INDIAN RAILWAYS

MASTER COPY
Controlling Officer
Signature
Designation

Document content	Technical Specification	Yes
	Schedule of Technical Requirement	Yes
Description of item	SPECIFICATION FOR DESIGN, SUPPLY, INSTALLATION, COMMISSIONING & MAINTENANCE OF ASPIRATION TYPE AUTOMATIC SMOKE / FIRE DETECTION WITH ALARM SYSTEM FOR INDIAN RAILWAYS AC COACHES	
Remarks	Nil	

S. No.	Month/Year of issue	Revision/ Amendment	Page No.	Reason for Amendment
1.	April- 2008	-	-	First issue
2.	November- 2010	Revision-1	All	Incorporation of experiences gained from trial and suggestions from experts.
3.	Nov-2012	Revision-2	All	Testing procedure revised& additional features like activation of brake application on detection of fire etc. added.
4	Sept-2014	Revision-3	17 & 18	• Amendment slip no. 1 deleted& Clause no. 2.14.1 i) modified. • Alarm threshold settings for various types of IR coaches specified at clause no. 2.6. • Clause no. 2.6.1 added to take action on each indication of fire alarm.
5	June-2017	Revision-4	All	• To incorporate experience gained by Railways. • System for Stand-alone and system for complete rake defined separately • Eligibility criteria modified & ISO clause included in Scope as clause no. 1.3 and for New Technologies clause 1.4 added. • The word 'any suitable' deleted wherever in the specification.
6	August-2019	Revision-5	All	• Amendment-1 of Nov-2017included and experience gained incorporated to increase supplier/OEM base.
7	August-2023	Revision-6	All	• To include Govt. of India policy on 'Make in India' in Para 1.3. • Heat Activated sampling Points (HASPs) replaced with Aspiration type Smoke Detectors from lavatories
8	August - 2024	Amendment No.1	All	• Standard data format and error codes. • Common interface for status monitoring & data downloading • Provision of mechanical clamp for isolating cock. • Modified audio message • Part-III Schedule of technical requirements added

Issued by:
Carriage Directorate
Research Designs and Standards Organization
Manak Nagar, Lucknow - 226011

Signature			
Name & Designation	Prepared By:- Nayan Kumar SSE(D)/Carriage	Checked By:-Shyam Shankar SSE(D)/Carriage	Approved By-Anurag Malik Jt. Director/SS/Carriage

Amendment slip No. 1 of August 2024 to Specification No. RDSO/2008/CG-04 (Rev.-6) for Design, Supply, Installation, Commissioning & Maintenance of Aspiration Type Automatic Smoke / Fire Detection with alarm system for Indian Railway AC coaches:

1. **Clause (b) of FOREWORD modified and shall be read as under:**

   This consists of three sections i.e. Section-A, Section-B and Section-C. Section-A covers the general technical requirements regarding design, supply, installation, commissioning and maintenance. Section- B covers the functional & design requirements for automatic smoke/fire detection with alarm system for very early warning and Section-C covers the Schedule of technical requirements i.e. Infrastructural requirement for automatic smoke/fire detection with alarm system.

2. **Clause No. – 11.1 and 11.2 of Section – A modified and shall be read as under:**

   11.1 Suppliers, whose prototype approval has already been done by RDSO, will not require prototype approval by Zonal Railways.

   11.2 For new Supplier/OEM, the prototype approval of the complete system will be done by RDSO.

3. **Clause No. – 1.7(a) of Section – B modified and shall be read as under:**

   The control supply to the Fire Detection System will be provided from Terminal Block (TB) X1 of Switch Board Cabinet (SBC) for LHB AC coaches and TB-4 for ICF AC coaches through DC MCB of adequate rating as under.

   - **For LHB variant of AC coaches**
     Supply shall be taken from place of installation of MCB S1F33 with 2A, 2P, C-curve, 110V DC MCB. The indication of MCB in Sheet no.11 of 48 of RDSO drawing no. RDSO/PE/SK/AC/0206-2019.
   - **For ICF type SC AC coaches**
     Supply shall be taken from dedicated 2A, 2P, C-curve, 110V DC MCB provided after the common 40A DC MCB (as per RCF drawing no. CC70401). The MCB shall be placed in the Power Panel besides other DC MCBs. New 2A MCB provided for FSDS.

4. **Clause No. – 2.6.2 (New clause) of Section – B added.**

   Two-digit Error code for FSDS system should be as per following format:

S. No.	For FSDS System Error codes are as per below	
	Error Description	**Error Code**
1.	Choking/overflow in sampling pipes.	E1
1.	Wiring Break/Electrical discontinuity within the system	E2
2.	Power Failure to Brake valve	E3
3.	Brake valve isolated	E4
4.	Automatic brake application	E5
5.	System functional without any error	00

5. **Clause No. – 2.6.3(New clause) of Section – B added.**
   Data downloaded from Fire and Smoke Detection System (FSDS) shall be as per following format along with details of coach no. and FSDS make:

S. No.	Date and time of alarm	Trouble /Error id	Alarm type with threshold value (%obs/m)	Message address etc.
1.				

6. **Clause No. – 2.12 of Section – B modified and shall be read as under**

The system shall be designed to work through 24 V DC Lithium-ion batteries backup also to ensure the functionality of the system even power supply from the coach gets interrupted. For such, a (12+12) volt/24 V DC sealed maintenance free battery with suitable/reliable battery charging mechanism as a secondary source/standby source of supply with a power back-up of at least 10-12 hours shall be incorporated in design aspect. The battery shall have in-built Battery Management System (BMS) to avoid deep discharging of battery. The battery shall be protected from any suspected vandalism. All safety measures including fire safety measures globally adopted for lithium ion batteries must be provided in the power/control panel. The control panel should have minimum IP54 protection from dust and water.

Assembly/sub-assemblies used for power supply & switching shall be reputed brands such as:

(i) MCB - Siemens, Schneider Electric, Finolex Cables, Havells, Polycab, Legrand MCB, ABB Ltd &Hager Group or any other make with prior approval of RDSO.

(ii) Battery –Servotec, Amararaja, Exide, CLN Energy, WAREE, SuKam, Battrixx and PTech. or any other make with prior approval of RDSO.

7. **Clause No. – 2.14.1 (ii), (iv)and (vi)of Section – B modified shall be read as under:**

ii) After a time, delay of 55 seconds after activation of brake application, an audio visual alarm like a hooter or buzzer etc. along with flashing lights should be activated. Simultaneously, it should activate an announcement in the affected coach in English and Hindi; "Kind attention please, smoke has been detected in the coach. Brakes have been applied on the train for your safety. Please move from this coach to other coaches. When the train stops, get off the coach carefully and stand away from the tracks. Be careful, that you are not in danger from any other trains passing through adjacent railway lines".

iv) In case of stand-alone system, supplier/OEM will provide necessary interface and accessories for automatic brake application in the event of fire alarm. The accessories required for brake application shall be procured from sources approved from RDSO/ICF/RCF/MCF. Provision of mechanical clamp for isolating cock to be provided to prevent unwanted isolation as per RCF's guideline no. MD4611.1, dated: 22.05.24.

(vi) All the connectors shall be of reputed make either from WAGO / Phoenix / Weidmuller / Amphenol / Harting / Allied Electronics Corporation / MurrElectronik. Coupler/ Connectors must be tested and certified as per DIN EN 60664 – 1, DIN EN 61984, IEC 60529, BS EN 45545, DIN IEC 60352-2, IEC 61373 / EN 50155 and IP 68.

8. **Clause No. – 2.17 of Section – B modified and shall be read as under:**

Common Interface Panel should be included in scope of work. The tentative panel schematic is at Annexure-B.USB 2.0 output port for data downloading on Fire and Smoke Detection System (FSDS) on common interface Panel at suitable location to be provided for event log extraction during service & maintenance. It should be possible to download data directly in Pendrive.

Section – C

[RDSO SPECIFICATION No. RDSO/2008/CG-04(Rev-06)] (INFRASTRUCTURAL REQUIREMENT)

1. **Scope:**

This section covers the infrastructural requirement for Aspiration type automatic smoke / fire detection with alarm system for Indian Railways AC coaches.

2. **Requirements:**

All the vendors seeking registration with Indian Railways shall comply with all the requirements mentioned below:

3. **Manufacturing Facilities:**

3.1. The manufacturer shall have adequate space and covered area with cemented floor to accommodate the following.

a) Damp free place for storage of raw material and finished products.
b) Independent Manufacturing area
c) Inspection area

3.2. Firm shall have following minimum M&P and Infrastructure at their works:

i) In Circuit Debugger / tester.
ii) Regulated DC power supplies.
iii) Microcomputer based and computer aided design system with workstations for R&D which will be, needed for failure investigation and future up-gradation
iv) Other regular tools like Hot Air gun, Thermocouple, Measuring tape, measuring scale, magnifying glass, screw drivers, cutting tools, crimping tools etc. used for manufacturing, electronic assembly line, inspection and testing of FSDS working.

