INDIAN RAILWAYS

SCHEDULE OF TECHNICAL REQUIREMENT
FOR
DESIGN, SUPPLY, INSTALLATION, COMMISSIONING
& MAINTENANCE OF ASPIRATION TYPE
AUTOMATIC SMOKE / FIRE DETECTION WITH ALARM SYSTEM
FOR
INDIAN RAILWAY AC COACHES (TENTATIVE)

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<th>S.No</th>
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<td>1.</td>
<td>April- 2008</td>
<td>-</td>
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<td>2.</td>
<td>November-2010</td>
<td>Revision-1</td>
<td>All</td>
<td>Incorporation of experiences gained from trial and suggestions from experts.</td>
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<td>3.</td>
<td>Oct-2012</td>
<td>Revision-2</td>
<td>All</td>
<td>Testing procedure revised &amp; additional features like activation of brake application on detection of fire etc. added.</td>
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Issued By:

Research Designs and Standards Organization
Manak Nagar, Lucknow - 226011.

Signature

Name & Designation | Prepared By:- JE/SS/Carriage | Checked By:- ADE/SS/Carriage | Approved By:- Director/SS/Carriage
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SCHEDULE OF TECHNICAL REQUIREMENT FOR DESIGN, SUPPLY, INSTALLATION, COMMISSIONING & MAINTENANCE OF ASPIRATION TYPE AUTOMATIC SMOKE / FIRE DETECTION WITH ALARM SYSTEM FOR INDIAN RAILWAY AC COACHES

0. **FOREWORD**

0.1 This schedule 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 does not include all the necessary provisions of contract.

0.2 This schedule draws reference to some of the following relevant Standards. Unless specified otherwise, the latest version of the relevant standards shall be taken as reference:

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0.3 In this schedule due consideration has been given to the development in the field of design, supply, installation, commissioning, maintenance of aspiration type automatic smoke/fire detection with alarm system for very early warning, its technologies, serviceability, requirements of Indian Railway and the practices followed globally in this field.

0.4 This schedule 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 aspiration type automatic smoke/fire detection with alarm system for very early warning.

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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 (e.g. all type coaches of Rajdhani/Garib Rath/Duronto/Shatabdi trains etc.).

1.2 The aspiration type or any suitable automatic smoke/fire detection with alarm system shall be a proven and established fire detection/protection technology and shall have completed at least five years of satisfactory service on National/International Railway Systems and on at least five hundred coaches 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, AC pantry car with kitchen and escorting staff area, high capacity power generation car, in Indian weather conditions.

2.0 DEFINITION AND EXPLANATION:

2.1 The Research Designs and Standards Organization, Manak Nagar, Lucknow-226011 is hereafter referred to as RDSO.

2.2 The aspiration type automatic smoke/fire detection with alarm system for very early warning of smoke/fire incidence for each IR coach is hereafter referred to as The System.

2.3 “Vendor” means the present firm/company on whom the order for the supply The System is placed/will be placed.

2.4 “Consignee” means the Indian Railways on behalf of the President of the Republic of India who are purchasing The System.

2.5 “Inspecting authority” means the organization or its representative nominated by the consignee to inspect The System on his behalf.

2.6 In case vendor needs any clarification in respect of any clause of this specification or regarding the drawings, the vendor shall obtain the same from purchaser.

3 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 schedule of technical requirements (STR) on the designated coach/(es).
3.2  The following system components shall be in the scope of supply:

3.2.1 Suitable aspiration type smoke detector/(s) in Passenger area and Heat Detector/(s) in Lavatory, Pantry Car and Generator Car for automatic smoke/fire detection with alarm system for very early warning for each IR coach. Cost of The System for each type of AC coaches shall be quoted separately.

3.2.2 Other suitable accessories required for specific design of The System offered to IR.

3.2.3 Centralized control unit in each Pantry Car or Power Car/SLR's of train or as decided by the consignee/IR. The vendor shall quote separate cost for complete central control unit for each Pantry Car or Power Car/SLR.

3.2.4 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.

4 DESIGN:

4.1 The vendor 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 STR and the best prevalent practices of the Railway industry.

4.2 The vendor will provide design document and engineering drawings with all the relevant standards and criteria used for designing The System in soft as well as 5 numbers hard copies to consignee/IR.

5.0 INSTALLATION AND COMMISSIONING:

5.1 The vendor shall study the code of practice followed in International Railways, for fire prevention in IR AC coaches like LHB Rajdhani, Shatabdi Express, Duranto Express and GaribRath Express for better appreciation of nature and potential fire hazards.

