

SECTION 13870

REFRIGERANT GAS DETECTION SYSTEM

PART 1 GENERAL

1.1 SUMMARY

A. Scope

1. Gas Detection System indicated on Drawings shows basic requirements; however, it is required by this Section or other Sections referencing "Refrigerant Gas Detection System".
2. Types of items specified in this Section include the following:
3. Turnkey Refrigerant Gas Detection System Design and Installation.
4. Control Panel, Field Sensors and Devices.
5. Fire Marshal Approval.
6. Start Up, Calibration, and Warranty Period Service.
7. Provide labor, materials, and equipment as specified and as indicated on DRAWINGS, including accessories as required by manufacturer for fully operational installation.
8. All installation work provided shall be per the recommendations of the equipment manufacturers and as required by the manufacturer's installation instructions and shop drawings.
9. Refer to SECTION 13855 and 13856 for additional control systems equipment requirements.
10. Note, the owner shall provide SUBA equipment for this system.

1.2 RELATED WORK SPECIFIED UNDER OTHER SECTIONS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division -1 Specification Sections, apply to this Section.
- B. Related Specification Sections: The following Sections contain requirements that relate to this Section:
 1. Division 13 "Instrumentation and Control" Sections.
 2. Division 15 Section "Basic Mechanical Requirements".
 3. Division 15 Section "Centrifugal Water Chillers".
 4. Division 16 Sections.

1.3 QUALITY ASSURANCE

A. Codes, Standards, Permits:

1. Applicable Codes. Refrigerant Gas Detection System shall be designated Fire Protection System as defined by Building Code of New York State (BCNYS), Chapter 9 - Section 908; Emergency Alarm Systems. System shall also be in accordance with New York Fire Code, Chapter 9 - Section 908; Emergency Alarm Systems. System shall also meet or exceed the latest applicable Building Code of New York State, New York Mechanical Code, New York Fire Code, NFPA, NGDA, ASHRAE 15 Standard 2003, and EPA

standard CFR and as designed herein. System shall incorporate latest revisions to bring up to current State of Indiana standards

2. Permits. Provide all building fire inspection and electrical installation permits from local municipal Fire Inspector and Electrical Inspector. Permits shall be in accordance with New York Fire Code Section 105.

B. System Supplier Qualifications:

1. Supplier. Supplier shall be a firm regularly engaged in supplying turnkey, Building Code of New York State compliant, Hazardous Material Emergency Alarm Systems; including Refrigerant Gas Detection Systems. Provide proof of last three (3) Fire Marshal Approved Refrigerant Gas Monitoring Systems.
2. Performance Specification and Liability. Complete code compliant system design details are not shown in bid package drawings. Specification provided is a performance specification. Supplier shall have full turnkey liability and responsibility for proper building code compliant design, approval and installation of refrigerant gas detection and emergency alarm system.

C. Provide per SECTION 13855.

1.4 SUBMITTALS; FIRE MARSHAL AND ENGINEER OF RECORD

A. General:

1. Provide submittal information to Fire Marshal and Engineering Firm of record according to following defined schedule:

Order	Submit To:	Content:	Purpose:
1st	Engineering Firm of Record	<ol style="list-style-type: none"> 1. Product Data Information 2. General System Layout 	For approval of specified components and for approval of system design concept
2nd	Authority Having Jurisdiction (AHJ) – in most cases this will be local municipal Fire Marshal	<ol style="list-style-type: none"> 1. Approved product and general system layout submittal 2. Entire balance of AHJ submittal package as defined by BCNYS 	Fire Marshal System Approval
3rd	Engineering Firm of Record	<ol style="list-style-type: none"> 1. Three (3) entire copies of AHJ approved submittal 	This must be done prior to final installation of the system

2. Submit each item in this Article according to requirements of local State Building Code and Conditions of Contract and Division 1 Specification Sections.

B. Information Required for Engineering Firm of Record Submittal / Approval Package.

1. Product Data Information: Submit manufacturer's product technical data information for all system components; highlighted specific data is required.

