

- 2.10.3.2 Sample Port Coverage Area
- 2.11 PRIMARY POWER SUPPLY
- 2.12 SECONDARY POWER SUPPLY
 - 2.12.1 Grounding
- 2.13 COMMUNICATION NETWORK
- 2.14 TESTS, INSPECTIONS, AND VERIFICATIONS

PART 3 EXECUTION

- 3.1 SYSTEM SEQUENCE OF OPERATION
 - 3.1.1 Normal Operation
- 3.2 INSTALLATION
 - 3.2.1 Display Control Panel
 - 3.2.2 Smoke Detector
 - 3.2.3 Air Sampling Network
 - 3.2.3.1 Non-Metallic Tubing
 - 3.2.4 Spare Parts
 - 3.2.5 Wiring
 - 3.2.6 60-Hertz Power
 - 3.2.7 Installation In Cabinets and Boxes
 - 3.2.8 Conduit and Raceways
 - 3.2.9 Labeling
- 3.3 FIELD TESTING
 - 3.3.1 External System Wiring
 - 3.3.2 System Acceptance Testing
 - 3.3.2.1 Suction Pressure Test
 - 3.3.2.2 Smoke Transport Time Test
 - 3.3.2.3 Deviations
 - 3.3.2.4 Sensitivity Verification Test
 - 3.3.2.5 Smoldering Smoke Test
- 3.4 ACCEPTANCE TEST DOCUMENTATION
- 3.5 MAINTENANCE

-- End of Section Table of Contents --

Use the Reference Wizard's Check Reference feature when you add a RID outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text are automatically deleted from this section of the project specification when you choose to reconcile references in the publish print process.

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM F402 (2005; R 2012) Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings

ASTM F442/F442M (2013; E 2013) Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR)

FM GLOBAL (FM)

FM APP GUIDE (updated on-line) Approval Guide <http://www.approvalguide.com/>

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA TC 3 (2013) Standard for Polyvinyl Chloride (PVC) Fittings for Use With Rigid PVC Conduit and Tubing

NEMA TC 13 (2005) Standard for Electrical Nonmetallic Tubing (ENT)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101 (2015) Life Safety Code

NFPA 318 (2009) Protection of Cleanrooms

NFPA 70 (2014; AMD 1 2013; Errata 1 2013; AMD 2 2013; Errata 2 2013; AMD 3 2014; Errata 3-4 2014; AMD 4-6 2014) National Electrical Code

NFPA 72 (2013) National Fire Alarm and Signaling Code

NFPA 75 (2013; Errata 2013) Standard for the Protection of Information Technology Equipment

NFPA 90A (2015) Standard for the Installation of Air Conditioning and Ventilating Systems

NATIONAL INSTITUTE FOR CERTIFICATION IN ENGINEERING TECHNOLOGIES (NICET)

NICET 1016-2 (2007) Program Detail Manual Fire Alarm Systems, 8th Edition

UNDERWRITERS LABORATORIES (UL)

UL 1449 (2014) Surge Protective Devices

UL 497B (2004; Reprint Dec 2012) Protectors for Data Communication Circuits

UL 651 (2011; Reprint May 2014) Standard for Schedule 40 and 80 Rigid PVC Conduit and Fittings

UL Fire Prot Dir (2012) Fire Protection Equipment Directory

1.2 SUBMITTALS

NOTE: Review Submittal Description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list to reflect only the submittals required for the project. Keep submittals to the minimum required for adequate quality control.

A "G" following a submittal item indicates that the submittal requires Government approval. Some submittals are already marked with a "G". Only delete an existing "G" if the submittal item is not complex and can be reviewed through the Contractor's Quality Control system. Only add a "G" if the submittal is sufficiently important or complex in context of the project.

An "S" following a submittal item indicates that the submittal is required for the Sustainability Notebook to fulfill federally mandated sustainable requirements in accordance with Section 01 33 29 SUSTAINABILITY REPORTING.

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.] [for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submittals with an "S" are for inclusion in the Sustainability Notebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Underwriter Laboratory (UL) listed UL Fire Prot Dir or Factory Mutual (FM) FM APP GUIDE Approved[; G]

All Test Data[; G]

SD-02 Shop Drawings

Connection Drawings[; G]

Schematics[; G]

As-Built Drawings[; G]

Floor Plan Layouts [; G]

SD-03 Product Data

Display Control Panel[; G]

Detector Assembly[; G]

Aspirating Fan[; G]

Power Supply[; G]

Filter[; G]

Piping Materials[; G]

Pipe Hangers and Supports[; G]

Battery and Charger[; G]

Software and Programming[; G]

Interface Equipment for Reporting and Monitoring[; G]

SD-05 Design Data

List of Parts and Components[; G]

Test Procedures and Recording Forms[; G]

Air Sampling Detection System Design Analysis Calculations[; G]

SD-06 Test Reports

Completed Test Procedures and Recording Forms[; G]

Field Testing[; G]

SD-07 Certificates

Contractor's State Certification[; G]

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals[; G]

1.3 QUALITY ASSURANCE

Provide manufactured fire-alarm equipment which meets the requirements according to the paragraph entitled, "Design Requirements" of this section. Use the latest standard design, and as listed by Underwriters' Laboratories (UL Fire Prot Dir) or approved by Factory Mutual FM APP GUIDE for it's intended use. Ensure all installed devices function with the display control panel and do not interfere with the operation of the control panel.

