance Plan (QAP) as per RDSO ISO doc no. QM-RF-8.1-3 version (latest).

5.5 The firm must ensure that proper analysis is being done on regular basis to study the rejections at various internal stages and it is well documented.

5.6 The firm should ensure that latest version all the relevant specifications, IS Standards are

available with the firm.

5.7 System for calibration of testing & measuring equipment.

5.8 System to ensure that Failure Indication Cum Break Application Device (FIBA) device is properly packed to meet the requirement of clause-13 of this specification.

5.9 Facilities included in Section-B of the specification are bare-minimum, entire responsibility for compliance of the specification shall lie with the vendor.

5.10 There shall be proper stacking of raw material and their record. FIFO system should be implemented, especially for non-metallic components. Non-metallic components shall be kept in proper dust & moisture free environment.

6.0 DOCUMENTATION

Firm shall maintain the following documents/ records:

6.1 A well-documented Quality Plan.

6.2 Incoming raw material register with Test Certificates references of suppliers and internal test results.

6.3 Stage inspection results including finished products results.

6.4 Records of internal rejection and its analysis vis-à-vis action plan.

6.5 Records of final products inspection by external agencies (like RDSO/Railways), Non-Conformity Reports and case analysis as well as action taken thereof.

6.6 There should exist a system of documentation in respect of rejection at customer end, warranty replacement and in service performance.

6.7 Records of raw material received and supplies made to Railways against the raw material. Incoming raw material with TC reference of supplier as well as internal test/audit checking from outside agency.

6.8 The details regarding Stage inspection and test result.

7 Qualification of Man Power

7.1 The Quality Control Section shall be separately headed by a full time technical expert having a minimum bachelor's degree in Mechanical/ Automobile/ Mechatronics etc. with at least 5 years of experience or diploma in Mechanical/ Automobile/ Mechatronics etc. with at least 8 years of experience. He shall be free from day-to-day production & testing responsibilities. He shall be mainly responsible for development for product, failure analysis, planning corrective and preventive action, control over raw material, devising actions in case of difficulties in achieving the parameters etc.

7.2 Production/ inspection activities shall be headed by a graduate engineer with at least 5 years of experience or a diploma holder with at least 8 years of experience. He shall be actively involved in day-to-day activities of stage inspection / compliance of QAP etc.