3.3. Clean room for electronic product manufacturing/assembly.

3.4. Ultrasonic cleaner (suitable for volume production cleaning) for assembled PCB's to prevent field failure of assemblies due to PCB surface impurities in high moisture/ humidity environments.

3.5. Dust free environment for assembly of electronic modules. Assembly area should have electro static discharge protection in line with IS:10087-1981(Anti-static mat in assembly area and wrist band earthed with anti-static mat)

4. **Testing Facilities:**

4.1. Firm should have following minimum testing facilities at their works:

v) Smoke generator test equipment as per "ARGE Guideline-Part 1" for functional test on fire detectors.
vi) Hot wire testing facility as per Annexure-1 of RDSO spec RDSO/2008/CG-04.
vii) Anemometer for air flow measurement.
viii) Insulation tester.
ix) Digital Multi-meter with basic DC Voltage accuracy of at-least 0.5%.
x) Test Jigs.
xi) Instruments to measure static charges.
i) Any other test equipment considered necessary for product's reliability.

4.2. The firm should have either in-house arrangement or tie-up with accredited agency for periodical calibration of all the equipment and test instruments.

5. INSPECTION TESTING:

5.1. General

5.1.1 Only after the detail drawings/documents and Design have been approved and the clearance given to this effect, the manufacturer shall take up the manufacture of the prototype. It is to be clearly understood that any changes, required to be done in the prototype or any additional tests other than specified herein are required to be conducted on the prototype unit or its components, they shall be done expeditiously. During the process of manufacture of the equipment, if the approving authority so desires, it may conduct/repeat any of the routine or additional tests to satisfy that the quality of the module being manufactured is of the required standards.

5.1.2 The test protocol indicating relevant clause of the test, condition of the test, specified value and observed value of the parameter for FSDS shall be submitted by the firm before offering the sample for testing.

5.1.3 Vendor Approving Authority may conduct surprise check on manufacturing process and quality control along with any of the tests to ensure quality of product and its conformance to this specification.

5.2. Inspection Testing

The tests shall be carried out at the works of the manufacturer in presence of Indian Railway representative on a prototype system as per relevant governing specifications modified or amplified. The manufacturer shall have all possible necessary arrangements for inspection and testing of the system.

5.2.1 Routine Tests:

The following shall comprise the routine tests and shall be conducted by the manufacturer in-house on every equipment and the test results will be submitted to the inspection authority before the inspection. The application software in proper format shall also be submitted to the inspection authority in advance.

5.2.2 Insulation Resistance Tests:

Insulation test shall be done between shorted terminals of supply port and the metallic portion of the enclosure at 500V DC.

Apply AC voltage of 1000V, 50Hz between the metal rack and the short-circuited points of power supply connector for one minute. (Neither disruptive discharge nor flash-over shall occur).

Functionality test shall also be performed subsequent to these tests.

5.2.3 Performance test:

All the units shall be tested for their functionality as required in service condition as per this specifications design requirements. To simulate such condition in test lab a PC based simulator shall be specially developed for this purpose by the manufacturer.

5.2.4 Reverse Polarity test:

The system shall be functional after applying 160V DC for one minute in the correct polarity as well as in the reverse polarity to check the polarity of connection in case of 110 V DC supply. In case a DC-DC converter is used the same shall be applied to the DC-DC converter with full connected load.

5.2.5 System level functional tests:

a) Constructional details.
b) Dimensional check.
c) General Workmanship.
d) Configuration.
e) Cables for electrical connections should be properly harnessed with cable

channel/tray or into ducts having adequate fire retardancy.

5.2.6 Visual inspection of complete system:

During visual test general workmanship, connector, cable and wiring shall be checked of the system. Dimensions shall as per approved drawing. The visual inspection shall broadly include:

a) Indications and displays.
b) Mounting and clamping of connectors.
c) Proper housing of cards.
d) Visual inspection system (with magnifying lens/CCD camera) or Automatic optical inspection unit.

Any other tests shall be carried out as considered necessary by the purchaser.

5.2.7 Acceptance Test:

As per clause 12.3 (Section-A) of this specification.

5.2.8 Installation &Commissioning testing:

The contractor shall carry out Commissioning test on completed coach at Railways. The contractor shall submit all test documents, test procedures and check sheets. Proforma to be followed for installation & commissioning tests as per clause 11.4 (Section-A) of this specification.

5.3. **Batch Testing of FSDS.**

i) Certificate of conformance to be provided for FSDS from OEM. Lot wise test record shall be maintained which may be verified by the inspecting officials.
ii) Manufacturer shall maintain proper account of FSDS being used. The record shall include various details like source of supply, procurement invoice no. and date, quantity, incoming rejection, lot-wise consumption etc. which may be verified by the inspecting officials.

6. **QUALITY CONTROL REQUIREMENTS**

6.1 The firm should have acquired ISO: 9001certification from the agency accredited by an accreditation body which is a part of International Accreditation Forum (IAF), and the product for which the approval is sought should be broadly covered in the scope of the certification for manufacture and supply.

6.2 The Quality manual of the firm for ISO: 9001 should clearly indicate at every stage the control over manufacturing and testing of the said railway product.

6.3 There should be a system to ensure the traceability of the product from raw material stage to finished product stage. The system should also facilitate to identify the raw material composition from the finish product stage.

6.4 It should be ensured that there is a Quality Assurance Plan for the product detailing the following various aspects.

- Organization chart
- Process flow chart
- Process control chart
- Stage inspection details from the raw material stage to finish product stage.
- Various Parameters to be checked and level of acceptance of such parameters indicated and method to ensure control over them.
- Disposal system of rejected raw material and components

6.5 There should be at least one full time technologist having a minimum Master's degree in relevant field with experience of at least 3 years or Bachelor's degree in relevant field with experience of at least 5 years or a person with Diploma in relevant field with 12 years' experience. He should be free from day-to-day production, testing and quality control

responsibilities. He should be mainly responsible for development of a product, analysis of products, control over raw material, and corrective action in case of difficulties in achieving the parameters.

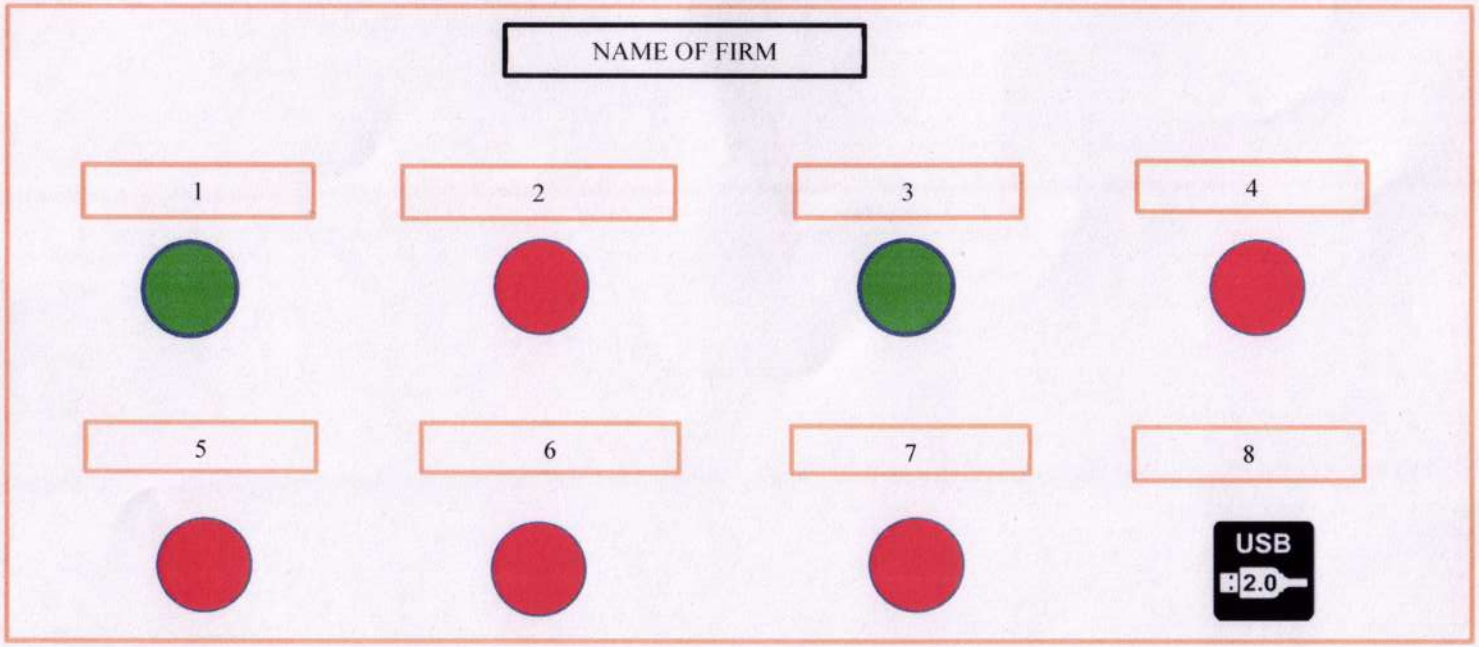
6.6 Ensure that the in-charge of the Quality Control Section is having a qualification of minimum Master's degree in relevant field with experience of at least 3 years or Bachelor's degree in the relevant field with a minimum of 5 years' experience or alternatively he should be a Diploma holder with minimum of 12 years' experience. He should be actively involved in day-to-day activities of quality control / stage inspection / compliance of QAP etc.