2. General System Layout: Submit general system layout on AutoCAD Drawings including all device locations, device identification numbers along with sequence of operation, system interlock details for interface to fire alarm system and building automation system.
- C. Information Required for AHJ / Fire Marshal Submittal / Approval Package.
1. Construction Documents: Submit construction documents including information specified in accordance with Building Code of New York State 2003 Section 106, Section 414, Chapter 9, and New York Fire Code 2003 Section 105.4, Section 606, Chapter 9, Section 907, 908; including, but not limited to:
 - a. BCNYS 2003 106.1.1 Information on Construction Documents.
 - b. BCNYS 2003 106.1.1.1 Fire Protection System Shop Drawings.
 - c. BCNYS 2003 106.3.4 Design Professional in Responsible Charge.
 - d. Detailed emergency power battery back up calculations for standby and alarm conditions.
 2. Wiring Diagrams: Submit system wiring diagrams differentiating between factory and field installed wiring. Include diagrams for equipment and for system with all terminals and interconnections identified. Indicate components for both field and factory wiring. Include control panel wiring details.
 3. Piping Diagrams: Submit system piping diagrams differentiating between factory and field installed piping. Include diagrams for equipment and for system with all interconnections identified. Indicate components for both field and factory piping. Piping riser details shall be supplied.
 4. Code Compliance Documentation: Submit code compliance documentation itemizing all building code references for design justification. Include Code Compliant Hazard Evaluation forms filled in for each zone monitored.
- D. Provide per SECTION 13855.

PART 2 PRODUCTS

2.1 SAFETY SYSTEM SUPPLIER

- A. Provide TURNKEY refrigerant monitoring system; including: Fire Marshal approval package with Professional Engineer sealed drawings, fabrication, permits, installation, supervision, Fire Marshal acceptance testing, commissioning, warranty period service and owner training for system specified from one of the following:
1. Refrigerant Monitoring System Supplier Requirements. Suppliers shall include documentation demonstrating previous supplied "Approved by Fire Marshal" Building Code of New York State "Code Compliant" refrigerant monitoring systems. Documentation to include sample "Approved" copies of Airflow Profile Reports and "Approved" Hazard Evaluation Forms with related Approved Drawings. Certification shall be in compliance with NFPA 72 standard for design, field technician and installation.
- B. Subject to compliance with requirements, provide refrigerant gas detection analyzer components from one of following:
1. Dräger Safety

2. Mine Safety Appliance
 3. Honeywell Analytics
- C. Deviations from Specification
1. Deviation from specified products or qualifications must be clearly spelled out and itemized by specification, section and number, clearly described in detail as to specific deviation, reason for deviation, benefit derived to Owner from deviation, and must be approved prior to receipt of contractors bid proposal.

2.2 GENERAL

- A. Refrigerant Monitoring System. Refrigerant monitoring system design and provision related to machinery rooms, industrial occupancies and refrigerated rooms for manufacturing, research and development, food and beverage preparation, other processes and storage shall be in accordance with applicable code sections referring to mechanical refrigeration, refrigeration, emergency and standby power systems, emergency alarm systems, hazardous materials – general provisions governed by Building Code of New York State (BCNYS), New York Fire Code (NYFC) and New York Mechanical Code (NYMC) and others as defined elsewhere in this specification.
- B. System shall provide a series of detection points located in areas where refrigerant from a leak is likely to accumulate and / or be sensed. Include infrared sensor(s), analyzer, sequencer and interface control panels(s), filters, sensors, alarm signaling devices, piping and all components necessary for a complete operational system.
- C. System shall provide various stages of alarming and control chiller room mechanical ventilation in accordance with sequence of operation at values not to exceed Threshold Limit Values (TLV's) specified by New York Mechanical Code. System shall be capable of detecting, indicating, alarming, shutting down equipment, interfacing to building automation, fire and security systems, as specified below, on contract documents, and per applicable codes, standards, and regulations.
- D. Under circumstances directed by regulations for mechanical equipment room design, refrigerants requiring LEL monitoring below 4% by volume, shall employ appropriate sensing technology and conform to Class 1, Division 2, National Electrical Code requirements. When refrigerant groups A2, A3, B2 other than NH₃, and B3 are used, follow appropriate guidelines indicated in regulations concerning area classification and equipment requirements.
- E. Monitoring shall be employed to provide minimum two (2) points of area sampling per chiller unless airflow profile test justifies alternative sensor quantity and location. Airflow profile testing shall be accomplished in accordance with NFPA / NGDA approved smoke testing methods. Monitoring shall be provided for pit or grated floor basement areas located in chiller mechanical room. System design considerations shall incorporate leak detection monitoring sensing locations for early warning indication to prevent a major loss of refrigerant and to minimize owners risk to EPA mandated accidental refrigerant release fines and penalties. Where multiple refrigerant types are used, it is system supplier's responsibility to properly select quantity and type of refrigerant detectors required to safely monitor equipment room.