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Signature			
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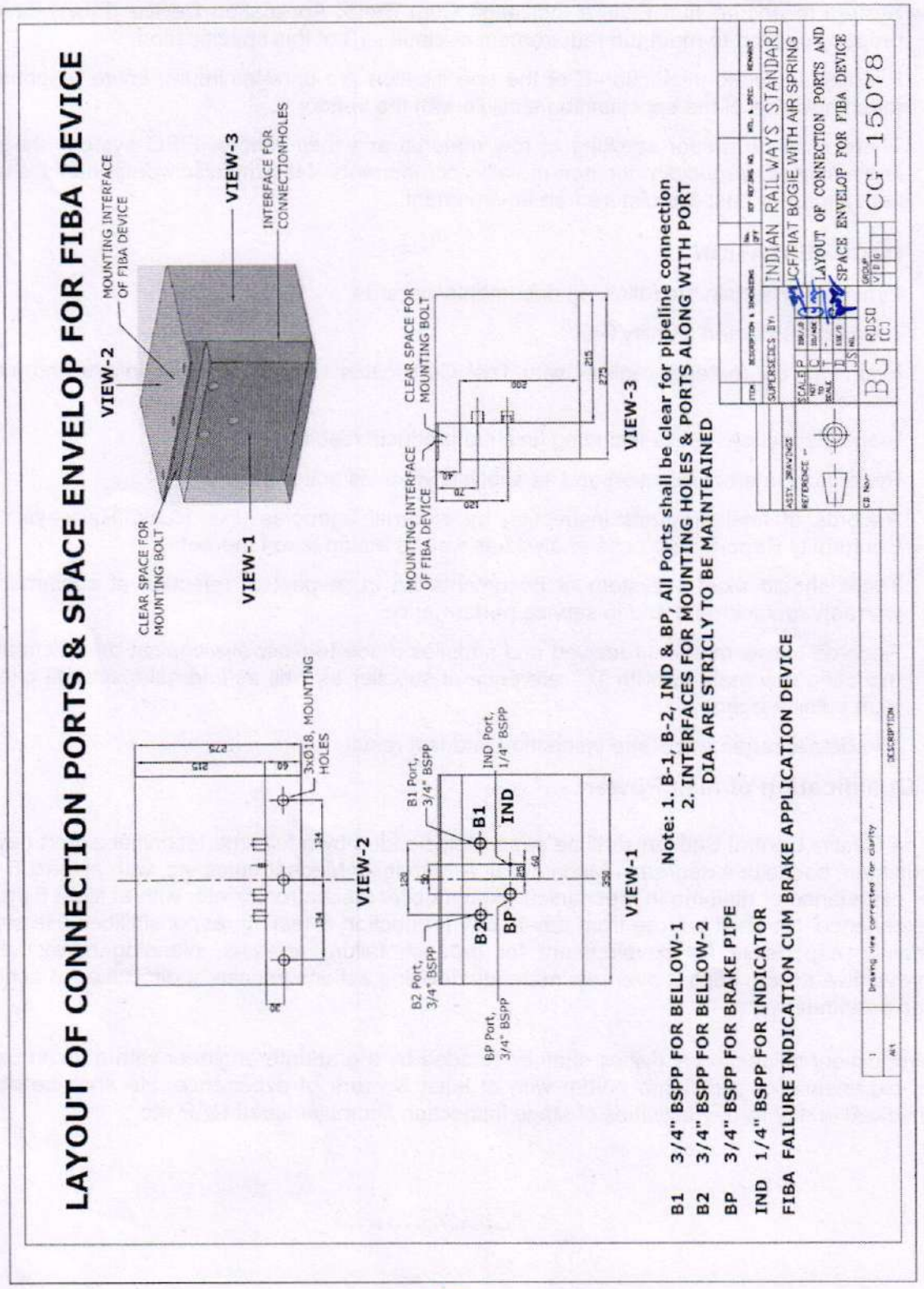
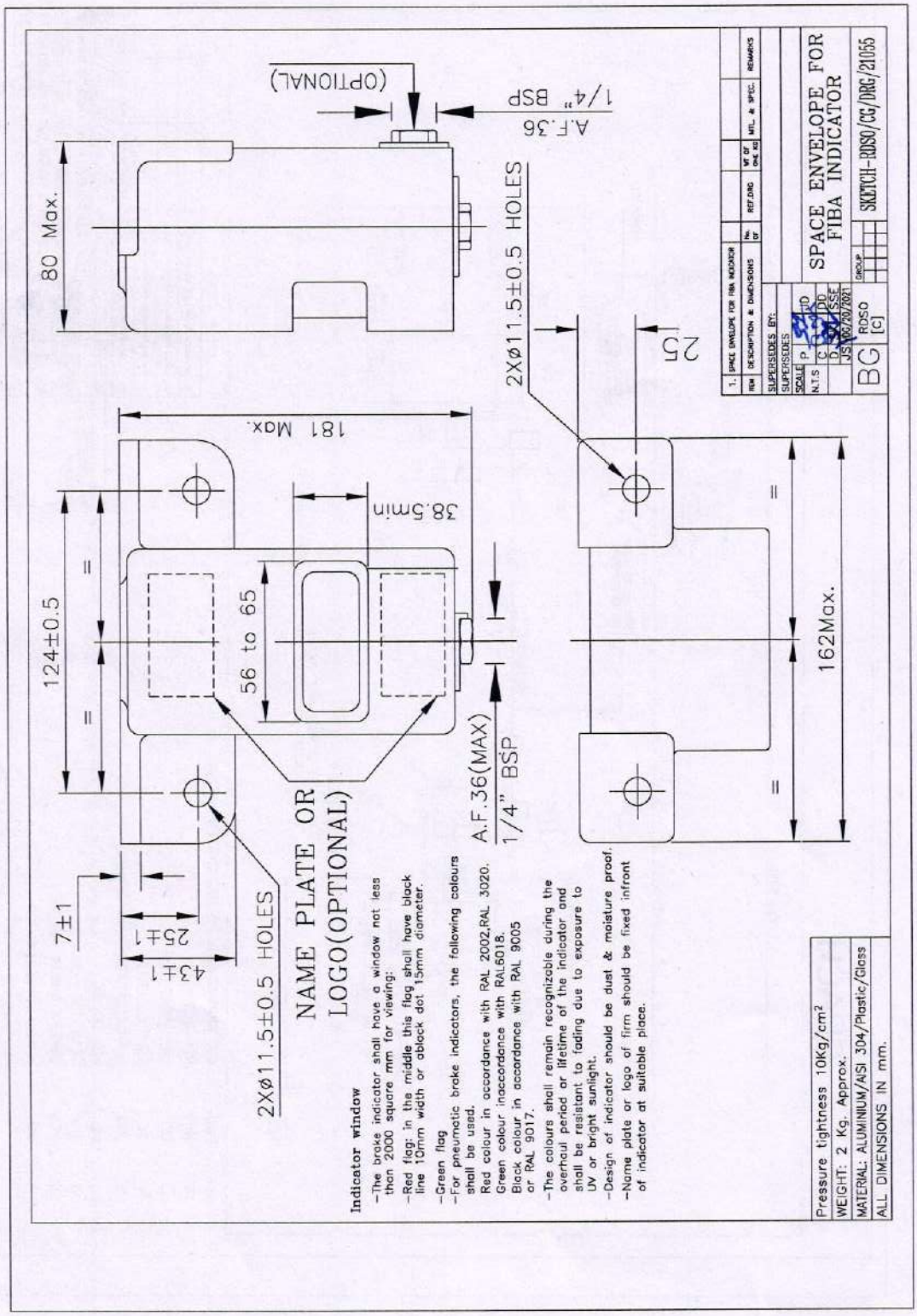
ANNEXURE – I



