



Consultants Specification for a High Sensitivity Modular Aspirating Smoke Detection (ASD) System

**Issue July 2022
Rev 1.0**

This document is provided for fire system documentation where modular aspirating smoke detection has been identified as the preferred solution. Any text and/or images can be freely used and lifted directly from any part of this document to produce a generic specification for tender purposes.

CONTENTS

1. ASPIRATED SMOKE DETECTION SYSTEM	3
1.1 STANDARDS AND APPROVALS	3
1.2 SYSTEM REQUIREMENTS	4
1.3 QUALITY ASSURANCE AND MANUFACTURER	7
1.4 EQUIPMENT CONTROLS	7
1.5 DETECTOR CONFIGURATION	8
1.6 CONNECTION TO THE FIRE ALARM CONTROL PANEL	9
1.7 MASD SYSTEM NETWORKING REQUIREMENT	9
1.8 NETWORK CABLE SPECIFICATION	10
2. SAMPLING PIPEWORK DESIGN	10
2.1 SAMPLING PIPE	11
2.2 SAMPLING POINT DESIGN	11
2.3 CAPILLARY SAMPLING DESIGN	11
2.4 AIR SAMPLING PIPE DESIGN CALCULATIONS	12
3. POWER SUPPLY AND BATTERIES	13
4. INSTALL, COMMISSION AND TEST	13
4.1 INSTALL AND COMMISSION	13
4.2 TEST	14
5. DOCUMENTATION	14

1. ASPIRATED SMOKE DETECTION SYSTEM

A high performance Modular Aspirated Smoke Detector (MASD) system shall be designed, supplied, installed and commissioned by a specialist Fire Alarm contractor trained and authorised by the detector Manufacturer. The MASD system protects areas indicated on the drawings and shall be in accordance with this specification and to the approval of the local Fire Brigade and relevant authorities.

Any deviations or alternatives proposed to this specification shall only be considered if permission in writing is granted by all parties including the Consultants, Contactors and End User for the project.

1.1 STANDARDS AND APPROVALS

The MASD system shall be CE marked and shall be certified to comply with the European Fire Alarm product standard EN54-20 (Aspirating Smoke Detectors). Independent testing shall be performed by a nationally authorised test laboratory and certification of compliance to EN54-20 shall be listed by at least the following major European certification bodies.

- LPCB
- VDS
- AFNOR
- BOSEC/ANPI

The following installation standards and codes of practice shall be followed where applicable to the specific risks being covered by the MASD system.

- Fire Industry Association - Code of Practice for Design, Installation, Commissioning and Maintenance of Aspirating Smoke Detector (ASD) systems.

- British Standard BS 5839 Part 1 - code of practice for designing, installing, commissioning, and maintaining fire detection and alarm systems in non-domestic buildings
- British Standard BS 6266 – Fire protection measures for Electronic Equipment Areas
- Locally accepted or required codes of practice if applicable, such as European CEN technical standard CEN/TS 54-14.

1.2 SYSTEM REQUIREMENTS

The MASD system shall consist of Modular Aspirated Smoke Detectors (MASDs) connected to sampling pipe networks designed to sample air from the protected areas. MASD units shall be constructed in a modular extensible fashion deploying from one to eight individually addressable smoke detector modules and a display/control module.

All detector and display modules shall share a common back plane for first fix mounting and connection enabling individual modules to be replaced without disturbing other modules making up the MASD unit. Each detector module shall have its own LASER-based detection chamber and aspirating fan and be independently configurable so that adding further modules in future has no negative impact on the performance of the existing modules.

As early warning of incipient fires and compensating for smoke dilution in large volume areas are key applications for aspirated smoke detection, the MASD detection modules shall be highly sensitive. Detection sensitivity shall be sufficiently high that the difference in smoke density between an alarm state and no alarm condition can be as small as 0.002%obs/m. The detector chamber shall be based on the light scattering principle with a high-power semiconductor laser used as the light source. The detector will operate on the forward scattering detection principle and is responsive to a wide range of particle sizes.

The MASDs shall also be highly resistant to unwanted alarms making them suitable for deployment in a wide range of environments. Detector sensitivity alarm profiles shall be selectable for each detector module. These alarm profiles shall match the sensitivity range of the detector to that required for application in the area being protected. Balancing the highest practical sensitivity (and hence fastest alarm response) and minimising potential false alarms from changing conditions in the environment being protected (including air pollution and other background particulate levels) is of key concern.