6.7 The firm must ensure that proper analysis is being done on monthly basis to examine the rejections at various internal stages and it is documented.

6.8 The firm should ensure that latest version all the relevant specifications, IS Standards are available with the firm.

Note: - SN 3.4 can be outsourced to ISO certified firm. MOU with sub vendor along with QAP and M& P shall be submitted to RDSO for prior approval RDSO official may visit to the premises of sub vendor for physical verification.

Annexure-B



150mmX100mm

1. POWER ON
2. FAULT
3. BRAKE VALVE ELECTRICALLY CONNECTED
4. BRAKE VALVE PNEUMATICALLY ISOLATED
5. ALERT
6. ACTION
7. FIRE
8. DATA DOWNLOADING PORT

INDIAN RAILWAYS

MASTER COPY
Controlling Officer.....
Signature..... 10.08.23
Designation.....

Document content	Technical Specification	Yes
	Schedule of Technical Requirement	No
Description of item	SPECIFICATION FOR DESIGN, SUPPLY, INSTALLATION, COMMISSIONING & MAINTENANCE OF ASPIRATION TYPE AUTOMATIC SMOKE / FIRE DETECTION WITH ALARM SYSTEM FOR INDIAN RAILWAYS AC COACHES	
Remarks	Nil	

S. No.	Month/Year of issue	Revision/ Amendment	Page No.	Reason for Amendment
1.	April- 2008	-	-	First issue
2.	November- 2010	Revision-1	All	Incorporation of experiences gained from trial and suggestions from experts.
3.	Nov-2012	Revision-2	All	Testing procedure revised & additional features like activation of brake application on detection of fire etc. added.
4	Sept-2014	Revision-3	17 & 18	• Amendment slip no. 1 deleted & Clause no. 2.14.1 i) modified. • Alarm threshold settings for various types of IR coaches specified at clause no. 2.6. • Clause no. 2.6.1 added to take action on each indication of fire alarm.
5	June-2017	Revision-4	All	• To incorporate experience gained by Railways. • System for Stand-alone and system for complete rake defined separately • Eligibility criteria modified & ISO clause included in Scope as clause no. 1.3 and for New Technologies clause 1.4 added. • The word 'any suitable' deleted wherever in the specification.
6	August-2019	Revision-5	All	• Amendment-1 of Nov-2017 included and experience gained incorporated to increase supplier/OEM base.
7	August-2023	Revision-6	All	• To include Govt. of India policy on 'Make in India' in Para 1.3. • Heat Activated sampling Points (HASPs) replaced with Aspiration type Smoke Detectors from lavatories

Issued by:
Carriage Directorate
Research Designs and Standards Organization
Manak Nagar, Lucknow - 226011

Signature			
Name & Designation	Prepared By:- Shyam Shankar SSE(D)/Carriage	Checked By:- A. S. Dugtal ADE/CD/Carriage	Approved By-Saurabh Davaggar Jt. Director/CD/Carriage

INDEX

Signature			
Name & Designation	Prepared By:- Shyam Shankar SSE(D)/Carriage	Checked By:- A. S. Dugtal ADE/CD/Carriage	Approved By-Saurabh Davaggar Jt. Director/CD/Carriage

SPECIFICATION FOR DESIGN, SUPPLY, INSTALLATION, COMMISSIONING & MAINTENANCE OF ASPIRATION TYPE AUTOMATIC SMOKE / FIRE DETECTION WITH ALARM SYSTEM FOR INDIAN RAILWAY AC COACHES

FOREWORD

a) This specification covers the technical requirements/provision for design, supply, installation, commissioning, maintenance and testing of Aspiration type automatic smoke/fire detection with alarm system for very early warning and the practices followed globally in this field.

b) This consists of two sections i.e. Section-A and Section-B. Section-A covers the general technical requirements regarding design, supply, installation, commissioning and maintenance and Section- B covers the functional & design requirements for automatic smoke/fire detection with alarm system for very early warning.

c) Following relevant standards (latest version) may be referred unless specified:

Doc. Name/No.	Description
IEC 60571	Electronic Equipment used on Rail vehicles
EN 50155	Railway Applications- Electronic equipment used on rolling stock
IEC 61373	Railway application-Rolling Stock equipment-Shock and vibration tests
IEC 62236-3-1	Railway applications- Electromagnetic compatibility- Part 3-1: Rolling Stock-Train and complete vehicle
EN 50121-3-2	Railway applications- Electromagnetic compatibility- Part 3-2: Rolling Stock-Apparatus
IEC 60068-2-75	Environmental testing- Part -2, Tests- Test Eh: Hammer Tests
IEC 60068-2-77	Environmental testing- Part 2-77: Test 77- Body impact and strength test
EN 54-2	Fire detection and fire alarm systems- Part 2: Control and indicating equipment
EN 54-4	Fire detection and fire alarm systems-Part 4: Power supply equipment
EN 54-5	Fire detection and fire alarm systems-Part 5: Heat Detectors-Point Detectors
EN 54-20	Fire detection and fire alarm systems-Part 20: Aspirating smoke detectors
EN 45545-6	Fire control and management systems
BS-6266	Fire protection for electronic equipment installation: Code of practice.
UL 268	Smoke Detectors for Fire Alarm Signaling System
ARGE Guideline	Fire Detection in Rolling Stock
FM 3230	Approval standard for smoke actuated detectors for automatic alarm signaling
IS 2189	Selection, Installation and Maintenance of Automatic Fire Detection and Alarm System- Code of Practice.
IS 2175	Specification for Heat Sensitive Fire Detectors for use in Automatic fire alarm system.
IS/ISO7240-20: 2010	Fire Detection and Alarm Systems

SECTION-A

1.0 SCOPE:

1.1 This section covers design, supply, installation, commissioning and maintenance of Aspiration type automatic smoke/fire detection with alarm system for very early warning for smoke/fire incidence in Indian Railway's fully air conditioned coach/coaches.

1.2 The system design shall be a proven and established technology/system on reputed National / International Railway systems. Documentary evidence along with proof of supply and satisfactory performance certificate (minimum 3 months successful functioning of the system of quantity not less than as stipulated for trial) from user Railway(s)/Rolling Stock manufacturer shall be provided by the supplier/OEM and shall be suitable for fire protection in Indian Railway's fully air conditioned coaches like AC first class, AC-2 tier, AC-3 tier, AC chair car in Indian weather conditions.

1.3 The Govt. of India policy on 'Make in India' shall apply. In this regard if any indigenous OEM has developed the Aspiration type smoke detection system but their system has not been fitted in any National/International Railways the Supplier/OEM may be considered for trial order subject to condition that their product complies the design and technical requirement of the specification and Supplier/OEM will have to submit the requisite type test certificates as per Annexure-A, acceptance test and system's compliance to ARGE Guideline Part-1 during the Prototype inspection.

1.4 Technologies other than Aspiration technology meeting all the functional & technical requirements mentioned in Para 1 & 2 of Section-B can also be considered provided it is a proven and established system globally to be demonstrated by firm and subject to clearance by RDSO. RDSO will decide for trials based on the technical details of the system and credentials of the firm to encourage the indigenous sources as per Make in India program. Although few characteristics in Para 1 & 2 of Section-B are defined for Aspiration type technologies only, therefore the supplier/OEMs who have technologies other than Aspiration type will have to establish for the similar/better characteristic for offered technologies.

2.0 DEFINITION AND EXPLANATION:

2.1 **System for complete Rake** is defined as fire detection system to be fitted in each coach of the rake along with Centralized Control Unit (CCU) with brake application with Guard's Emergency Brake Valve in Guard compartment of Generator cum brake van.

2.2 **System for Stand-alone Coach** is defined as fire detection system to be fitted in each coach with brake application system in each coach. For stand-alone coach system there will be no CCU. The standalone coach system should be compatible for conversion to System for complete rake. The supplier will give in writing, a confirmation for the same along with offer.

3.0 SCOPE OF WORK:

3.1 The scope of work shall include design, supply, installation, commissioning, performance testing, and maintenance of the system as per this specification on the designated coach/(es).

3.2 The following system components shall be in the scope of supply for automatic smoke/fire detection with alarm system for very early warning for each IR coach:

3.2.1 **Passenger coaches:** Aspiration smoke detectors in Passenger area, Doorway area, electrical cabinet area, Lavatory area etc.. Sampling points should be covering the entire area of the coach.

3.2.2 For stand-alone system the supplier/OEM shall quote for complete equipment for a coach as per the tender requirements. The supplier/OEM shall supply all the additional accessories that will be required for Brake application in each coach for making it fully functional.

3.2.3 Other suitable accessories required for specific design of the system offered to IR to make the system fully functional and operational without any constraints.