Signature			
Name & Designation	Prepared By: Sameer Kumar (SSE/VDG/Carriage)	Checked By: Praveen Kumar (DD/VDG/ Carriage)	Approved By: Shobhit Pratap Singh (Director/VDG/Carriage)

ANNEXURE - II



Signature			
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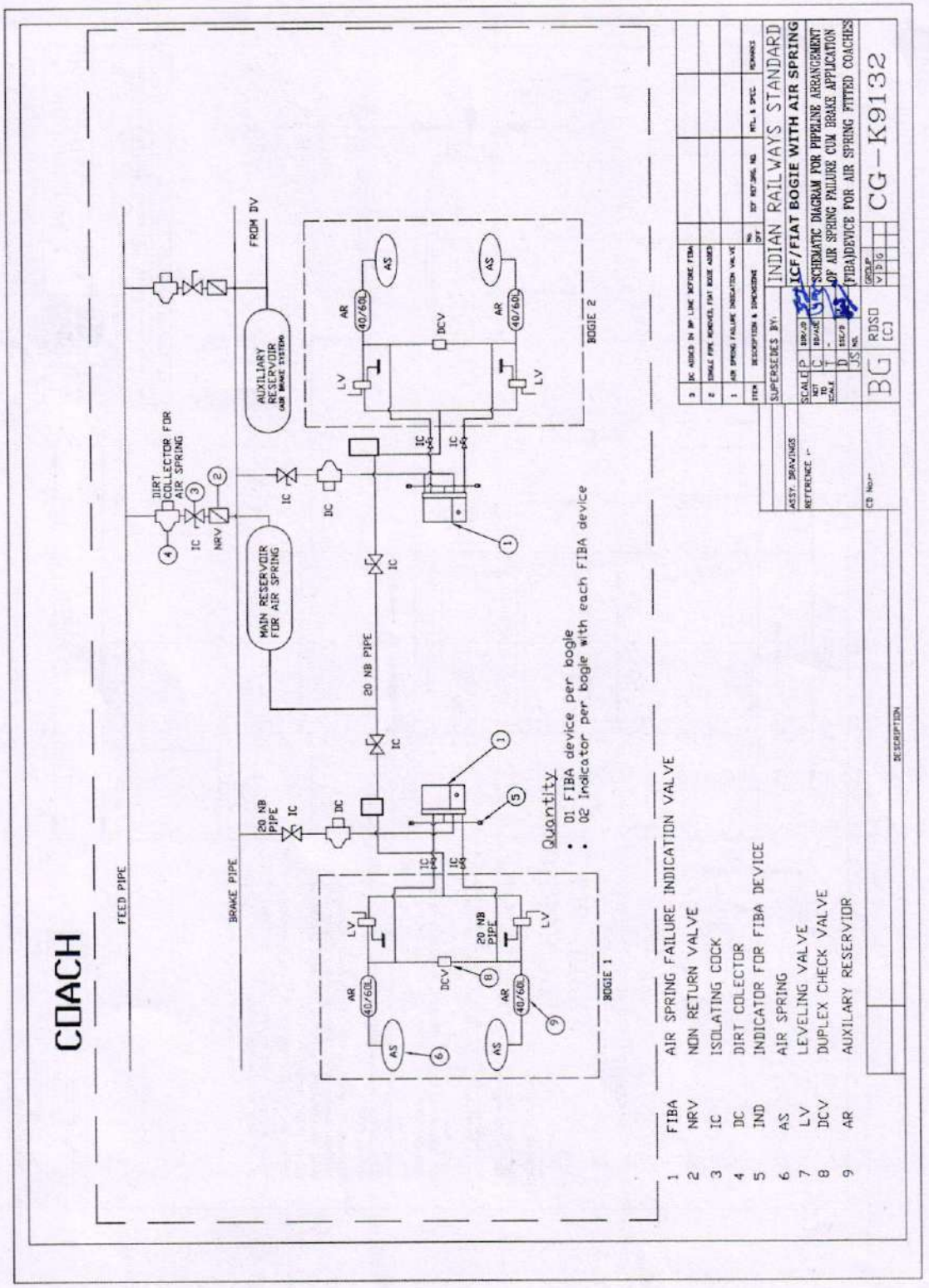
ANNEXURE - III