Provide components and system safety and interface logic as outlined following without exception. Provide expansion capability to handle additional 20% sample point capacity.

- F. Refrigerants shall be classified in accordance with ASHRAE 34 and New York Mechanical Code. For refrigerant blends assigned dual classifications, as formulated and for the worst case of fractionation, the classification for the worst case of fractionation shall be used.
- G. System classification. Refrigeration systems shall be classified according to degree of probability that refrigerant leaked from failed connection, seal or component could enter an occupied area. Distinction is based on basic design or location of components.
 - 1. Low-probability systems. Double-indirect open-spray systems, indirect closed systems and indirect-vented closed systems shall be classified as low-probability systems, provided all refrigerant-containing piping and fittings are isolated when quantities in code are exceeded.
 - 2. High-probability systems. Direct systems and indirect open-spray systems shall be classified as high-probability systems.
- H. Refrigerant detector. Provide refrigerant detector with an audible and visual alarm inside refrigerating machinery room and outside each entrance to refrigerating machinery room or zone. Detector, or sampling tube that draws air to detector, shall be located in area where refrigerant from leak will concentrate. Alarm shall be actuated at a value not greater than corresponding TLV-TWA values shown in New York Mechanical Code for refrigerant classification. Alarms shall be manual reset. Detectors and alarms shall be placed in approved locations. Description of each alarm shall be clearly marked by signage near annunciators. Visual display of refrigerant concentration shall be located outside of area being monitored. Detectors are not required for ammonia systems when machinery room complies with New York Mechanical Code.
- I. Protection from refrigerant decomposition. Where any device having an open flame or surface temperature greater than 800 degrees F, is used in a room containing more than 6.6 pounds of refrigerant in an independent circuit, a refrigerant detector shall be used to automatically shut off the combustion process in the event of a refrigerant leak.
- J. Ventilation Interface. Upon actuation of refrigerant detector at danger level conditions, mechanical ventilation system shall be energized and exhaust air from machinery room per Building Code of New York State.
- K. Machinery room special requirements. Group A2, B2, A3 and B3 refrigerants shall also comply with following.
 - 1. Ammonia room ventilation. Ventilation systems in ammonia machinery rooms shall operate continuously except when machinery rooms are equipped with vapor detector that will automatically start ventilation system and actuate alarm at detection level not to exceed 1,000 ppm or other as specified by code.
 - 2. Where quantity of any Group A2, B2, A3 or B3 refrigerant in a single independent circuit would exceed 25 percent of lower flammability limit (LFL) upon release to space, all

electrical equipment and appliances shall conform to Class 1, Division 2, hazardous location classification requirements of NFPA 70.

3. Remote controls. Remote control of mechanical equipment and appliances located in machinery room shall be provided at an approved location immediately outside machinery room and adjacent to its principal entrance.
- L. Ventilation system. A clearly identified switch of break-glass type shall provide on-only control of machinery room ventilation fans.
- M. Emergency control box. Emergency control boxes shall be provided for refrigeration systems required to be equipped with a treatment system, flaring system or ammonia diffusion system. See code for location, construction, operational and identification procedures.
- N. Alarm and detection systems required shall be supervised by a central, proprietary or remote station service or shall initiate an audible and visual signal at a constantly attended on-site location as defined by AHJ. This contractor shall provide and install electrical wire and conduit to fire alarm control panel for interlocks required by AHJ. Approved fire alarm contractor to supply necessary fire alarm panel hardware for interlocks, fire system programming, landing of interlock wires, commissioning assistance, etc. as required making a complete operating system.