Submit fully verified and dated copies of all test data and results with a copy of the approved test procedure and any factory test information.

1.4 SERVICES OF A CERTIFIED FIRE ALARM SPECIALIST

Provide on-site services of a Certified Specialist, thoroughly experienced in installation of air sampling detection systems and fire alarm system work, to perform or directly supervise the installation, make all necessary adjustments, and perform all tests on the air sampling smoke detection system at the site.

The specialist is considered certified when the specialist holds a valid Fire Alarm System, Level III Certification from the National Institute for Certification in Engineering Technologies, or a valid Level III Fire Alarm Engineering Technician Certification from the International Municipal Signal Association (IMSA) or is licensed by the State of Florida as a Fire Alarm Contractor I in accordance with Florida State Statute, Chapter 489, Part II.

Submit evidence of the Contractor's State Certification.

Certification of other recognized agencies with equivalent requirements will be considered by the Contracting Officer. Provide evidence of the equivalent certification and the basis of certification to the Contracting Officer for approval prior to any work being performed at Kennedy Space Center. Submit Contractor certification requirements in accordance with NICET 1016-2.

PART 2 PRODUCTS

Submit list of parts and components for the installed system by manufacturer's name, part number, and nomenclature. Recommend stock levels required for normal maintenance and unscheduled repairs.

Use components in the installation that are no more than two (2) years old.

2.1 SYSTEM DESCRIPTION

2.1.1 Design Requirements

Submit air sampling detection system design analysis calculations consisting of: the battery capacity, loading calculations, and fan speed and air flow/transport calculations; include schematic diagrams showing pipe segments, pipe diameters, lengths of pipe, node numbers, and sample port diameters to verify the requirements are met.

Provide electronic media and hard copies of all new and revised software and drawings with the submittal at least 14 days prior to the acceptance testing phase of the project as described in the paragraph entitled, "Field

Testing," of this section. Provide as-Built drawings documenting final system configuration including deviations from and amendments to the drawings, and field installation changes, concealed and visible.

Provide intergraph compatible (DXF or DWG Format) computer generated [floor plan layouts](#) indicating location of monitoring facility fire alarm control panel [preaction control panel], air sampling piping (lengths of pipe) and sampling ports (sizes and locations). Floor plan must also indicate geographic monitor zone boundaries, location of display control panel, bar level annunciation panels if separate, and all other associated equipment that is required to provide a complete operational system.

Submit Air Sampling Smoke Detection System [connection drawings](#) for approval.

Connection drawings to consist of point-to-point wiring diagrams of internal and external wiring including, but not limited to, all smoke detection devices, and panel wiring. Point-to-point wiring is defined as wiring from device with integral terminal strip to next device with integral terminal strip, wiring between modules internal to control panels, circuit termination's on terminal strips in control panels, and terminal boxes with integral terminal strips.

Submit Microstation compatible (DGN Format) computer generated Connection Drawings.

Submit [schematics](#) for approval for each Air Sampling Smoke Detection Systems consisting of the following:

Provide module schematic drawings (minimum size 11 inches by 17 inches) prior to system acceptance testing.

Program logic and/or ladder logic diagrams that show interaction of system components.

Submit [as-built drawings](#) for approval 14 days prior to the acceptance testing phase of the project. Provide two (2) sets of electronic media and hard copies of all new and revised software and drawings with the submittal. Provide As-built drawings documenting final system configuration including deviations from the amendments to the drawings, and field installation changes, concealed and visible.

2.1.2 Performance Requirements

Prepare test procedures and test record forms for conducting and recording complete tests on control panels, wiring systems, and air sampling piping networks installed in accordance with the manufacturer's requirements and these specifications. Submit two copies of the [test procedures and recording forms](#) for the preliminary tests to the Contracting Officer for approval, at least 14[_____] days prior to the preliminary system test. The test procedure is to identify each device, circuit, piping network, and sampling port to be tested, describe the initial condition, each step or function in the test, required test results annotating acceptable ranges and actual values, and submit manufacturer's specifications for all test equipment to be used. Provide test forms with suitable spaces for recording test results on all equipment, devices, wiring and sampling ports. The test record forms also have identified spaces for verification signatures of official witnesses and dates of the tests.

2.2 DISPLAY CONTROL PANEL

Provide a display control panel for various configurations to control and monitor all operations of the detector assembly and aspiration system to suit particular applications. Channel and distribute power and communication for the air sampling smoke detection system from the display control panel including referencing and chart recording. Ensure all alarm lamps, trouble lamps, and alarm level threshold set-points are visible on the panel face. Protect all time delays, alarm level adjustments, and testing facilities for detector sensitivity within a secured enclosure to prevent tampering. Provide an override circuit per manufacturer's requirements for fail-safe operation in the event that the programmed alarm threshold is not set or is disabled, or that the fourth alarm threshold automatically defaults to the full-scale smoke level. Provide display control panels that contain all components necessary to maintain a smoke level history log and a historical event log. Ensure storage capacity for the smoke level history log is a minimum of 40,000 samples. Ensure historical event log is capable of a minimum storage capacity of 100 events. Ensure display control panel is capable of retaining this information upon loss of both primary and secondary power sources.

For single zone or multiple zone applications a unitized, self-contained, single enclosure detector/display control panel can be utilized.

In multiple zone installations, where it is desirable to have a central control point monitoring and controlling the remote detector assembly panels, use a multi-zone display control panel. Provide a display control panel appropriately sized based on the number of remote detectors used.