3.2.4 Centralized control unit with brake valve in each Power Car for complete rake system. The supplier/OEM shall quote separate cost for fire detection system and for central control unit with brake valve for complete rake system.

3.2.5 Any other sub system/(s), communication & monitoring equipment/(s) between the system and authorized staff, software, interfaces etc. to make the system work satisfactorily in regards of the system configuration, testing and maintenance.

3.2.6 The requirement of the above shall be decided by consignee as per their requirement.

3.2.7 The supplier/OEM will ensure provision of following signage in bilingual form (Hindi and English) at locations where attention is required:

Operating instructions in the form of information boards or inscriptions are to be intelligible to everyone. These information boards or inscriptions are to be made in the form pictographs to the extent possible. If written instructions are required, these are to be provided in a bilingual version, i.e. Hindi and English.

4.0 DESIGN:

4.1 The supplier/OEM shall study the design of different types of IR AC coaches and operating condition so as to design the system to meet requirements of this specification and the best prevalent practices followed globally in Railways for passenger coaches.

4.2 The supplier/OEM shall provide design document and engineering drawings with all the relevant standards and criteria used for designing. The documents in soft as well as in hard five (5 nos.) copies to be submitted to consignee/IR.

5.0 INSTALLATION AND COMMISSIONING:

5.1 The supplier/OEM shall consult coach manufacturing unit (ICF, RCF and MCF) with respect to relevant coach detailed drawings. It would be better on the part of the supplier/OEM to visit and physically assess the existing coaches for better appreciation of the work contents.

5.2 Mounting, installation & commissioning of the system on the designated coach/coaches shall be carried out by the supplier/OEM at consignee's premises or the place decided by the consignee/IR.

5.3 The system installed and commissioned shall be checked by the supplier/OEM for proper functionality and performance. The supplier/OEM shall issue the completion certificate of individual coach along with satisfactory performance test report and data (in support of the test) to consignee/IR.

5.4 The supplier/OEM shall supply five (05 nos.) operation and maintenance manual of system free of cost in hard and soft copies to consignee for proper maintenance of the system at first contract and 02 nos. operations and maintenance manual at every subsequent contract. The Manuals shall be self-illustrated, having principle of operation, maintenance schedule of all the proprietary items of the system being supplied by them. The Manual shall also contain information on the following:

- Details of attention required during IOH / POH or any other schedule.
- Test procedure and standards for various system equipments for coach/rake testing.
- Details of measuring equipment/gauges, jigs & fixture, tools, machinery and plant for maintenance of the system.
- Typical defects and their remedial measures.
- List of spares kit of the system for day-to-day maintenance and for IOH/POH in the form of periodic overhaul kit.
- Identification mark/codes for main equipment and their components to avoid mixing & traceability.
- The supplier/OEM shall also submit the frequency and detailed work content of various inspection/maintenance schedule necessary for maintenance of the system offered by them. Whether these requirements are time based or distance travelled based shall be indicated for each schedule.
- The supplier/OEM shall also arrange to supply Wall Charts (pictorial view showing all components name along with their part Nos.) of all equipments of the system along with the equipments being supplied by them for display in maintenance depots. These shall be supplied free of cost @ 05 sets against first contract and 02 sets against every subsequent contract.

5.5 The supplier/OEM shall supply at least five (05) nos. full versions of software copies free of cost if the central monitoring is based on any specified software.

6.0 MAINTENANCE:

6.1 The supplier/OEM shall be liable for all scheduled and un-scheduled repairs of all the systems installed by them for the satisfactory performance of the system for the entire warranty period.

6.2 The supplier/OEM shall also give an offer for carrying out the Annual maintenance of the system beyond the warranty period if consignee/Indian Railway so desires.

6.3 The attention during warranty shall include the followings:

6.3.1 Thorough checking of the entire system during preventive maintenance visits as defined in maintenance manual of firm for proper functioning of the system at the nominated maintenance depot by consignee/IR.

6.3.2 The fault noticed or complaints during warranty period shall be rectified by the supplier/OEM free of cost by next trip or at first availability of the train at maintenance depot or within 48 hours of the receipt of the complaint.

The supplier/OEM shall also ensure the functionality of the battery used for standby source of supply to the system; the electrically discharged/faulty battery shall be replaced during the warranty period.

6.3.3 The supplier/OEM shall have adequate and well qualified service engineers and technicians at his own cost to ensure proper functionality of the system during warranty period.

6.4 **Following activities should also be carried to ensure the proper working of the system as below by open-line:**

FOR LHB COACHES

S. No.	Schedule	Details
1.	D2	i) Check air flow reading, it should be within the range i.e. Fn± 20%, where Fn is the normal air flow value. ii) If less than Fn-20%, clean the filter and re-check iii) If still less than Fn-20%, flush the pipeline with vaccum cleaner and check. If problem still persists, seek further guidance from Supplier/OEM. iv) If more than Fn+20%, check intactness of the pipe & capillary network and seek further guidance from Supplier/OEM. v) Check intactness of power supply input voltage from DC power supply to detector and output voltage from detector to other devices. vi) Check back up battery voltage if back up battery voltage is less than 18 VDC seek further guidance from Supplier/OEM.
2.	D3	Conduct smoke test by simulating smoke generation from any source e.g. smoke generator at the farthest end from the system and verify detector performance as per maintenance manual. If any discrepancies observed, investigate with firm's consultation.

3.	SS1	i) Clean the sampling points, sampling pipe and capillaries by vaccum cleaning ii) Replace any defective/malfunctioning parts and carry out smoke test
4.	SS2	Complete testing of the system including replacement of must change items (free of cost by the firm if under warranty)

*All activities of preceding schedule must be carried out during succeeding schedule.

FOR ICF COACHES

S. No.	Schedule	Details
1.	A	i) Check air flow reading, it should be within the range i.e. Fn ± 20%, where Fn is the normal air flow value. ii) If less than Fn-20%, clean the filter and re-check iii) If still less than Fn-20%, flush the pipeline with vaccum cleaner and check again. If problem still persists, seek further guidance from Supplier/OEM. iv) If more than Fn+20%, check intactness of the pipe & capillary network and seek further guidance from Supplier/OEM. v) Check intactness of power supply input voltage from DC power supply to detector and output voltage from detector to other devices. vi) Check back up battery voltage if back up battery voltage is less than 18 VDC, seek further guidance from Supplier/OEM.
2.	6th monthly	Conduct smoke test by simulating smoke generation from any source e.g. smoke generator at the farthest end from the system and verify detector performance as per maintenance manual. If any discrepancies observed, investigate with firm's consultation.
3.	1st POH	i) Clean the sampling points, sampling pipe and capillaries by vaccum cleaning ii) Replace any defective/malfunctioning parts and carry out smoke test
4.	2nd POH	Complete testing of the system including replacement of must change items (free of cost by the firm if under warranty)

*All activities of preceding schedule must be carried out succeeding schedule.

7.0 PROCEDURE FOR PRODUCT APPROVAL:

7.1 The Supplier/OEM shall have a well-documented 'Internal Quality Assurance System' to ensure sustained quality of product being supplied/ manufactured.

7.2 **Special Conditions:**

a) The supplier/OEMs of the system shall be recognized on the basis of the OEM design. An OEM for this purpose shall be defined as a company having the facilities and the necessary infrastructure for designing the system. Their system designs should have been accepted for Rolling Stock passenger

coaches. The system equipment designed shall be tested and certified with at least one National/Internationally recognized agencies like UL/FM/LPCB/BRE Global /Vds/Active Fire/IFAB. During prototype approval supplier/OEM will also submit all relevant certificates including type tests as per Annexure-A, acceptance test and system compliance to ARGE guidelines.

b) Application/Offer shall be considered from OEMs or from companies entering into a valid MOU/Agreement with OEM as defined above [in clause 7.2 a)]. The MOU should clearly state that the OEM undertakes to fulfill the warranty and support obligations with respect to technology up-gradations as and when required for the system assembly, even in case the MOU is rescinded at some later stage.

c) Since the system is related to passenger's safety, field trials shall be necessary for each OEM's design of the system. The system of a particular design shall be subjected to 3 months' field trial after commissioning on IR's system. For field trials of a particular OEM's design, a complete system shall be installed on a rake (for complete rake system) and minimum 10 coaches for Stand-alone type, as prototype for checking and verifying the fitment, design and requirements as specified in this specification. The installed and commissioned system shall be checked for the functionality and performance as specified in Annexure 1 & 2 of this specification. Further quantity shall be supplied only on satisfactory completion of field trials.

The supplier/OEM approved for complete rake shall be treated as approved for Stand-alone type also; however, supplier/OEM approved for Stand-alone type only shall have to undergo field trial as mentioned above for Complete Rake.

d) In case of any failure reported during field trials attributable to poor design or material, the field trials shall be extended suitably as decided by consignee.

e) After completion of stipulated field trials, a performance test of the system shall again be ensured and subjected to the tests laid down in Annexure 1 & 2 of this specification. In case the system response is not as per the requirements of this specification, the system design shall be deemed to have failed the field trials.

f) The supplier/OEM shall ensure that the system supplied with components manufactured from the sources as indicated at the time of approval of product are strictly as per this specification. In case design/source of any component of the system is changed, fresh field trials shall be necessary.