The MASD shall be capable of automatically and dynamically adjusting the specific alarm thresholds applied within the parameters of the alarm profiles selected. Artificial intelligence techniques shall be used to learn and monitor the pattern of background smoke in the environment over time and automatically adjust detection alarm thresholds to avoid false alarms while maintaining constant and optimum sensitivity. A Fast Learn initial sampling of the environment for up to 15 minutes shall be used when the detectors are initially deployed to produce a starting base and then the system shall automatically add and update its database of background readings. Use of static alarm levels requiring manual adjustment over time to adjust to site conditions is not acceptable.

Four alarm levels shall be provided by the MASD system, individually configurable for each MASD detector module. These alarm levels can be described as Auxiliary Alarm, Pre-Alarm, Fire Alarm and Fire 2. Their alarm sensitivities will be set in the range from 0.002 – 25% obscuration/meter according to the selected alarm application profile.

Examples of typical use of the alarm levels are:

- Alarm Level 1 (Pre-Alarm) - Activate a visual and audible alarm in the fire risk area.
- Alarm Level 2 (Auxiliary) - Activate the electrical/electronic equipment shutdown and activate visual and audible alarms in a local control location.
- Alarm Level 3 (Fire 1) - Activate an alarm condition in the Fire Alarm Control Panel to call the Fire Brigade and activate all warning systems.
- Alarm Level 4 (Fire 2) - Activate evacuation action and shut down of systems.

Detector modules shall have built in air filters fitted to make detection robust and suitable for both polluted and clean air environments. Filters shall be easily replaceable as part of standard maintenance and the MASD shall indicate automatically which filters are due for replacement. Detection algorithms shall be capable of discriminating signals generated by dust particles from those of smoke particles and filter these out to further improve smoke detection integrity.

In order to prolong detector and filter life a "Wastegate" airflow management system shall be incorporated in each detector module which directs only a small proportion (less than 10%) of the sampled air through the built-in filter and on to the detection chamber. The remaining sampled air is sent directly to the exhaust outlet.

Each MASD unit shall support up to 2000 meters of pipe with 400 sampling holes while conforming to normal (class C) sensitivity alarm level. Each detector module shall support up to 250m pipe length and 50 sampling holes at class C sensitivity. Up to 160 sampling holes at high sensitivity (class A) shall be supported per MASD (up to 20 per detection module).

Entry to the detector module from the pipe network shall be possible from either top or bottom of the mounted module without any compromise to the clarity of alarm and fault indications on the MASD.

Each detector shall monitor and provide warning in the event of any malfunctions including among others high or low air flow in sampling pipes, filter contamination, microprocessor failure and power supply failure.

1.3 QUALITY ASSURANCE AND MANUFACTURER

- The MASD system shall be manufactured in Europe within an ISO 9001 quality environment. These ISO 9001 procedures shall be independently audited by the LPCB.
- The MASD shall come with a minimum warranty period from the Manufacturer of five years.
- Approved equipment Manufacturer is Carrier Fire & Security. The ModuLaser range and accessories from Carrier and PipeCAD design software are accepted as compliant to this specification.

1.4 EQUIPMENT CONTROLS

The MASD display/control modules shall incorporate a colour TFT display and control keys. In addition to local status indicators, they shall support a TCP/IP connection. This shall enable sending of configurable email notifications for faults and other detector conditions. The TCP/IP connection shall also support operation of remote diagnostic software which can be used to examine the detector status in advance of a site visit.

The display shall give the status of the following levels of alarm: Pre-Alarm, Auxiliary, Fire 1 and Fire 2. In addition to a generic fault condition indicator the MASD display shall have dedicated indicators for the following fault conditions:

- Detector head fault
- Air flow fault
- Filter fault

The display/control module shall also have the following operator functions available for quick access:

- **RESET:** Will clear any latched alarms or faults and set the status display to its normal operation message.
- **TEST:** Shall initiate a lamp test and then display its nominal operating sensitivity as calculated by the Artificial Intelligence System.
- **ISOLATE:** Shall toggle the unit's isolation state. When isolated the unit cannot generate alarms. An isolated detector will signal a fault condition to the Fire Alarm Control Panel to indicate its inability to generate alarms.