2.3 DISPLAY CONTROL PANEL STATUS INDICATIONS

Ensure that the display control panel displays the detector's continuous output of smoke levels per active zone; in a minimum 10 percent increments of full scale. Ensure that each controller contains a bar graph display feature with bar graph indicators being light-emitting-diodes (LED) or liquid crystal display(LCD).

2.3.1 Alarm Threshold

Provide the display control panel with a minimum of four (4) alarm threshold levels for each zone:

Alarm Level 1 - ALERT

Alarm Level 2 - ACTION

Alarm Level 3 - FIRE 1

Alarm Level 4 - FIRE 2

Ensure programmed alarm thresholds are clearly visible on the face of the display control panel, and are adjustable through the full bar graph scale of the display control panel. Provide a visual alarm level indicator that illuminates and/or flashes when the detector output signal reaches the programmed threshold level for the programmed time. Ensure that the visual alarm indicators on the display control panel have circuitry arranged so that they can be manually reset through the display control panel reset feature. Program alarm thresholds to the following values unless the results of the System Acceptance Tests, indicate a clear need to change

them. In the event that such a need is indicated, notify the Contracting Officer and provide complete documentation concerning the need to deviate from these values. Include within the deviation documentation request, information that complies with the paragraph entitled, "Sensitivity Verification Test." Ensure initial threshold levels are approved prior to the final acceptance test.

Alarm Level 1: set ALERT at 0.0250 percent obsc./foot

Alarm Level 2: set ACTION at 0.0500 percent obsc./foot

Alarm Level 3: set FIRE 1 at 0.1000 percent obsc./foot

Alarm Level 4: set FIRE 2 at 0.2000 percent obsc./foot

Ensure the display control panel contains individual adjustable alarm time delay features for each of the alarm threshold levels. Provide an adjustment range between 0 to 60 seconds. Program the alarm threshold time delays to 30 seconds for alarm levels 1 and 2, and 15 seconds for alarm level 3 and 4.

2.3.2 Air Flow Status Indicators

Ensure the display control panel receives signals from the detector air flow sensor and continuously displays the status of the air flow through the detector. Ensure display control panel indicates a trouble condition when the air flow through the detector is insufficient to permit proper operation of the detection system. Use the initial setting set at the factory and select the final setting based on the system configuration as a 10 percent reduction in air flow through the detector assembly. Ensure the display control panel transmits a trouble signal to the KSC Fire Monitoring Station via the facility fire alarm system from the preaction control panel.

Ensure the air flow fault threshold setting(s) are adjusted by the manufacturer's on site representative and meet site specific conditions. Have a programmable time delay for the air flow fault alarm signal with a range of 0 to 60 seconds for each zone. Program the air flow fault time delay to [10] [_____] seconds unless the results of the system acceptance and commissioning tests, required in this specification, indicate a clear need to change them. In the event that such a need is indicated, provide the Contracting Officer with complete documentation concerning the need to deviate from these values.

2.4 DETECTOR STATUS INDICATORS

Provide a separate detector lamp indicating normal operating status when the system is functioning as designed. Ensure detector status indicates a fault upon the loss of power, an open circuit or an electrical/electronic problem within the detector's circuitry or external wiring. Transmit the Trouble signal to the KSC Fire Monitoring Station via the facility fire alarm system from the [fire alarm] [preaction] control panel.

Provide a fault indicator for each zone. Ensure the detector fault indicator flashes and a trouble relay or separate detector failure relay operates when there is a failure/problem within the detector's circuitry or external wiring. Configure the detector fault indicator setting per the manufacturer's recommendations.

Provide a detector fault time delay. Adjust the time delay from 0 to 60

seconds for each detector failure indicator lamp/relay.

- a. Initial setting not more than [10][_____] seconds.
- b. Ensure the air flow fault and detector fault relay outputs are configured to annunciate a zone trouble and general trouble condition at the [fire alarm][preaction] control panel. Transmit the outputs to the KSC FMS via the facility fire alarm system. Split these functions as two separate trouble indications.

2.5 FRONT PANEL SWITCHES

Provide a reset switch for each zone. Confirm that any alarm/fault condition causes the indicator lamps to flash and remain in this state until reset. Provide a disable switch or a separate maintenance by-pass switch to isolate each detector for testing purposes.

Provide a detector bar graph sensitivity test switch for each zone. Ensure it is capable of testing the sensitivity of the detector from the front of the control panel. Accomplish detector sensitivity testing by pressing a switch on the control panel, and holding it until the bar graph indicates 100 percent of full scale. Where remote sensitivity testing can be accomplished through a data link to a remote computer or alarm panel, incorporate logic to disable the remote test at the display control panel and return the detection system to normal operation after 60 seconds.

Provide a detector fault test switch for each zone. The test switch simulates a detector head fault condition and verifies the integrity of the communication link between the controller and the detector.

Activating the detector fault test switch causes the test relay to energize and the detector status indicator lamp to extinguish.

If the communication link between the controller and the detector is monitored automatically, a separate detector fault switch is not required.

2.6 DISPLAY CONTROL PANEL AND DETECTOR INTERFACE

Provide all contacts, hardware, conduit, wire, and power required for proper operation and interface between the Display Control Panel and the Air Sampling Detector Assembly. Ensure the display control panel has a minimum of four independently programmable ALARM LEVELS.