8.0 SUPPLIER/OEM'S RESPONSIBILITY:

8.1 The supplier/OEM shall be completely responsible for the execution of the contract strictly in accordance with the terms of this specification and the conditions of contract, not withstanding any approval which purchaser or the Inspecting Officer may have given for the following:

8.1.1 The detailed drawings prepared by the supplier/OEM.

8.1.2 His sub-contractor for materials.

8.2 The performance test to be carried out either by the supplier/OEM and/or the consignee and/or the Inspecting Officer.

8.3 For meeting all the mandatory/legislative/safety requirements for such system including the information to be displayed/communicated to the relevant agencies.

8.4 For ensuring that the equipments/systems do not lead to unsafe or hazardous conditions for IR passengers & equipments.

8.5 The supplier/OEM shall be responsible for sufficiency of packing, marking etc. of all the parts of the system to ensure their delivery without damage. The supplier/OEM shall comply with the instructions of consignee/ RDSO or his nominee, if in his opinion, more precautions than those taken by the supplier/OEM are necessary for the proper execution and safe delivery of all the parts of the system.

8.6 The supplier/OEM shall at his expense, replace the parts of the system failing or proving unsatisfactory in service and attributed to defective/ faulty design, defective material or poor workmanship, within the period of warranty. The period of warranty shall stand extended by the duration for which the part of the system remains inoperative under exercise of this clause. In such cases, the period of warranty would commence when the replaced part/(s) are commissioned in service. The sole judge in this case would be the consignee.

9.0 SPARE PARTS:

9.1 The supplier/OEM shall recommend a list of spare parts required for day to day maintenance of the system and spares in the form of kit for the various sub assemblies for the maintenance at the time of IOH/POH. The list shall give the estimated maintenance frequency, batch no. / part number, quantity and price of each component or as per kit. The price for spares/consumables shall also be submitted, with the offer, separately.

9.2 The supplier/OEM shall ensure availability of all spares of the system for a period of at least 10 years. This shall be irrespective of the fact whether the supplier/OEM or his sub supplier/OEM/(s) have stopped manufacturing of the equipment/(s) to the design supplied to IR.

10.0 WARRANTY AND REPLACEMENT:

Supplier/OEMs shall be liable for warranty of 36 months from the date of commissioning/ 48 months from date of supply whichever is earlier. During warranty the supplier/OEM shall rectify the equipment by repairing or replacing the components with original spares at his cost. The warranty period would get extended on a pro-rata basis if warranty repairs/replacements are not provided within 5 days of notice. If the supplier/OEMs fail to provide warranty services within 5 days of notice, Railway reserves the right to take the action as per extant rules. Supplier/OEM will replace the standby source of power supply at his/her own cost during warranty if the codal life of the standby source happens to be less than 36 months.

10.1 Supplier/OEMs shall ensure the availability of spare parts of supplied system for a period of at least 10 years.

10.2 Two preventive maintenance visits during warranty period by the supplier/OEM has to be undertaken at the time of 1st and 2nd POH (for ICF coaches) or during SS1 and SS2 schedule (for LHB coaches). Filters and batteries to be changed free of cost during 2nd preventive maintenance visit.

11.0 PROTOTYPE INSPECTION

One complete system as per this specification shall be installed/retrofitted by the supplier/OEM on a designated coach as prototype for checking/verifying/clarifying the fitment and requirements of this specification. The installed/retrofitted system on designated coach shall be checked for functionality and performance as per Annexure 1 & 2 of this specification.

11.1 Suppliers, whose prototype approval has already been done by PUs/RDSO, will not require prototype approval by Zonal Railways.

11.2 For new Supplier/OEM, the prototype approval of the complete system will be done by PUs/RDSO.

11.3 During prototype approval supplier/OEM will also submit all relevant certificates including type tests as per Annexure-A and Location of sampling point shall be decided by any nationally/internationally approved air flow modeling tool or reality based 1:1 full scale smoke test, in accordance to ARGE Guidelines for designing and verification of smoke detection system sampling pipe/sampling points network along with documentation mentioned at Para 16.1.

11.4 **Proforma for testing of automatic smoke/fire detection system against RDSO spec no. RDSO/2008/CG-04 during installation and commissioning:**

<table>
<tr><th>S.No.</th><th>Description</th><th>Requirements of spec no. RDSO/2008/CG-04</th><th>observations</th></tr>
<tr><td>1.</td><td>Check the Number of Air Sampling Points in the Coach.</td><td>Clause no. 2.21.2 of Section – B: Sampling pipe/sampling point and capillaries shall be fitted and secured by suitable anticorrosive fastenings arrangements in all the areas as specified in clause 3.2.1. There shall not be any sagging in sampling pipe.</td><td></td></tr>
<tr><td>2.</td><td>Check the threshold values of the system for Alert, Action and Fire settings</td><td>Clause 2.6
<table><tr><th>Stage</th><th>Alarm</th><th>Threshold (%obs/m)</th><th>Delay period (sec)</th></tr><tr><td>1.</td><td>Alert</td><td>0.35 ± 0.05</td><td>20</td></tr><tr><td>2.</td><td>Action</td><td>0.6 ± 0.05</td><td>30</td></tr><tr><td>3.</td><td>Fire</td><td>1.6 ± 0.05</td><td>45</td></tr></table></td><td></td></tr>
<tr><td>3.</td><td><u>Over heated wire test: As per Annexure-1 (apparatus)</u></td><td>Procedure:
1. Set the system under test at highest sensitivity.
2. Connect the wire to the 6 V output</td><td></td></tr>
</table>

S.No.	Description	Requirements of spec no. RDSO/2008/CG-04	observations
		terminals of the transformer. Ensure that the wire is laid on the insulating board so that there are no kinks or crossovers. Connect 240 V mains electricity supply to the primary terminals of the transformer for a period of 60 seconds for energisation. Requirement In all possible conditions of the coach environment the system shall respond within 60 seconds after the cessation of energization.	
4.	AIR FLOW MONITORING TEST ANNEXURE—2	Requirement: 1. When the volumetric air flow reading in system reaches the value of Fn – 20%, the aspirating smoke detection unit shall generate an airflow fault signal. 2. When the volumetric air flow reading in system reaches the value of Fn + 20%, the aspirating smoke detection unit shall generate an airflow fault signal.	
5.	The artificial smoke (Smoke generator) to be created near each sampling points to verify the aspiration of the system	For verification of functionality of all sampling points.	
6.	Performance of brake application	The brake application should activate at stage 3 (Fire)	

12.0 TEST

12.1. The acceptance test will be required to be done in the presence of inspecting authority at the time of inspection for which necessary equipments & arrangements shall be provided by the supplier/OEM at their cost.

12.2. Visual check of the entire system regarding material quality, work quality, effect on aesthetics of the coach etc.

12.3. ACCEPTANCE TEST:

12.3.1. The Acceptance tests shall be as per the applicable standards of the system offered. The test specified in Anexxure-1 & 2 of this specification are Acceptance Tests to be carried out after installation on a designated coach by

an inspecting authority nominated by the consignee/purchaser/IR on the samples picked up by him from the inspection lot as specified in clause 13 of this section. All the acceptance tests shall be carried out at the manufacturer's cost. All Acceptance Tests are mandatory for accepting a lot.

12.4. TYPE TEST:

12.4.1. The test specified in Annexure-A shall constitute type test and all shall be carried out at reputed national/international test lab(s) at supplier/OEM cost. The submission of test reports mentioned in Annexure-A are mandatory for product approval for all supplier/OEM and shall be submitted to purchaser/consignee during prototype approval. Reputed National / International labs having accreditation from standardization authorities/bodies of the country. For India NABL accredited labs (accredited for IS:7240-20 and relevant standards of specification) to be considered.

12.4.2. All Type Test specified in Annexure-A shall be submitted to purchaser/consignee, to confirm that the system meets the specified requirements of this specification in following cases at their cost. (As Per IEC 60571 clause-12.1.2).

- Modification of equipment likely to affect its function or method of operation.
- Failure or variations established during type test.
- Resumption of production after an interruption of more than five years.

12.4.3. If a test method requires a specimen to be operational, then the specimen shall be connected to supply and monitoring equipment with characteristics as required by the manufacturer's data. Unless otherwise specified in the test method, the supply parameters applied to the specimen shall be set within the manufacturer's specified range(s) and shall remain substantially constant throughout the tests. The value chosen for each parameter shall normally be the nominal value, or the mean of the specified range.

12.4.4. Where a specimen under test has multiple sensitivity settings, the sensitivity of the specimen (detector under test) during all tests shall be set at the highest sensitivity setting used during the fire sensitivity test(s). It is not intended that the environmental tests are conducted at all possible sensitivity settings, only at the highest used during the fire sensitivity test.