5.2 The vendor shall consult coach manufacturing unit with respect to relevant coach detailed drawings. It would be better on the part of the vendor to visit and physically assess the existing coaches for better appreciation of the work contents.

5.3 Mounting, installation & commissioning of The System on the designated coach/coaches shall be carried out by the vendor at consignee's premises or the place decided by the consignee/IR.

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

5.5 The vendor shall follow all the safety measures and precautions at the time of installation & commissioning of The System at the site.

6.0 MAINTENANCE:

6.1 The vendor 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 vendor 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 comprehensive maintenance during warranty shall include the followings:

6.3.1 Thorough checking of the entire system in every trip/maintenance schedule of train 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 vendor free of cost by next trip or at first availability of the train at maintenance depot or within 24 hours of the receipt of the complaint. The vendor 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 maintenance of the train.

6.3.3 The vendor shall have adequate and well qualified (such as holder of accreditation certificate for smoke and fire detection system) service engineers and technicians at his own cost to ensure proper functionality of The System during warranty period.

6.3.4 The vendor will be also liable to depute his staff to investigate and attend the specific problems arises during operation of The System, if requested by the consignee/IR.

6.4 The vendor shall supply 05 nos. operation and maintenance manual of The 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 on test bench as well as single unit/coach/rake testing.
- Details of 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 POH in the form of periodic overhaul kit.
- Identification codes for main equipment and their components to avoid mixing.
- The vendor 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 vendor 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.

6.5 The vendor 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.

7. PROCEDURE FOR PRODUCT APPROVAL:

7.1 The Vendor shall have a well-documented ‘Internal Quality Assurance System’ to ensure sustained quality of product being supplied/manufactured. The Quality Assurance System shall ensure that bought out or imported components of The System are strictly as per requirements laid down in this STR.

7.2 Special Conditions:

a) The vendors 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 product approved and listed with at least two national/international listing and approval agencies like UL, FM, LPCB, Vds, Active fire etc. for the

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facilities of designing The System and the necessary infrastructure to carry out detailed tests. The System design shall have approved fire protection technology on national/international railway system and shall have completed five years of satisfactory service on national/international railway Systems on at least five hundred coaches and shall be providing regular service for protection against fire. The OEM’s whose designed system for fire protection has completed five years of successful and satisfactory service on National/International Railway Systems on at least five hundred coaches shall submit verifiable documentary proof of satisfactory and successful performance of The System.

b) The MOU signed between vendor and OEM shall 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, even in case the MOU is rescinded at some later stage. In case any part of The System is manufactured outside India and assembled in India, a certificate of country of origin shall be provided with each supply clearly establishing the source of manufacture along with compliance of clause number 2.2 of section-B of this STR.

c) Since The System is invaluable for 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 9 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 (15 to 18 coaches) as prototype for checking and verifying the fitment, design and requirements as specified in this STR. The installed and commissioned system shall be checked for the functionality and performance as specified in Annexure 1, 2 & 3 of this STR for approval of the prototype for field trial.

d) For a given order on an OEM whose product has not undergone field trials, the first 15-18 coach sets shall be put on field trial for 9 months. Further quantity shall be supplied only on satisfactory completion of field trials.

e) In case of any failure during field trials attributable to poor design or material, the field trials shall be repeated for next 9 months. IR shall decide the cause of failure after investigation in this regard.

f) 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 & 3 of this STR. In case The System response is not as per the requirements of this STR, The System design shall be deemed to have failed the field trials.

g) The vendors shall ensure that The System supplied with components manufactured from the sources as indicated at the time of approval of

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product are strictly as per this STR. In case design/source of any component of The System is changed, fresh field trials shall be necessary.

8.0 VENDOR’S RESPONSIBILITY:

8.1 The vendor shall be completely responsible for the execution of the contract strictly in accordance with the terms of this STR 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 vendor.

8.1.2 His sub contractor for materials.

8.2 The performance test carried out either by the vendor 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 vendor shall further, not withstanding any exercise by the consignee / RDSO of the power of superintendence, be responsible for sufficiency of packing, marking etc. of all the parts of The System to ensure their delivery without damage. The vendor shall comply with the instructions of consignee/ RDSO or his nominee, if in his opinion, more precautions than those taken by the vendor are necessary for the proper execution and safe delivery of all the parts of The System.