2.6.1 Alarm Level 1 (Alert)

Configure and program the display control panel so that when ALERT is reached for any detector, the alarm level lamp for that detector illuminates and an audible and a visual alarm sound at the display control panel. Ensure a supervisory alarm activates at the [FACP][PCP] and is transmitted to the KSC FMS via the facility FACP.

2.6.2 Alarm Level 2 (ACTION)

Configure and program the display control panel so that when ACTION is reached for any detector, the alarm level lamp for that detector illuminates and an audible and a visual alarm sound at the display control panel. Ensure a supervisory alarm activates at the [FACP][PCP] and is transmitted to the KSC FMS via the facility FACP.

2.6.3 Alarm Level 3 (Fire 1)

Configure and program the display control panel so that when FIRE 1 is reached for any detector, the alarm level lamp for that detector illuminates and an audible and a visual alarm sound at the display control panel. Ensure a silent alarm activates at the [FACP][PCP] and is transmitted to the KSC FMS via the facility FACP.

2.6.4 Alarm Level 4 (Fire 2)

Configure and program the display control panel so that when FIRE 2 is reached for any detector, the alarm level lamp for that detector illuminates and an audible and a visual alarm sound at the display control panel. Ensure an alarm activates at the [FACP][PCP] and is transmitted to the KSC FMS via the facility FACP.

2.6.5 Trouble Indications

Confirm the air sampling control panel set-up so that in the event of an air flow fault, or a detector fault; the appropriate air flow fault lamp or detector fault lamp illuminates. Ensure that the display control panel activates a trouble alarm at the [FACP][PCP] and transmits it to the KSC FMS via the facility FACP.

2.7 DETECTOR ASSEMBLY

Ensure a single detector is a tested and approved type, for a maximum coverage of 2,000 square meter 20,000 square feet. Ensure the detector is usable in environments with relatively high levels of airborne dust and other contaminants through the use of a filter or other approved method.

2.7.1 Nuisance Alarm Avoidance

Treatment of contaminants is by either an air filtration mechanism or by electronic discrimination of particle size. If a mechanical filtering system is used, provide a disposable filter cartridge to permit visual inspection of the filter without having to dismantle the display control unit. Confirm the filter has a maximum nominal pore size of 20 microns per manufacturer's requirement.

2.7.2 Detector Head

Provide a detector head consisting of: inlet and outlet ports, quick connector type electrical receptacles for controller interfacing, a detection chamber with light source and optical components, and signal processing electronic circuitry; all in a single assembly.

2.7.3 Light Source

Air is drawn into the detector via the aspirating system, then exposed to the light source within the detection chamber. Light scattered by smoke particles within the air stream is converted to an electronic signal directly proportional to the obscuration level within the chamber. A signal corresponding to the obscuration level within the chamber is then transmitted to the display control panel.

2.7.4 Detector Sensitivity

Submit manufacturer data indicating a minimum sensitivity range from 0.0015 to 7.0 percent obscuration per 0.005 to 20.0 percent (obs/m) foot (obs/ft). The manufacturer recommends the detector sensitivity for the area to be protected by zone. The Contracting Officer approves the detector sensitivity level prior to installation of any equipment.

2.8 ASPIRATING FAN

Provide a high-efficiency aspirating fan, with a ball bearing, electric centrifugal-flow impeller pump designed for long life. Ensure the aspirator flow and pressure ratings meet the maximum transport time for an air sample removed from the furthest sample point of each branch within the piping network and does not exceed 60 seconds.

2.9 AIR FLOW SENSORS

Provide a detector equipped with a sensing device(s) which detects any change in the air flow through the detector which could impair the proper operation of the detector. Ensure the sensor(s) is wired to the control panel. The sensor initiates a TROUBLE condition at the [FACP] [PCP] and transmits the condition to the KSC FMS via the facility FACP.

2.10 AIR SAMPLING NETWORK

Provide a VESDA Laser Plus or equal air sampling detection system(s) to contain all of the equipment, devices, software and programming, and piping networks required for system operation in accordance with NFPA Codes and KSC requirements, including communication, interface equipment for reporting and monitoring to the KSC Fire Monitoring Station via the facility fire alarm control panel (FACP). Ensure the air sampling system(s) circuits are NFPA 72 Class A Style D initiating device circuits and NFPA 72 Class A Style 7 signaling line circuits. Ensure initiating and signaling line circuits are 24 V DC. Ensure the system conforms to all the applicable requirements of: NFPA 70, NFPA 72, NFPA 75, NFPA 90A, NFPA 101, and NFPA 318.

The air sampling network is a closed-end system, engineered for a maximum transport time of 60 seconds, and has equal sensitivity throughout the entire system. Balance the air sampling network so that the volume of air drawn from the last sampling point is not less than 60 percent of the volume from the first sampling point. Ensure each sampling point (hole) has a maximum coverage of 23.2 square meter 250 square feet of floor area for above ceiling protection. Ensure each underfloor sampling point has a maximum coverage of 23.2 square meter 250 square feet.

[In areas subject to condensation build up within the sampling pipe, employ a water trap to prevent moisture from entering the detector.

]2.10.1 Labeling

Label all pipe and sampling points identifying as follows: "SMOKE DETECTION SAMPLING PIPE DO NOT DISTURB" and "AIR SAMPLING POINT" respectively.