12.4.5. The specimen shall be mounted by its normal means of attachment in accordance with the manufacturer's instructions. If these instructions describe more than one mounting method then the method considered to be most unfavorable shall be chosen for each test.

12.4.6. The detector under test for measurement of response threshold value (RTV) shall have different range of sensitivity, different working principal or different method to determine RTV. In such case the objective of any test method chosen shall be to determine a measure of the aerosol concentration, which when passing through the detector, just cause an alarm.

12.4.7. Unless otherwise stated, the tolerances for environmental test parameters shall be as given in basic reference standards for the test. If a requirement or test

procedure does not specify a tolerance or limits, then deviation limits of ±5% shall be applied.

12.4.8. The details of the supply and the monitoring equipment and alarm criteria (As given in clause no. 2.14.1 of Section-B) used shall be clearly mentioned in the test report.

13.0 SAMPLING CRITERIA FOR CONFORMITY:

13.1 The Inspection lot size for aspiration type automatic smoke/fire detector with alarm system shall be minimum one rake for accepting a lot.

13.2 Representative samples for aspiration type automatic smoke/fire detectors with alarm system shall be drawn at randomly 10% of the lot size or minimum 02 numbers whichever is more. For fail criteria, clause 7 of IS:2500 (Part 1) shall be applied.

13.3 Samples selected for Acceptance Test shall confirm the entire requirements as laid down in Annexure-1 & 2. If any one of the test sample fails to meet the requirements of Acceptance test, double the number of the samples from the same lot shall be drawn for re-testing. If any of these samples fail, the entire lot shall be rejected.

14.0 MARKING:

Every item of the system shall be legibly marked (for life cycle) to indicate the followings:

1) Name and code of the manufacturer
2) Month and year of manufacture.
3) Identification marks, i.e. Part Number, Batch Number, etc.
4) Connection diagram of the equipment.
5) Relevant approval mark of authorized approval agency.
6) Quantity of the material packed.
7) Other details if any shall be marked in accordance with the instruction given by the consignee/purchaser/IR.

15.0 PACKING

15.1 The supplier/OEM shall ensure that all outer parts and exposed threaded portions of the various items of the system equipment(s) are suitably covered with protection caps to prevent ingress of foreign matter/damage to thread during transportation, handling and storage. The equipment and its sub assemblies shall be suitably packed in a wooden/synthetic box so that it can withstand bumps and jerks encountered in road/rail transportation.

15.2 Supplier/OEM shall also ensure that all other items of the system are suitably packed before dispatch to prevent damage in transporting, handling and storage.

16.0 DOCUMENTS AND TRAINING

The supplier/OEM shall arrange training to IR personnel in maintenance and trouble shooting of the system supplied by them. Two days training shall be provided in operation, maintenance & trouble shooting of the system. The supplier shall provide detailed technical write-up and suitable training material to all trainees of IR. The syllabus for training shall be approved by the

purchaser/consignee/IR. The venue of training will be mutually agreed between supplier/OEM and consignee/purchaser. Training shall be arranged free of cost.

16.1 The supplier/OEM shall provide the following documents during the installation & commissioning:

i) Operating and maintenance instructions.
ii) Periodic maintenance schedule (daily/trip/monthly) if any.
iii) Any recommended test instructions/procedures to be followed.
iv) Schematic diagram of installation & commissioning and their instructions.
v) List of spare parts.
vi) List of consumables if any.
vii) Details of critical items and their Technical data sheets e.g. smoke detectors, capillaries, pipes and fitting etc.
viii) List of do's and don'ts.

16.2 **Training:**

(i) The supplier/OEM will provide theoretical and practical training to the staff of Workshop and Railways for a period of two days and will also demonstrate the function of the system installed.

(ii) The supplier/OEM shall also submit the list and details of testing equipments required for testing of the system periodically.

17.0 INFRINGEMENT OF PATENT RIGHT

The supplier/OEMs are required to give undertaking on "INFRINGEMENT OF PATENT RIGHTS". The undertaking shall be as under:

Indian Railways shall not be responsible for infringement of patent rights arising due to similarity in design, manufacturing process, use of similar components in the design & development of this item and any other factor not mentioned herein which may cause such a dispute. The entire responsibility to settle any such disputes/ matters lies with the manufacturer/ supplier.

Details / design/documents given by them are not infringing any IPR and they are responsible in absolute and full measure instead of railways for any such violations. Data, specifications and other IP as generated out of interaction with railways shall not be unilaterally used without the consent of RDSO and right of Railways / RDSO on such IP is acceptable to them.

SECTION-B

FUNCTIONAL & DESIGN REQUIREMENT

1.0 FUNCTIONAL REQUIREMENTS:

The system supplied should work satisfactorily under the following operating conditions of IR coaches:

1.1. **Coach Dynamics:**

Equipment shall withstand satisfactorily the vibrations and shocks normally encountered in service as indicated below:

i)	Maximum vertical acceleration	1.0g
ii)	Maximum longitudinal acceleration	3.0g
iii)	Maximum transverse acceleration	2.0g

The vibrations are of sine wave form and the frequency vibration is between 1 Hz to 50 Hz.

The amplitude 'a' expressed in millimeters is given as a function of f, by equations $a = 25/f$ for values of 'f' from 1 Hz to 10 Hz.

$a = 250/f^2$ for values of 'f' exceeding 10Hz and up to 50 Hz.

1.2. In the direction corresponding to the longitudinal movement of the vehicle, the equipment is subjected for 2 min. to 50 Hz. Vibrations of such a value that the maximum acceleration is equal to 3g.

1.3. **Coach-body displacement encountered under dynamic conditions.**

i)	Vertically-	±100 mm
ii)	laterally -	±55 mm
iii)	longitudinally-	±10 mm
iv)	bogie rotation about center pivot-	$\pm 4^0$

1.4. **Ambient Temperature**

(i)	Ambient temperature	:	1 °C to 50° C
	Max. temperature under Sun	:	70° C
	Relative humidity	:	20% to 95%

(ii) The rainfall is fairly heavy.

(iii) During dry weather, the atmosphere is likely to be dusty.

(iv) Temperature variations can be quite high in the same journey or short period of time.

(v) Coaches operate in coastal areas with continued exposure to salt laden air.

1.5. **Coach inside condition:**

i) Air conditioned Coaches are equipped with roof mounted air conditioning system with central ducting system and side distribution branch lines. The coaches are conditioned to a nominal temperature of 23°C to 25°C, RH 55% to 60% & air flow @ 4000 cubic meter /hour.

ii) The coach length over coupler is approximately 24 meter.

1.6. **Power Supply:**

110±30% Volt DC supply with 15% ripple content is available from the coach circuits. For main source of supply to the system the supplier/OEM shall convert the voltage from coach circuit as per their requirements. For standby source of supply, battery and battery charger or other means of standby source of supply to the system shall be used. All the supplier/OEMs will have to obtain EN 50155 (latest) certification for control panel (term also includes any sub panel for main/standby source of power supply if separately provided).

1.7. **During fitment of the system following to be ensured:**

a) The control supply to the Fire Detection System will be provided from Terminal Block (TB) X1 of Switch Board Cabinet (SBC) for LHB AC coaches and TB-4 for ICF AC coaches through DC MCB of adequate rating. The MCB shall be always in 'on' position.

b) Positive and negative wire of 110 V DC supply shall be segregated by placing them in separate conduits.

c) All equipment/ materials shall be UL 94 V0 Grade fire retardant as per approved sources of RDSO/RCF/ICF/MCF.

d) "Code of practice for prevention of fire in AC coaches" No. RDSO/PE/0/0008- 2005(Rev.'0') for wiring shall be followed.

e) "System specification and code of practice for wiring for 110 V DC self-generation train lighting system" no. EL/TL/48-2005(Rev.'1') and "Code of practice for Train Lighting Maintenance on Prevention of fire" no. EL/TL/56 shall be strictly followed for wiring circuit of Fire Detection System.

f) All cables shall be E-beam irradiated with copper conductor as per RDSO Spec no. ELRS/SPEC/ELC/0019(Rev'4') up to 750 V grade and procured from RDSO approved sources.

2.0 DESIGN REQUIREMENTS:

2.1 The system design shall be a proven and established technology/system on National/ International Railway systems. Documentary evidence of such as proof of supply and satisfactory performance certificate from user Railway(s) shall be provided by the supplier/OEM.

2.2 All the system equipment/(s) designed, shall be tested and certified with at least one National/International accredited laboratories such as:

- UL (Underwriters Laboratory)
- FM (FM Approvals, FM Global)
- Loss Prevention Certification Board (LPCB) or BRE Global.
- Verband der Sachversicherer e.V (Vds).
- Active fire.
- IFAB.

2.3 The system shall be designed for very early detection of smoke/fire incidence as defined in EN 54-20. The design should incorporate principle for higher sensitivity to detect all possible size of smoke particles.

2.4 The system shall be designed to give very early warning against any smoke/fire and shall be capable to protect entire passenger area, electrical panels (Power panel, AC control panel and Inverter panel), lavatory, Doorway & Gangway of coach. The system shall be compact, lightweight and highly reliable & robust in design.