8.6 The vendor 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. SPARE PARTS:

9.1 The vendor 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 POH. The list shall give the
estimated maintenance frequency, batch no./part number, quantity and price of each component or as per kit.

9.2 The vendor shall ensure availability of all spares of The System for a period of at least 6 years. This shall be irrespective of the fact whether the vendor or his sub vendor/(s) have stopped manufacturing of the equipment/(s) to the design supplied to IR.

10. WARRANTY AND REPLACEMENT:

The warranty period for The System and its accessories shall be 24 months from the date of commissioning or 30 months from the date of supply whichever is earlier. The supplier shall replace all the items/equipments rejected on final acceptance due to their non-compliance with the requirements of this STR and the products those show deficiencies within the time period of warranty by products complying with the requirements free of cost within a period of two weeks.

11 PROTOTYPE INSPECTION

One complete system as per this STR shall be installed/retrofitted by the vendor on a designated coach as prototype for checking/verifying/clarifying the fitment and requirements of this STR. The installed/retrofitted system on designated coach shall be checked for functionality and performance as per Annexure 1, 2 & 3 of this STR.

12. 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 vendor 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 i.e. EN54-20 or EN54-7. The test specified in Annexure-1, 2 & 3 of this STR are Acceptance Tests to be carried out 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 vendor cost. The submission of test reports mentioned in Annexure-A are mandatory for product approval and shall be submitted to purchaser/consignee.

12.4.2 All Type Test specified in Annexure-A shall be repeated and submitted to purchaser/consignee after a period of ten years irrespective of the manufacturer/vendor supply order to IR, to confirm that The System meets the specified requirements of this STR. In addition to above the manufacturer/vendor shall also repeat the entire Type Tests in following cases at their cost. (As Per IEC 60571 clause-10.1.1)

- 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 Unless otherwise specified in the test procedure, all Type Tests shall be carried out, after the test specimen (detector under test) has been allowed to stabilize in the standard atmospheric conditions for testing as described in IEC/EN 60068-1 as follows:

- a) Temperature- 15 to 35 degree centigrade
- b) Relative Humidity- 25 to 75%
- c) Air Pressure- 86 to 106kPa

12.4.4 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.

12.4.5 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.

12.4.6 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.
12.4.7 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.

12.4.8 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.

12.4.9 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. **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 and 5% of the lot size or minimum 04 numbers whichever is more for heat activated device/mechanism.

13.3 Samples selected for Acceptance Test shall confirm the entire requirements as laid down in Annexure-1, 2 & 3. 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. **MARKING:**

Every item of The System shall be legibly marked to indicate the following:

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. **PACKING**

15.1 The vendor 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 Vendor shall also ensure that all other items of The System are suitably packed before dispatch to prevent damage in transporting, handling and storage.

16. **TRAINING**

The vendor shall arrange training to IR personnel in maintenance and trouble shooting of The System supplied by them. Fifteen 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 vendor and consignee/purchaser. Training shall be arranged free of cost.

17. **INFRINGEMENT OF PATENT RIGHT**

The vendors seeking 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. 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

\[ a = \frac{25}{f} \] for values of f from 1 Hz to 10 Hz.

\[ a = \frac{250}{f^2} \] 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 - ±4°

1.4 Ambient Temperature

(i) Ambient temperature : -4°C to 50°C

Altitude : Sea level to 2500m

Max. temperature under Sun : 70°C

Relative humidity : 40% 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) Air conditioned pantry cars have cooking and escorting staff area, the meals and snacks are prepared on electrical heaters.

iii) Each Power car is equipped with two no’s diesel generator set, each 500KW capacity with air conditioned crew & guard compartment. Power is generated in power cars and supplied to all coaches through electrical couplers.

iv) 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 vendor/supplier 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. The standby source of supply to The System shall comply with the EN 54-4 “Fire detection and alarm systems power supply equipments.”

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 and of satisfactory service from user Railway(s) shall be provided by the vendor.

2.2 All The System equipment/(s) designed, shall be tested, approved and listed with at least two National/International accredited laboratories such as:

- UL
- FM
- Loss Prevention Certification Board (LPCB).
- Verband der Sachversicherer e.V (Vds).
- Active fire etc.
2.3 The System shall be designed for very early detection of smoke/fire incidence. The design should incorporate any suitable 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 of coach, power car/SLR, kitchen & escorting staff area of pantry car. The system shall be compact, lightweight and highly reliable & robust in design with inbuilt redundancy to cater for any sensor failure.