2.10.2 Piping Materials

Provide sampling pipe consisting of 19 millimeter 3/4 inch inside diameter

material. Tubing and fittings as defined in this section, are limited to thermoplastic materials meeting or exceeding the requirements of PVC or an approved equal. Use Rigid Plastic Conduit CPVC conduit not lighter than Schedule 40. Ensure Rigid CPVC is the slip-joint solvent-weld type and fittings unthreaded solid CPVC. Ensure conduit and fittings are airtight and installation conforms to NEMA TC 3, TC 13, NFPA 70 and UL 651. The conduit color is orange. Accomplish directional changes in the piping network by long radius bends. Obtain Contracting Officer approval for the use of standard elbow joints prior to installation. Use a compression type fitting for final connection to the detector, glue is not permitted.

2.10.3 Design Layout

Design and install the air sampling network to monitor total room/zone concentration of smoke. Accomplish the design using a computer program based on sound fluid dynamic principles and is approved by Factory Mutual Engineering (FM) FM APP GUIDE or listed by Underwriters Laboratories (UL) UL Fire Prot Dir for it's intended use. This type of design requires that air samples be continuously drawn from the areas being protected.

2.10.3.1 Zone Coverage

The maximum allowable coverage for any single detector is not to exceed 10,000 square feet 929 square meter. When the floor area to be protected exceeds 929 square meter 10,000 square feet, use multiple detectors.

2.10.3.2 Sample Port Coverage Area

Each high level above floor sampling port has a maximum coverage of 23.2 square meter 250 square feet. Do not exceed 23.2 square meter 250 square feet underfloor area coverage. Ensure sampling piping is installed above the suspended ceiling and supported from the building structure. Center the sampling point fitting(s) in the ceiling tiles and connect to the main air sampling pipe using 1 to 2 square meter 3 to 6 feet lengths of 5 to 6 millimeter 0.1875 to 0.25 inches ID flexible tubing. Size the sampling port as specified on the approved design drawings and confirmed by the computer generated design calculations.

2.11 PRIMARY POWER SUPPLY

The normal power for the detectors and the display air sampling control panel is 120 V AC, 60 hertz. Operate all system components satisfactorily between 85 and 110 percent of normal voltage. Provide air sampling detection system disconnect/protective device with a fused switch and a red factory finish. Mount this disconnect switch adjacent to the air sampling detection system. In addition, mark it "AIR SAMPLING DETECTION SYSTEM DISCONNECT" with a permanently affixed label that is plastic or phenolic type with a red background and white lettering using a minimum of 6 millimeter 0.25 inch block. Provide an installed switch capable of being locked in the "on" or "off" position. This feature is not to interfere with the circuit protection capability of the device. Equip switch with surge suppression for all phase and neutral conductors. Install current limiting Class RK1 fuses properly sized to protect the air sampling detection system equipment.

2.12 SECONDARY POWER SUPPLY

Provide a battery and charger as a means of automatically supplying the entire smoke detection system with backup power in the event the primary

power system fails. In the event of AC power failure, the system switches to battery backup power and switches back to AC power upon return of primary power. If the backup batteries are removed for any reason, the air sampling control panel continues operation. The system controls charging and floating level to maintain batteries in optimum condition. Provide capability to recharge batteries in event of discharge. Use fused wiring to protect against battery over-current and polarity reversal. Primary power, battery, or charging equipment failure results in a trouble signal and visual indication at the display control panel, transmitted to the [FACP][PCP] and then to the KSC FMS via the facility FACP.

Provide spill proof sealed battery modules, (no corrosive fumes). Use batteries that are listed for fire alarm service and suitable for high discharge currents required under alarm conditions. Size batteries to operate the air sampling smoke detection system in normal supervisory condition for 24 hours, minimum, then operate the system in the alarm mode for 10 minutes, minimum.

Provide a battery disconnect switch with DC rated contacts to allow testing for loss of secondary power supply.

2.12.1 Grounding

Design equipment allowing for low-impedance bond to the protective grounding system. Ensure equipment functions in an environment which supplies only a safety ground per local electrical code requirements. Isolate cabinet and equipment ground from battery return at the equipment and within the frame or cabinet.

2.13 COMMUNICATION NETWORK

Utilize the RS 232 or RS 485 standard for the network using type TFN for No. 18 or No. 16 AWG twisted shielded pair cable for digital communication. Obtain authorized network access by utilizing a minimum of two levels of password protection. Achieve computer access via an RJ 11 six conductor receptacle.

2.14 TESTS, INSPECTIONS, AND VERIFICATIONS

Submit proof that all components are currently [Underwriter Laboratory \(UL\) listed UL Fire Prot Dir or Factory Mutual \(FM\) FM APP GUIDE](#) approved for their intended use and function.

PART 3 EXECUTION

3.1 SYSTEM SEQUENCE OF OPERATION

3.1.1 Normal Operation

Provide a display control panel consisting of an enclosure assembly, installation kit, and required number of display control cards, with 1 to 4 zones as required and shown on drawings. Power each display control panel from a 24 V DC source and monitor for alarm and trouble conditions by the preaction control panel. Provide the following indicator lights for the [display control panel](#):

Bar Graph Display	Alarm Level Lights
Air Flow Fault Light	Detector Fail Light

CPU Fail Light

Normal Operation Indicator

Power Supply Light

Isolate Light

Trouble Light

For normal operation, air from the protected zone is drawn through a piping network to the detector unit by an aspirating fan in the detector assembly. The air is then illuminated by a light source. Smoke particles scatter this light to a sensitive, solid-state photosensor. An analog signal is transmitted to the display control panel which displays smoke obscuration levels on a bar graph display. Each increment on the bar graph represents a percentage of the full scale sensitivity of the detector. Independently programmable alarm points provide additional visual indication on the display control panel and activate associated relays for additional annunciation and alarm.