2.5 The system designed shall be of high sensitivity i.e. detection of smoke at incipient stage of a fire. The sensitivity to detect smoke level at very early stage shall not be more than 0.05 % obs. / m. The system shall also be designed for temporary smoke profiling of any smoke and shall not give any false alarm.

2.6 The system shall be designed for multi-level alarm. The system's design shall also allow user to programme & logic these levels as per requirements. The system shall be designed to show smoke level reading in % Ob/m (percent Obscuration/meter) and/or in % Ob/ft (percent obscuration/foot). The values of all levels shall be set by the manufacturers/suppliers as per coach requirement. The smoke threshold settings for various coaches shall be as under:

Stage	Alarm	Threshold (%obs/m)	Delay Period (Sec.)
1	Alert	0.35 ±0.05	20
2	Action	0.6 ±0.05	30
3	Fire	1.6 ±0.05	45

2.6.1 **Indications of alarms and the system requirements shall be as under:**

a) System for complete Rake:

- **Alert:** Flasher light to be activated at CMS, no indication to the passenger's in the affected coach.
- **Action:** Flasher light to be activated in affected coach & audio visual (Hooter & Flasher Light) indication at CMS.
- **Fire :** Brake application shall take place automatically. After a time delay of 55 seconds after activation of brake application, an audio visual alarm like a hooter or buzzer etc. along with flashing lights should be activated in the affected coach. Audio visual (Hooter & Flasher Light) indication to be continued at CMS.

b) System for Stand-alone Coach:

- **Alert:** LED to flash on fire detection panel, no indication to passengers in affected coach
- **Action:** Flasher light to be activated on fire detection panel of affected coach.
- **Fire:** Brake application shall take place automatically. After a time, delay of 55 seconds after activation of brake application, an audio visual alarm like a hooter or buzzer etc. along with flashing lights should be activated in affected coach.

2.7 The system design shall allow user to programme smoke threshold value and alarm time delay's setting as per day and night requirement of the coach/(es). The programmable alarm time delay of the system shall be in between 0-60 seconds. The system shall give an alarm if the smoke threshold level stays above the set smoke threshold level for a set time delay.

2.8 The designed system shall have suitable inbuilt filtration arrangement to avoid contamination of air borne particles/smoke particles over detection unit's sensor/(s) to maintain the sensitivity and life of the system. The system shall have self-monitoring of filter contamination and residual life and can be easily accessed by the user/maintenance staff.

2.9 The system shall be designed for self-diagnostic to any failure/trouble within The system i.e. wiring break within the system, discontinuity in the smoke and fire detection circuit, dust contamination of filters, system disability, obstruction in air flow either due to blockage in sampling pipe/point or breakage of sampling pipe, fault in aspirator fan, general fault/trouble etc. The fault/trouble conditions shall be displayed at onboard detectors display of each coach and central control unit as well as indicated by audio and/or visual signals for easy access to user. The system design may allow user to reset any alarm condition but after reset The system shall give alarm till the threshold level does not reaches to the safe smoke threshold level zone. Similarly, spurious alarm signal should not be processed. Alarm conditions shall over ride all trouble conditions.

2.10 The system for complete rake shall be designed to work and maintain continuity by transmitting signals through the spare pins of existing couplers on board even one or more of the coaches fitted with the system are detached and new coach/coaches with existing couplers but without the system are attached. The transmitted signals shall not have any interference with the other train line wires and shall not be affected by power surges. The couplers have been provided at both ends of the IR Rajdhani/Garib Rath/Duranto/Shatabdi trains coach/coaches.

2.11 The system shall be mounted as per the manufacturer's recommendation or as decided by the consignee/IR and shall be protected against any suspected vandalism in such a manner that it does not adversely affect the working of the coach sub- systems, coach aesthetics and cause any injury to the passengers.

2.12 The system shall be designed to work through 24 V DC batteries backup also to ensure the functionality of the system even power supply from the coach gets interrupted. For such, a (12+12) volt/24 V DC sealed maintenance free battery with suitable battery charging mechanism as a secondary source/standby source of supply with a power back-up of at least 24 hours shall be incorporated in design aspect. The battery shall be protected from any suspected vandalism.

2.12.1 The battery management of the system shall be designed to avoid deep discharge. The battery(s) should have adequate residual life after the system shutdown, so as to ensure proper functionality of battery. Firm will have to replace the battery in case of malfunctioning including deep discharge etc. during entire warranty period.

2.13 The system shall be designed to have its own event logging for all alarm conditions, fault conditions, etc. and shall be recorded in non-volatile memory for analysis of data in respect of time with provision to download events logged as and when needed. The system design may allow user to program significant smoke change and significant time delay to decide one event. The system shall be designed to store at least 10,000 events in its non-volatile memory.

2.14 The system design shall allow user to calibrate and set for any alarm threshold as per user's requirements. The calibration and alarm settings of the system shall not be disturbed due to change of environmental conditions, vibration encountered during run. In case of spurious operation of the system, the design shall allow user to isolate it either from the system or from the central control unit.

2.14.1 The system shall be so designed that once the final alarm (signifying fire) is activated, it should be possible to:

i) Activate brake application in train through Guard's Emergency Brake Valve for complete rake system or through solenoid valve of the affected coach for standalone system. For this purpose, necessary interface to actuate brake application shall be designed and supplied by the supplier/OEM. The brake valve design should have provision for isolation of the brake valve in case of malfunctioning.

ii) After a time, delay of 55 seconds after activation of brake application, an audio visual alarm like a hooter or buzzer etc. along with flashing lights should be activated. Simultaneously, it should activate an announcement in the affected coach in English, Hindi; "there is a suspected fire on this coach. The brakes have been applied. Please evacuate through the vestibules. Doors can be used for evacuation once the train has come to a stop".

iii) The hooter (90 - 100 dBA at a distance of 1 meter) should be at an appropriate location inside the compartment, so that it must be audible to all passengers.

iv) In case of stand-alone system, supplier/OEM will provide necessary interface and accessories for automatic brake application in the event of fire alarm. The accessories required for brake application shall be procured from sources approved from RDSO/ICF/RCF/MCF.

v) Indication on detection panel about continuity of electric supply and health of brake valve solenoid.

vi) Coupler/ Connectors must be tested and certified as per DIN EN 60664 – 1, DIN EN 61984, IEC 60529, BS EN 45545, DIN IEC 60352-2, IEC 61373 / EN 50155 and IP 68.

2.15 The system design shall not incorporate use of any radioactive material. A declaration shall be submitted by the supplier in this regard at the time of product approval.

2.16 The system design shall be capable to provide natural language annunciation to all faults and alarms at the locations decided by the consignee/IR.

2.17 The system design shall allow user to use USB/Ethernet/RS 232 compatible serial port/RS 485 compatible parallel ports or any similar nationally/internationally approved serial/parallel ports for configuration, status monitoring, command

input, event log extraction and software up-gradation (if required in the offered design of the system) during service and maintenance.

2.18 Elastomeric or better insulation cable like PTFE (Polytetrafluorethylene) of suitable size shall only be used by the supplier/OEM for the purpose of internal wiring of the equipments and external connections.

2.19 The cables to be used for all external wiring shall confirm to latest RDSO's specification as detailed in Para 1.7 of Section-B.

2.20 The system shall be designed to give very early warning against any smoke/fire. Sampling pipe/sampling points network shall be designed to cover entire coach's passenger area including lavatories, doorway & gangway of coach and electrical cabinets as per the consignee's requirements. Location of sampling point shall be decided by any nationally/internationally approved air flow modeling tool or reality based 1:1 full scale smoke test, in accordance to ARGE Guidelines for designing and verification of smoke detection system sampling pipe/sampling points network. The design of sampling pipe/sampling points shall be such that it can be easily serviced.

2.20.1 The sampling pipe material and fittings (like UPVC – Un-plasticized Poly Vinyl Chloride, CPVC – Chlorinated Poly Vinyl Chloride) shall have adequate mechanical strength (as per clause 5.7 of EN 54-20), fire retardant property [as per EN 45545-2 (R22, HL3)] and shall be suitable for the coach environment.

2.20.2 Sampling pipe/sampling point and capillaries shall be fitted and secured by suitable anticorrosive fastenings arrangements at an adequate distance above the ceiling of the coach. There shall not be any sagging in sampling pipe. All dropout sampling points shall be covered with suitably designed netted cover which shall have less effect on aesthetic of coach.

2.21 Central control unit (CCU) design shall be light in weight, compact and robust which can sustain change in environmental condition and vibration encountered during run. The CCU shall be designed to fit in a space of approximately 750mm x 750mm x 200mm. The CCU shall be designed to recognize all coaches within the rake fitted with The Rake Based System for central monitoring. The inter coach communication up to CCU should be done through existing couplers fitted at both end of a coach or other suitable means. The network shall be design to be active for all the time to report the condition/health of all the systems within a train rake as well as condition/health of the system of an individual coach. The CCU design shall have feature for easy identification setup for each coach, if some coaches are detached or some new coaches are attached within a train rake. The control panel design shall also show:

2.21.1 The representation of smoke levels of all the systems connected to CCU.

2.21.2 A real-time event list, prioritized according to the urgency.

2.21.3 The smoke level trending analysis to compare smoke levels across the systems in real time.

2.21.4 Exact details about the coach/coaches and device/(s) involved in an event.

2.22 The service and maintenance software of CCU shall be designed to allow user to configure it for very early warning smoke detection, fire protection systems and monitoring of the system. The service and maintenance software shall be compatible with standard input/output in the personal computer/laptop, smoke detection and fire protection systems. The software shall be approved by any reputed national/international approval bodies and shall meet all local codes, standards and regulations.