2.5 The System designed shall be of high sensitivity i.e. detection of smoke at incipient stage of a fire with minimum sensitivity level of .005 % obs./m The responding time of The System for any smoke shall be as per clause No. 2 of ARGE Directive “Fire Prevention in rolling Stock” i.e the detection system in passenger and staff areas must respond within a period of 1 minute after beginning of smoke release under all possible conditions of service. 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 these levels as per their requirements. The system shall be designed to show smoke level reading in % Ob/m (percent Obscuration/meter) as well as in % Ob/ft (percent obscuration/foot). The values of all levels shall be set by the manufacturers/suppliers as per coach requirement. The final level alarm smoke threshold setting shall not be beyond 6.0% Ob/m.

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.

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 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 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.

2.13 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:

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h) Activate brake application on the affected coach. For this purpose, necessary interface to actuate brake application shall be designed and supplied by the vendor.

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.

iii) Thereafter 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”.

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 shall be designed for automatic communication and display to the designated staff through SMS module.

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

2.18 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.

2.19 Elastomeric or better insulation cable like PTFE of suitable size shall only be used by the vendor for the purpose of internal wiring of the equipments and external connections.

2.20 The cables to be used for all external wiring shall confirm to latest RDSO’s specification No.E-14/01 Part-I for control cable.

2.21 Sampling pipe/sampling points network shall be designed to cover entire coach’s passenger area including lavatories and selected 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 directive 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.
2.21.1 The sampling pipe material and fittings (like UPVC/CPVC) shall have adequate mechanical strength, fire retardant property and shall be suitable for the coach environment or as recommended by the manufacturer of the System.

2.21.2 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.

2.22 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 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. For compatibility with different design Systems, the CCU design shall incorporate RS485 communication protocol to monitor and control all the Systems used within a formed train rake. The network shall be designed 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:

2.22.1 The representation of smoke levels of all the Systems connected to CCU.
2.22.2 A real-time event list, prioritized according to the urgency.
2.22.3 The smoke level trending analysis to compare smoke levels across the Systems in real time.
2.22.4 Exact details about the coach/coaches and device/(s) involved in an event.

2.23 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.

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

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• 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.

2.25 The control equipment of The system should have the capability for the following actions compatible with multi alarm levels that may be incorporated as per requirements:

• To activate an electrical/electronic visual signal (e.g. 24V DC strobe) in the fire risk area.

• To activate the electrical/electronic audio-visual (e.g. 24V DC strobe cum horn) or to activate SMS module in the escorting/nominated staff area or other appropriate location.

• To activate audio alarm signal (e.g. 24V DC-hooter/horn) at control panel and activate all warning systems.

• To activate a suitable counter measures (e.g. evacuation action or shutdown of systems, automatic suppression system, auto braking of train etc.)
OVER HEATED WIRE TEST

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 mm².

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.

4. Requirement
In all possible conditions of the coach environment The System shall respond within 60 seconds after the cessation of energization.
AIR FLOW MONITORING TEST

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 \((F_n)\) (Lt./min.) shall be determined from the sampling configuration used for the fire test with the help of anemometer.

2. The aspirating smoke detection unit under test shall be tested at test flow rate \((F_t)\) (i.e. \(F_t = F_n \pm 10\%\)) for testing the air flow monitoring.

3. For an aspirating smoke detection unit under test that has a memorized normal flow, the \(F_t\) 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 \(F_t\) by 20\%, which shall be observed through anemometer installed between the sampling pipe and aspirating smoke detection unit.

5. For increased flow the volumetric airflow is increased from \(F_t\) by 20\%, which shall be observed through anemometer installed between the sampling pipe and detection system unit.

d. Requirement:

1. When the volumetric air flow reading in anemometer reaches the value of \(F_t - 20\%\) of \(F_t\), the aspirating smoke detection unit shall generate an airflow fault signal.

2. When the volumetric air flow reading in anemometer reaches the value of \(F_t + 20\%\) of \(F_t\), the aspirating smoke detection unit shall generate an airflow fault signal.
PERFORMANCE TESTING OF HEAT ACTIVATED DEVICE

1. **General:**

   Performance test of heat activated device/mechanism at an elevated ceiling temperature of 65± 05 °C.

2. **Apparatus:**

   2.1 Hot plate of minimum 2KW with variable rating. The hot plate shall be powered, such that its temperature rises from ambient to 500°C in approximately 11 minutes.