All alarm, fault and system events shall be logged by the MASD system. Each MASD shall support recording of up to 180,000 events through a capacity of 20,000 events at detector module and display module.

In addition, the sampled database of historic background environmental data shall be available to view in an easy-to-read chart recorder graphic through the TFT display and/or an external PC program. The Chart Recorder shall provide a minimum of one month of background readings at one sample per second for the following readings:

- Airflow rate into each detector module
- Temperature at detector module
- Detector output reading for each detection chamber
- Alarm thresholds over time

1.5 DETECTOR CONFIGURATION

The configuration of a detector shall be programmed via four navigation keys and an enter key. The display module shall support a menu structure and the parameters available for customisation. Alternatively, the detector can be programmed using a Windows™ application running on a PC connected through a USB or TCP/IP interface.

1.6 CONNECTION TO THE FIRE ALARM CONTROL PANEL

The connection to the Fire Alarm Control Panel shall be via relays located at the detector, or via an intelligent addressable interface card that connects directly onto the point type detector loop cabling. Direct Open Protocol connection to control panels from multiple manufacturers shall be available in the form of an Apollo Protocol loop interface card for compatible fire alarm systems.

Three programmable alarm relays shall be available for each detector – giving up to 24 relays for an MASD unit. Each relay shall be configurable to trigger on a specific alarm level such as Pre-Alarm or Fire 1 condition or be set to provide specific fault conditions such as flow or filter fault.

Each MASD detector shall have a programmable input which can be configured for the following functions:

- Remote sensitivity override
- Remote isolate
- Remote reset
- Remote day/night mode switching
- Reference detector input
- Power supply fault monitoring – mains and battery

1.7 MASD SYSTEM NETWORKING REQUIREMENT

MASD units shall be networkable to enable large systems with many detectors to be effectively monitored and managed. The central point of control for the MASD system network shall be a Command Module. The Command Module shall be similar to the display unit of an individual MASD but capable of connecting to any MASD on the network and operating and displaying events for that MASD.

Up to 126 MASD modules shall be connectable to a single Command Module unit. Each MASD detection module and display/control module shall count towards the 126 unit capacity.

The network topology shall be RS485 2-core twisted pair cable between each module, connected ring with fault tolerance to both short circuit and open circuit conditions. Each module in the network shall provide isolation of the incoming RS485 signals and boosting of the outgoing signals so that up to 1.2km cable distances between every two connected modules is supported.

The Command Module shall provide a central programming and display point for all detectors in the system. It can also provide a direct single Detector/Fire alarm system interface point through an addressable protocol interface card and open protocol access to external systems.

To facilitate monitoring and management of alarms in external integrated systems the Command Module unit shall support a TCP/IP connection which can report the status for all networked MASD units using an open MODBUS protocol. The MODBUS communication protocol shall enable interrogation of alarm states for each detector by an external building management or alarm management system supporting the MODBUS protocol.

1.8 NETWORK CABLE SPECIFICATION

- Capacitance of 100 picofarads per metre or less
- Resistance of 100 milliohms per metre or less
- Impedance of loop typical 100 to 120 ohms
- Maximum distances between MASD modules 1.2km providing cable meets above specifications.

2. SAMPLING PIPEWORK DESIGN

The sampling pipe shall be designed to provide optimum efficiency in covering the required areas while allowing for adequate air transport timings to the MASDs. The response time for the least favourable sampling point in the system shall not exceed 95 seconds or a time determined by the local authorities. Air sampling calculations shall be provided from Manufacturer approved and certified design software such as PipeCAD.

2.1 SAMPLING PIPE

The sampling pipe selected shall be installed and identified in accordance with the relevant local requirements. The pipe material should be suitable for the environment in which it is installed, or should be of the material required by the detector manufacturer. All joints in the sampling pipe must be air tight and made by using solvent cement, except at entry to the detector. All pipes should be supported to requirements of the local codes and manufacturer's recommendations. The far end of each trunk pipe run shall be fitted with an end cap and drilled with a hole sized to achieve the performance as calculated by the system design tool.

- All changes of direction shall be made with radius bends.
- The far end of each trunk pipe shall be fitted with an end cap and drilled with a hole or otherwise appropriately sized to achieve the performance as specified and as calculated by the system design.
- All joints shall be air tight and made by using solvent cement, except at entry to detector mounting box.
- All pipe work shall be supported at not less than 1200 mm.