2.23 The service and maintenance software shall be designed for following monitoring and configuration components:

- The configuration component shall allow users to configure all detectors by using Laptop/PC or through CCU.
- The monitoring component shall allow users to monitor individual System. The alarm condition can be verified locally (from the individual coach System) or through CCU.
- It shall allow user to know the alarm condition of an individual coach and display exact coach number where the alarm condition occurred.
- It shall allow user to setup more than one control unit within the rake formation, if required by the consignee/purchaser/IR.
- The software shall also support password-based access control.

2.24 For stand-alone system, the system shall have provision of data down loading with an external device e.g. laptop/hand held terminals etc.. The control panel design shall also show:

2.24.1 The representation of smoke levels.

2.24.2 A real-time event list, prioritized according to the urgency.

2.24.3 The smoke level trending analysis to compare smoke levels across the systems in real time

Annexure-1

OVER HEATED WIRE TEST (As Per Cl 12.3.1)

1. General:

1.1 This test conforms to BS 6266 with minor modification of using one piece of 800 mm wire in one piece instead of 1 m wire which was designed for testing in environments with forced ventilation, such as telecommunication facilities.

1.2 System performance test using electrically overloaded PVC-coated wire (800 mm). This method is suitable for the testing of high sensitivity of smoke/fire detection unit. To simulate the early stages of a fire, a length of wire is electrically overloaded so that smoke or vapour is driven off.

2. Apparatus:

2.1 Wire 800 mm length, of 10/0.1 mm strands insulated with PVC to a radial thickness of 0.3 mm, the cross sectional area of the conductor being 0.078 mm^2.

2.2 Transformer 240 V to 6 V, capable of supplying at least 30 A.

2.3 Insulating board of non-combustible material, of minimum size 600 mm x 600mm.

2.4 Stop watch capable of measuring in 1 second intervals.

3. Procedure:

1. Set the system under test at highest sensitivity.
2. Connect the wire to the 6 V output terminals of the transformer. Ensure that the wire is laid on the insulating board so that no kinks or crossovers. Connect 240 V mains electricity supply to the primary terminals of the transformer for a period of 60 seconds for energization.

4. Requirement

In all possible conditions of the coach environment the system shall respond within 60 seconds after the cessation of energization.

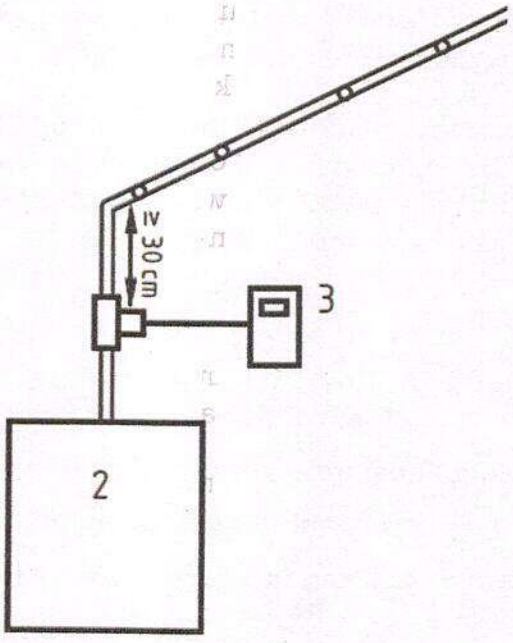
Annexure-2

AIR FLOW MONITORING TEST (AS per Clause 12.3.1)

A. AIR FLOW MONITORING

a. General:

1. The airflow through the aspirating smoke detection unit shall be monitored to detect leakage or obstruction on the sampling device or sampling point(s)



(Fig.-1)

b. Apparatus:

1. Aspirating smoke detection unit - The aspirating smoke detection unit under test is set up in accordance with the manufacturer's instruction.
2. Anemometer- To measure the normal air flow value (Fn) by a calibrated flow meter such as an anemometer with the worst-case sampling device. The minimum distance between the anemometer and the first sampling point is 30 cm. No sampling point shall be made between aspirating smoke detection unit and anemometer (Fig-1).

c. Procedure:

1. The normal air flow (Fn)(Lt./min.) shall be determined from the sampling configuration used for the fire test with the help of application software or anemometer.
2. The aspirating smoke detection unit under test shall be tested at test flow rate (Ft) (i.e. Ft = Fn ± 10%) for testing the air flow monitoring.

3. For an aspirating smoke detection unit under test that has a memorized normal flow, The Fn shall be entered to the memory in accordance with normal operating instruction for the detection system. This shall only be done once at the start of each test and shall not be done during/after the conditioning.

4. For decreased flow, the volumetric airflow is decreased from Fn by 20%, which shall be observed through application software or anemometer installed between the sampling pipe and aspirating smoke detection unit.

5. For increased flow the volumetric airflow is increased from Fn by 20%, which shall be observed through application software or anemometer installed between the sampling pipe and detection system unit.

d. Requirement:

1. When the volumetric air flow reading in the system reaches the value of Fn – 20%, the aspirating smoke detection unit shall generate an airflow fault signal.

2. When the volumetric air flow reading in the system reaches the value of Fn + 20%, the aspirating smoke detection unit shall generate an airflow fault signal.

Annexure-A

Type Test for Smoke Detectors (As Per Clause 12.4)

Sr. No	Tests	Requirements	Test Method
1.	Repeatability	The detector shall meet the requirements of relevant part of EN 54	As per relevant part of EN 54
	Reproducibility	The detector shall meet the requirements of relevant part of EN 54.	
2.	Fire Test	The detector shall meet all the requirements of test fires.	UL 268 or As per relevant part of EN 54 or FM 3230
3.	Humidity Test at 93±2% RH and temperature of 40±20C	The sensitivity values using gray smoke during exposure to the humid atmosphere shall not vary more than ±1% /ft.Obs. (0.014 OD/mtr.) from the value recorded prior to the test.	UL 268/ IEC 60571/ EN 50155
4.	Dry Heat Test	4.1 The performance test shall be done as specified in relevant part of EN54. 4.2 The detector shall meet the requirements of relevant standard. 4.3 No failure or damage shall occur. 4.4 No out-of-tolerance results shall appear.	IEC-60571/ EN 50155
5.	Low Ambient Temp./ Cold Test	a. The performance test shall be done as specified in relevant part of EN54. b. The detector shall meet the requirements of relevant standard. c. The performance test shall not show any failure or damage nor any results which are beyond the specified tolerances	IEC-60571/ EN 50155
6.	Stability Test	6.1 No False alarm shall occur. 6.2 During or immediately after performance tests, the sensitivity of the detectors shall not vary more than ± 1%/foot obscuration from the value recorded prior to the test.	UL268/ IEC 60068/ IEC 60571/ EN 50155
7.	Impact Test	7.1 The performance test shall be done as specified in the relevant part of EN54. 7.2 The detector shall meet the requirements of the relevant standard. 7.3 No visual deformation 7.4 Mechanical integrity of detector shall not change.	IEC 60068-2-75 /IEC 60571/ EN 50155
8.	Shock, Vibration and Bump Test: (Category 1, Class B as	8.1 The performance test shall be done as specified in relevant part of EN 54.	IEC-60571/ EN 50155

Signature			
Name & Designation	Prepared By:- Shyam Shankar SSE(D)/Carriage	Checked By:- A. S. Dugtal ADE/CD/Carriage	Approved By-Saurabh Davaggar Jt. Director/CD/Carriage

	per IEC 61373, clause 1)		8.2 The detector shall meet the requirements of relevant part of EN 54. 8.3 No visual deformation 8.4 Mechanical integrity of detector shall not change.	
9.	EMC	Transient Burst Susceptibility Test	9.1 The performance test shall be done as specified in UL 268/relevant part of EN 54 standards. 9.2 The detector shall meet the requirements of relevant standard. 9.3 After the test the detector under test shall continue to operate as intended.	IEC-60571/ EN 50155
		Electrostatic Discharge Test		
10.	Variation in supply voltage parameters		10.1 The performance test shall be done as specified in relevant part of EN54. 10.2 The detector shall meet the requirements of relevant standard. 10.3 The detector shall function correctly without any intervention or need for resetting. 10.4 No spurious operation of detector shall occur.	IEC-60571/ EN 50155
11	Dielectric Test		The detector shall withstand test potential for one minute. (The test potential shall be according to the rated voltage of detector as specified in UL-268 at clause 59.1).	UL 268/ IEC60571/ EN 50155