Signature			
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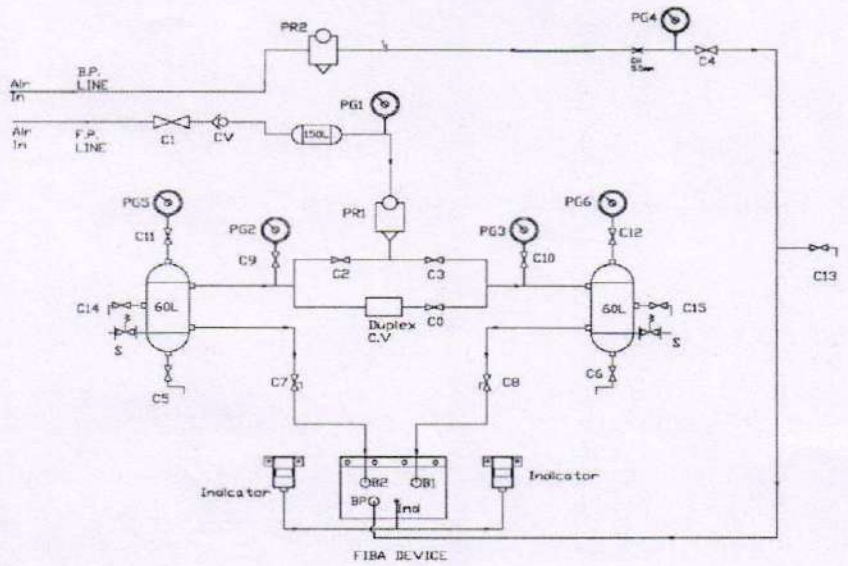
ANNEXURE - IV



FIBA TEST BENCH PNEUMATIC CIRCUIT

Qty.	Part No.	Description	Remarks	Qty.	Part No.	Description	Remarks
1	PG6	Pressure Gauge	Operating Pressure Range:- 0-16 Kg/cm^2	1	C6	Isolating Cock	Thread Type & Size:- BSP & 1/2"
1	PG5	Pressure Gauge	Operating Pressure Range:- 0-16 Kg/cm^2	1	C5	Isolating Cock	Thread Type & Size:- BSP & 1/2"
1	PG4	Pressure Gauge	Operating Pressure Range:- 0-16 Kg/cm^2	1	C4	Isolating Cock	Thread Type & Size:- BSP & 1/2"
1	PG3	Pressure Gauge	Operating Pressure Range:- 0-7 Kg/cm^2	1	C3	Isolating Cock	Thread Type & Size:- BSP & 1/2"
1	PG2	Pressure Gauge	Operating Pressure Range:- 0-7 Kg/cm^2	1	C2	Isolating Cock	Thread Type & Size:- BSP & 1/2"
1	PG1	Pressure Gauge	Operating Pressure Range:- 0-16 Kg/cm^2	1	C1	Isolating Cock	Thread Type & Size:- BSP & 1/2"
1	C15	Isolating Cock	Thread Type & Size:- BSP & 1/2"	1	CH	Choke	Choke 5.5 mm
1	C14	Isolating Cock	Thread Type & Size:- BSP & 1/2"	1	C0	Isolating Cock	Thread Type & Size:- BSP & 1/2"
1	C13	Isolating Cock	Thread Type & Size:- BSP & 1/2"	1	CV	Check Valve	Check Valve With 3 mm Choke
1	C12	Isolating Cock	Thread Type & Size:- BSP & 1/2"	1	PR2	Pressure Regulator	Operating Pressure Range:- 0-12 Kg/cm^2 Accuracy:- ±0.05 Kg/cm^2 (At Any Pressure)
1	C11	Isolating Cock	Thread Type & Size:- BSP & 1/2"	1	PR1	Pressure Regulator	Operating Pressure Range:- 0-12 Kg/cm^2 Accuracy:- ±0.05 Kg/cm^2 (At Any Pressure)
1	C10	Isolating Cock	Thread Type & Size:- BSP & 1/2"	1	150L	Stainless Steel Reservoir	Capacity:- 150 Liter
1	C9	Isolating Cock	Thread Type & Size:- BSP & 1/2"	1	60L	Stainless Steel Reservoir	Capacity:- 60 Liter
1	C8	Isolating Cock (With Vent)	Thread Type & Size:- BSP &^{3} 4"	1	60L	Stainless Steel Reservoir	Capacity:- 60 Liter
1	C7	Isolating Cock (With Vent)	Thread Type & Size:- BSP &^{3} 4"	2	S	Safety Valve	Set Pressure of Safety Valve 10.5 Kg/cm^2 Max.

Signature			
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