2.2 SAMPLING POINT DESIGN

Due regard shall be given to local regulations and the manufacturers' recommendations in relation to the number of Sampling Points, distance between Sampling Points and distance of the Sampling Points from the ceiling or roof structure and forced ventilation systems.

2.3 CAPILLARY SAMPLING DESIGN

Where false ceilings are installed, the sampling pipe shall be installed above the ceiling, and sampling points shall be installed on the ceiling and connected to the pipe network by means of a capillary tube. The maximum length of the capillary tube shall be 6 metres, no more than 24m of capillary on a single pipe inlet i.e.(8 x 3m) or (4 x 6m).

The capillary tube shall connect to a ceiling sampling point specifically designed and approved by the detector manufacturer. The performance characteristics of the Sampling Points shall be taken into account during the system design. Connection fittings shall be made into special sampling pipe couplings.

2.4 AIR SAMPLING PIPE DESIGN CALCULATIONS

Air sampling pipe design calculations shall be provided by a sampling pipe aspiration modelling software such as PipeCAD. Pipe work calculations shall be supplied with the proposed pipe layout design to indicate the following performance criteria:

- Transport Time
- Balance between sampling holes
- Balance between sampling pipes
- Flow rate for pipe with aspirator speed
- Total flow rate
- Detector sensitivity
- Detector type
- Individual and total pipe length
- System classification to sensitivity class A, B or C

3. POWER SUPPLY AND BATTERIES

The system shall be powered from a regulated supply of nominally 24V DC. open product standard EN54-4. The power supply, battery charger and battery shall comply with the relevant codes, standards or regulations, in particular European product standard EN54-4. The battery size and calculation shall be provided to cover the required standby backup (typically 24 hours standby battery backup followed by 30 minutes in an alarm condition).

4. INSTALL, COMMISSION AND TEST

The Contractor shall install the system in accordance with the manufacturer's installation and instruction manual and applicable local codes. The Contractor must ensure that individuals performing site works have acquired satisfactory technical knowledge of the detector.

4.1 INSTALL AND COMMISSION

The installed system shall be capable of meeting a proven performance test. The installer shall provide evidence of flow/balance calculations to ensure optimum sampling performance. These calculations shall be done by computer aided design software depicting 3D isometric drawings of the pipe network. The detector shall perform a 15 minute fast learn procedure to learn the initial background conditions and set initial alarm thresholds.

A visual check of all pipes shall be carried out to ensure that all joints, bends, and sampling points are installed to the manufacturer's recommendations. Confirmation is to be provided that the programmed features of the detector/s are operational and in accordance with the specification, that all ancillary warning devices operate as specified and that the interconnection with Fire Alarm Control Panel is operational.

The Installer shall ensure the following are operational and programmed in accordance with the specification:

- Set clock function to local time
- Set Alarm profile and day and night operation time frames.
- Check Time delays, Review inbuilt chart recorder information for detector output and air flow.
- Check all ancillary warning devices operate as specified.

The Installer shall record all tests and results and a copy of these results shall be retained on site in a logbook.

4.2 TEST

Introduce smoke to the least favourable sampling point in each sampling pipe. Response time is not to exceed ninety seconds and is to be within 15% of the PipeCAD calculation.

Activate the appropriate Fire Panel zones and fill out the log book accordingly.

The MASD shall support testing by provision of a Test Wizard function which guides the engineer through all the necessary steps.

5. DOCUMENTATION

Provide an operator's manual detailing full operation of the system and include a schedule of detector locations. "As installed" drawings shall be submitted including pipe layouts, design calculations from PipeCAD and performance criteria.

A baseline of the initial detector parameters shall be recorded for reference in future maintenance visits and system alterations. These parameters shall be stored to be accessible by any engineer attending site simply by inspecting the MASD software configuration data.

For More Information

This document has been produced to assist in the collation of an Aspirating Smoke Detection system (ASD) specification for tender and quotation purposes.

All elements contained within are free to use as required and can be reproduced and copied without further permission.

Carrier is also able to provide FREE certified CPD seminars on a number of subjects associated with fire detection systems as well as related subject matter.

For course details and availability or for any further information please contact:

Ray Puttock – Commercial Support Manager

EMS Ltd
Sea Street
Herne Bay
Kent CT6 8JZ

01227 369570

ray.puttock@carrier.com