3.2 INSTALLATION

Install all equipment in accordance with manufacturer's recommendations, and this document.

3.2.1 Display Control Panel

Install equipment in accessible locations in such a manner as to prevent damage from vibration or jarring. Equipment requires a minimum of **914 millimeter 3 feet** clearance directly in front of the display control panel and the detector unit for maintenance per **NFPA 70**. With multiple equipment, the three (3) foot clearance is required directly in front of the complete configuration. In addition, provide a **711 millimeter** minimum **28 inch** clear aisle way for access to the equipment. Provide cabinets with a pin-tumbler cylinder lock (Lock Cylinder No. Best Universal Lock Co. No. A8817-XUS26D-7KSC) with removable core that accepts the standardized key currently in use with all other fire alarm control panels at KSC. Lock core will be provided by the government.

3.2.2 Smoke Detector

Securely mount the smoke detector to the building structure (i.e., column, permanent wall) using approved type anchors. Determine the mounted detector's orientation by the piping layout and application. Maintain total access for servicing with a minimum clearance of **914 millimeter 3 feet** directly in front of the detector. Prior to installation, obtain approval from the Contracting Officer for mounting of the detector to cable trays, movable walls and other equipment or frames.

3.2.3 Air Sampling Network

Supply the smoke detection system with an air sampling network for air/smoke transport to the detector from the protected area. Design the piping network using an FM approved or UL listed air sampling system computer modeling program for design calculations. Ensure the air sampling network consists of a balanced piping system including main branch piping with sampling points (holes) at pre-determined locations with end caps. All piping network supports are from the building structure only. Obtain Contracting Office approval for alternate means of support such as from cable trays, raceways, duct work, etc. prior to installation. Mount all piping which is adjacent to the detector tight against the wall or other

structural elements which the detector is mounted on, and terminate within 457 millimeter 18 inches of the detector inlet ports. Connect the air sample piping to the detector by a union with an 457 millimeter 18 inch PVC nipple of the same ID as the air sampling network piping, to facilitate maintenance. Optional open or closed end system, per manufacturer's approved computer modeling design program can be used. Do not exceed 91.5 millimeter 300 feet for main piping runs. Seal all fire rated penetrations of floors, ceilings and walls, per local building code requirements and use no silicone containing materials. Clean air sample tubing inside and out. Join using manufacturer's approved methods and materials for air-tight connections except at the detector enclosure connections for servicing. Locate sampling ports so that they are clear of all supply air registers and/or air flows.

3.2.3.1 Non-Metallic Tubing

For safe handling of solvent cements, primers and cleaners used for joining thermoplastic pipe and fittings refer to ASTM F402. Support all piping at approximately 1.5 meter 5 feet maximum intervals on center with bracing for end of pipe run not to exceed 31 meter 1 foot. Provide fasteners, pipe hangers and supports of appropriate dimensional size for supporting tubing without distortion. Refer to construction documents for additional and/or special attachment details. Ensure installation of conduit and fittings is airtight and conforms to: NEMA TC 3, NEMA TC 13, NFPA 70, UL 651 and ASTM F442/F442M.

3.2.4 Spare Parts

Provide spare parts directly interchangeable with the corresponding components of the installed system. Ensure spare parts are suitably packaged and identified by nameplate, stamping, or tagging. Furnish the following:

- a. Two (2) filter assemblies
- b. [_____]

3.2.5 Wiring

Provide wiring conforming to the requirements of NFPA 70 and NFPA 72 and the following special requirements:

- a. Install air sampling system circuits in a separate raceway or conduit system. Within the air sampling system, install air sampling initiating and signaling line circuits, and 60-hertz power circuits in separate raceway or conduit systems. Ensure 60-hertz power circuits do not enter enclosures containing 24 V DC air sampling system circuits, except where required to connect to the air sampling system.
- b. Provide continuous conductors from a terminal point at the detector to a terminal point at the display control panel. Break wires at each terminal; do not loop wires over a terminal. Install solderless ring tongue terminal lugs with manufacturer's required tooling on the device wiring connection leads. Use this ring type lug on stranded wire only. Make termination of solid wire conductors on compression or screw type terminals. When screw type terminals are used, capture the conductor under 80 percent of the screw head surface.
- c. Use solid copper conductors with an insulation rating of not less than

300 volts. Mark conductors with the AWG size, voltage rating and manufacturer's name permanently marked on the conductor jacket at no less than 0.70 meter 2 feet intervals. Conductor size and color is described below. Where modifications are made to existing systems, match the new or added conductors the size and color coding of the existing system.

- d. Use shielded, twisted pair, solid copper conductors for network communication circuits. Ensure conductor size is as indicated but not less than No. 16 AWG diameter for signaling circuits. Mark cables with circuit designation. Maintain consistent color coding for the positive and negative loops throughout the cable system. List cable as type FPL, Power-Limited Fire Protective Signaling Cable.
- e. Use a two loop direct current initiating detector circuit per NFPA 72, Style D with the positive loop conductor colored blue and the negative loop conductor colored black. Ensure conductors size is as indicated, but not less than No. 16 AWG diameter. Use conductor insulation Type TFN for No. 16 AWG diameter, and Type THHN/THWN for 1.6 millimeter No. 14 AWG diameter and larger.