   2.2 01 Nos. Digital temperature measuring sensors with probe.

   2.3 Measuring tape.

3. **Arrangement:**

   3.1 The performance testing of heat activated device/mechanism shall be done at all possible ceiling heights of all type of IR coaches.

   3.2 Fix temperature measuring sensor at heat activated device/mechanism location with suitable means.

4. **Procedure:**

   4.1 Connect hot plate with 240 volt AC supply.

   4.3 Record activation temperature of heat activated device/mechanism.

5. **Requirement**

   The heat activated devise/mechanism shall be activated at an elevated ceiling temperature of 65± 05 °C.
<table>
<thead>
<tr>
<th>Sr. No</th>
<th>Tests</th>
<th>Requirements</th>
<th>Test Method</th>
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<tbody>
<tr>
<td>1</td>
<td>Repeatability</td>
<td>The detector shall meet the requirements of relevant part of EN 54</td>
<td>As per relevant part of EN 54</td>
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<td></td>
<td>Reproducibility</td>
<td>The detector shall meet the requirements of relevant part of EN 54.</td>
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<tr>
<td>2</td>
<td>Fire Test</td>
<td>The detector shall meet all the requirements of test fires.</td>
<td>UL 268</td>
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<td>or</td>
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<td></td>
<td></td>
<td></td>
<td>As per relevant part of EN 54</td>
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<tr>
<td>3</td>
<td>Humidity Test at 93±2% RH and temperature of 40±2°C</td>
<td>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.</td>
<td>UL 268</td>
</tr>
<tr>
<td>4</td>
<td>Dry Heat Test</td>
<td>4.1 The performance test shall be done as specified in relevant part of EN54.</td>
<td>IEC-60571</td>
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<td></td>
<td></td>
<td>4.2 The detector shall meet the requirements of relevant standard.</td>
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<td>4.3 No failure or damage shall occur.</td>
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<td>4.4 No out-of-tolerance results shall appear.</td>
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<tr>
<td>5</td>
<td>Low Ambient Temp./ Cold Test</td>
<td>a. The performance test shall be done as specified in relevant part of EN54.</td>
<td>IEC-60571</td>
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<td></td>
<td>b. The detector shall meet the requirements of relevant standard.</td>
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<td>c. The performance test shall not show any failure or damage nor any results which are beyond the specified tolerances</td>
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<td>6</td>
<td>Stability Test</td>
<td>6.1 No False alarm shall occur.</td>
<td>UL268</td>
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<td>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.</td>
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<tr>
<td>7</td>
<td>Impact Test</td>
<td>7.1 The performance test shall be done as specified in the relevant part of EN54.</td>
<td>IEC 60068-2-75</td>
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<td>7.2 The detector shall meet the requirements of the relevant standard.</td>
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<td>7.3 No visual deformation</td>
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Signature

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Approved By:- Director/SS/Carriage
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<tr>
<td>7.4 Mechanical integrity of detector shall not change.</td>
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<tr>
<td>8. Shock, Vibration and Bump Test: (Category 1, Class B as per IEC 61373, clause 1)</td>
<td>8.1 The performance test shall be done as specified in relevant part of EN 54.</td>
<td>IEC 60571</td>
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<td>8.2 The detector shall meet the requirements of relevant part of EN 54.</td>
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<td>8.3 No visual deformation</td>
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<td></td>
<td>8.4 Mechanical integrity of detector shall not change.</td>
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<tr>
<td>9. EMC</td>
<td>9.1 The performance test shall be done as specified in UL 268/relevant part of EN 54 standards.</td>
<td>IEC 60571</td>
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<td>9.2 The detector shall meet the requirements of relevant standard.</td>
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<td></td>
<td>9.3 After the test the detector under test shall continue to operate as intended.</td>
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<tr>
<td>10. Variation in supply voltage parameters</td>
<td>10.1 The performance test shall be done as specified in relevant part of EN54.</td>
<td>IEC 60571</td>
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<td></td>
<td>10.2 The detector shall meet the requirements of relevant standard.</td>
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<td></td>
<td>10.3 The detector shall function correctly without any intervention or need for resetting.</td>
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<td></td>
<td>10.4 No spurious operation of detector shall occur.</td>
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<tr>
<td>11. Dielectric Test</td>
<td>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).</td>
<td>UL 268</td>
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Date of Issue: Oct. 2012  
Spec No. RDSO/2008/CG-04 (Rev. 2)