3.2.6 60-Hertz Power

Provide 120 volt, 60-hertz power to the display control panel. Provide one black phase conductor, one white solidly grounded neutral conductor and one green equipment grounding conductor. Provide conductor size as shown on the drawing with the minimum size No. 12 AWG copper. Install surge arresters in accordance with NFPA 70, UL 497B and UL 1449.

3.2.7 Installation In Cabinets and Boxes

Install wiring in control cabinets and boxes in a neat and orderly manner with wire properly grouped, tie-wrapped, or laced parallel and perpendicular to the major axis, supported and identified. Provide continuous control wiring from device to device with no splices [unless otherwise indicated]. Permanently mark and terminate all wires entering or leaving control cabinets, boxes, and devices on screw terminals. Provide consistent marking throughout the air sampling smoke detection system and have the same identification shown on the connection drawings.

3.2.8 Conduit and Raceways

Provide fire alarm system initiating, alarm and control circuit conduit and raceways with a minimum size of 3/4-inch. Install in accordance with NFPA 70.

Install rigid galvanized heavy wall steel conduit in: all locations classified as hazardous, exterior above grade, and interior exposed; from floor to 1.5 meter 5 feet above finished floor unless shown on the drawings. EMT with hexnut expansion gland-type fittings can be installed in all other areas. Use flexible metal conduit, maximum length 2 meters 6 feet, as the final connecting raceway to an air sampling system mounted on vibrating equipment or on a suspended ceiling.

Conceal conduit in interior finished areas. Provide a fire stop for conduit penetrating fire-rated construction i.e., walls, floors, ceilings, roofs, etc. with a UL listed or FM approved material commensurate with the fire resistance rating of the structure penetrated.

Install conduit in a vertical position parallel with walls and perpendicular to the floor and ceiling. Install conduit in a horizontal position parallel with the floor and ceiling and perpendicular to walls. Install changes in direction of runs with symmetrical bends. Provide factory made elbows for bends of over one inch in diameter.

3.2.9 Labeling

Provide red background with white lettering smoke detector labels that are plastic or phenolic type with a minimum of 6 millimeter 0.25 inch block lettering to indicate detector and zone. For example: "AIR SAMPLING SMOKE DETECTOR No. 1-1 ZONE No. 5."

Provide at the display control panel red background and white lettering labels that are plastic or phenolic type with a minimum of 6 millimeter 0.25 inch block lettering to indicate the controller, the detector controllers served, and location. For example: "AIR SAMPLING SMOKE DETECTOR CONTROLLER No. 1 - SERVES DETECTOR No. 1-1 ROOM [____], DETECTOR No. 1-2 ROOM [____], DETECTOR No. 1-3 ROOM [____], DETECTOR No. 1-4 ROOM [____]."

Clearly label pipe network every 1.5 meter 5 feet in open room areas, and within ceiling cavity; and every 0.61 meter 2 feet, centered in the floor panels, within the raised floor cavity, to distinguish the pipe from other facility pipe work or protective cabling enclosures. For example: "SMOKE DETECTION SAMPLING TUBE DO NOT DISTURB."

Label all air sampling points with a round red label, each with a center hole to match the diameter of the drilled sampling point. For example: "AIR SAMPLING POINT DIA [____] millimeter [____] inches." Indicate fractional dimensions in decimal format with a minimum of [3] [____] decimal places.

Paint electrical junction boxes and covers "red." Label with a plastic or phenolic label with a red background and white lettering. Size block lettering as needed. For example: "AIR SAMPLING SMOKE DETECTOR SYSTEM."

3.3 FIELD TESTING

After complete installation of the equipment and at such time as directed by the Contracting Officer, conduct tests to demonstrate that the installation requirements of this specification have been met and that the sequential functions of the system comply with the requirements specified herein. Conduct tests covered in the following paragraphs in two parts:

- a. Preliminary - Conduct an "in house" test verifying all the system(s) and components function in accordance with the approved contract drawings and specifications. Perform this functional test in the presence of government inspectors and repeat until performing one full test without device or system malfunction.
- b. Final Acceptance - After the successful completion of the preliminary testing, fully test the system(s) formally with full documentation (including As-Built Drawings) using the previously approved recording form. Final acceptance of the system is based upon the written approval of the test witnessed by the Contracting Officer. On both preliminary and final tests, follow the approved testing procedures.

3.3.1 External System Wiring

Perform the following tests on the external system wiring before connection to the control panel. Check continuity of circuits with an ohmmeter. Insert temporary jumpers in appropriate sockets of missing detectors and install the end-of-line resistor when this test is performed. Meet the value of the end-of-line resistor, plus or minus 10 percent for the resistance reading of each circuit. Check each wire for grounds with a 500-volt insulation resistance test set. For resistance to ground obtain a value not less than 20 megohms. All tests are witnessed by the Contracting Officer or designee.

3.3.2 System Acceptance Testing

Subject each zone of every system to a full operational test in the presence of the Contracting Officer to demonstrate proper operation before any system is considered acceptable. Acceptance criteria for air sampling piping network(s) and detector(s) include the measurements and tests for each detector and its air sampling piping network. The approved operational test procedure submitted by the subcontractor for the air sampling system and display control panel includes the following tests:

3.3.2.1 Suction Pressure Test

Measure, record, and compare pressure at all sampling ports, except the end cap port to APPROVED Design Calculations. Verify the suction pressure is within the manufacturer's specified range. Measure the pressure in inches of water or pascals.

3.3.2.2 Smoke Transport Time Test

Measure and record the time required for smoke to travel from the most remote sampling port in each air sampling piping network to the detector, and compared to APPROVED Design Calculations. Determine this TIME on each branch line individually by introducing a "gross" smoke source into the sampling port which is hydraulically most remote from the detector. The TIME from the beginning of smoke introduction until the bar-graph on the display control panel reflects the presence of smoke in the detector is the Transport Time. The MAXIMUM ALLOWABLE Transport Time is [60] [120] seconds.

3.3.2.3 Deviations

If the measured and recorded results significantly differ from the measurement predicted by the APPROVED Design Calculations, determine and correct the cause of deviation. If the cause is a difference between the system as built and the system as designed, resubmit revised shop drawings and calculations for approval to the Contracting Officer. If the revised drawings and calculations agree with measured results, the system is considered acceptable provided that all other provisions of this specification have been met.

3.3.2.4 Sensitivity Verification Test

This test is a month long (30 day minimum) test for all detection system installations. Each air sampling piping network by zone is subjected to this test before the system is considered acceptable. The purpose of this test is to ensure that the earliest possible alarm for smoke is rendered with the fewest number of false alarms. This is considered mandatory due to the fact that the ambient levels of dust or other air borne particulate

which the detector senses as smoke varies from building to building or room to room within a given building or area.

- a. Implement proper test procedures and data analysis to eliminate all false alarms from transient dust or smoke which can become airborne due to installation activity, cleaning and/or normal operations.
- b. During the period while the sensitivity verification test is being conducted, ensure normal operations continue unaltered within the area being protected. Verify that the preaction control panel (PCP) monitors the air sampling detection system and the facility panel monitors the PCP. The PCP is to only transmit supervisory and trouble conditions to the KSC FMS. During this trial period, a successful test has the air sampling detection system not activate any automatic suppression systems or cause a facility evacuation.
- c. After the air sampling detection system has been installed and all acceptance tests successfully conducted, maintain the event log and the smoke level history log for a period of not less than 30 calendar days.
- d. Conduct data review and analysis after 7 calendar days of operation to identify any gross trends, and again at the end of 30 calendar days of operation. Additional interim analysis can be required depending on the results of the first week review.
- e. During data review and analysis consider the normal base line, or ambient, pollutant level recorded, and all deviations from the established base line as recorded by the data logger from the display control panel.
 - (1) Compare the level of the ambient base line with the alarm threshold levels selected. Twenty percent is the minimum acceptable range between the ambient base line and the first alarm threshold of the detector's full scale sensitivity calibration setting.
 - (2) Investigate each peak recorded to determine its cause. Analyze and consider whether the peak recurrence is at regular intervals, or whether it is a single event. Recurring peaks are usually related to activities within the protected area. Non-recurring peaks are generally the results of other types of activities, including fires. Consideration of normal activity within the fire zone, the time of day, and day of the week can be of assistance in determining the cause of a peak.
 - (3) Compare the magnitude and duration of the recorded peaks to the alarm threshold levels selected and initial time delay settings to determine the possible occurrence of a false alarm.
 - (4) Based on the data review, make adjustments to alarm levels and time delay settings, as required to eliminate false alarms.
 - (5) Peaks or alarms that are attributed to smoking in the protected area ARE NOT considered to be false alarms. Specifically configure the air sampling detection systems to alarm when smoking takes place within the protected area.
 - (6) Change detector sensitivity if data indicates that the adjustments to the alarm threshold levels and the time delay settings do not

eliminate false alarms. If the false alarms can not be eliminated, provide alternative solutions to the Contracting Officer for approval and implementation.

Fully document any change to the initial settings as prescribed by this specification with supportive analysis and review data and submitted by the manufacturers to the Contracting Officer for approval.

NOTE: Delete this paragraph unless a unique application requires the "Smoldering Smoke Test" to validate the operability for the installed air sampling detection system. Normal air sampling detection system installation do not require the "Smoldering Smoke Test."

[3.3.2.5 Smoldering Smoke Test

Include in the test procedure a method similar to the British Wire overheat test using a set length of wire and a variac transformer to apply 120 V AC for a duration of 3 minutes, or use a predetermined length of wire coiled and laid on tin foil on a hot plate set at 371 - 482 degrees C 700 - 900 degrees F for 1 to 3 minutes to ensure that the installed system(s) performance complies with the approved contract drawings and specifications. Perform test in the vicinity of possible fires. For example: at equipment heights 1 to 1.5 meter 3 to 5 feet above the finished floor and under the raised floor. Repeat the test in different locations within each protected zone under normal and abnormal operating conditions of the HVAC system. This ensures that the smoke source in both a high and still air flow environment have been addressed.

]3.4 ACCEPTANCE TEST DOCUMENTATION

The installer records the results of the acceptance testing. Submit to the Contracting Officer [10] [_____] copies of the [completed test procedures and recording forms](#).

3.5 MAINTENANCE

Submit at least [3] [_____] copies of the [Operation and Maintenance Manuals](#) for the complete Air Sampling Detection System.

Submit information bound in manual format and grouped by technical sections consisting of manufacturer's standard brochures, schematics, procedures, recommended spare parts, recommended test equipment, and safety precautions. Submit this information prior to any acceptance tests being performed.

-- End of Section --