2.3 CONTROL PANEL AND CONTROL PANEL EQUIPMENT

- A. Main Refrigerant Gas Detection Control Panel: Panel location as shown on contract documents. Provide wall mount, NEMA 12 enclosure painted safety blue. Panel shall include refrigerant gas detection controller having ability to provide TCP/IP communication to transmit data to owner.
- B. System shall be configured to provide additional dry contact alarm contacts and output signals for control or for interface as follows, noted on drawings and specified in the code:
 1. Interface to 24 hour supervised area through Fire Alarm Control Panel (FACP). Include contacts for interface as supervisory alarms, trouble alarms and fire alarms.
 2. Building management system Maintenance dry alarm status contacts, Warning level alarm (first level) contact, Danger level alarm (TLV - TWA level) alarm (second level) contact.
 3. Direct interlock to Purge Air Supply and Exhaust Fan starter control circuit. Purge Mode.
 4. Direct interlock to Purge Mode damper controls.
 5. Direct interlock to shut down combustion equipment located in chiller room.
- C. Alarms shall be provided as follows: At warning level (25 ppm or 30% of TLV-TWA level, whichever is greater), system shall actuate warning amber beacon and audible horn. At TLV-TWA level, system shall activate purge ventilation system, energize red beacon, sound refrigerant leak audible alarm and shut down area combustion equipment. If system malfunction occurs, blue beacon and audible alarm shall energize at control panel. Provide dry alarm contacts for each alarm level for interface to BMS and FACP. All control system interlocks and logic shall be provided in control panel. Where indicated; third level contacts shall be used to initiate area ventilation prior to TLV level to prevent shutdown of combustion equipment. Analyzer display shall indicate which channel is in alarm.

- D. Fire Alarm Control Panel interface shall be as defined or other based on AHJ direction. Warning level alarm dry contact for Fire Alarm Supervisory input, danger level alarm dry contact for Fire Alarm Supervisory input, and malfunction (trouble) alarm dry contact for Trouble input. This contractor shall install conduit and wire to FACP; fire alarm system hardware, programming, and electrical termination shall be by fire alarm contractor.
- E. Purge Ventilation. Upon system reset, alarm beacons shall be deactivated only if area monitored has returned to safe condition. Purge ventilation system shall remain activated for 30 minutes after alarm condition has cleared. Panel indication shall denote purge ventilation system is still activated. Provide functionality for "Auto - Manual On" purge fan control
- F. Alarm Reset. Provide alarm reset function at control panel to acknowledge and silence or reset self-latching alarm circuit. Alarm beacons and horns shall remain on until system is reset from panel face or from remote reset pushbutton. Alarms shall stay latched to prevent them from automatically resetting when alarm condition goes away.
- G. Alarm Test. Provide alarm test function at control panel to test alarm annunciation functionality. During test, output signals to FMS, FACP, and combustion shutdown shall be disabled.
- H. Trouble Relay. Provide malfunction relay outputs as required for system interface to FACP and FMS. Relay(s) shall be energized in normal operation, de-energized due to malfunction at any channel nor for other situations indicating Trouble; i.e. loss of power, loss of sample draw flow, sensor malfunction, etc.
- I. Panel Face Indication. Provide indication at control panel for power on, zone alarm status, alarm status for relief vent alarms (where applicable) and purge fan status.
- J. Power Supply. Provide terminals for dedicated 115 VAC, 60 Hz. input power supply. Power all alarm warning devices and system components from this panel circuit. All remote field devices associated with this system shall be 120 VAC or as indicated.
- K. Battery Back Up System. Provide battery back up system to meet Building Code of New York State requirements for emergency alarm systems back up power supply system; include sizing for load with duration of back up per code. Provide load calculation information in submittal data and for permanent site records. Interface power loss status contacts to fire alarm system per building code requirements.

2.4 FIELD DEVICES AND MISCELLANEOUS.

- A. Diffusion Refrigerant PPM Sensors. Provide NEMA 4X water and corrosion resistant plastic enclosure, photoacoustic infrared sensor technology in wall mount enclosure. Sensor to be mounted on strut type steel channel at each chiller as noted above and in drawings. Sensor shall provide 50% step change response in <70 seconds and T90 response >2.5 minutes and <4 minutes. Sensor shall be compound specific and calibrated for refrigerant as required per chiller manufacturer's requirement. Sensor full range shall be 0-1000 PPM with 4-20 mADC non-isolated, sourcing output and RS-485 Modbus RTU as standard. Sensor power shall be

24V DC/AC standard with 110/220 VAC optional. Accuracy shall be 20-100 ppm +/-5ppm and 100-1000 ppm +/-6%. Repeatability shall be +/-5 ppm full scale. Sensor low level detection shall be 20 ppm. Operating temperature range of 32 to 104 degrees F. Optional strip heater shall be available to extend temperature range. Humidity range shall be 0-95% RH non-condensing. Device shall be capable of sensing for R11, R12, R22, R123, or R134a. Analyzer shall have capability to be switched to monitor, at a future date, another refrigerant type by changing one part and recalibration. Sensor shall have UL31010-1 and Canadian CAN/CSA-C22.2 Fire and Shock approvals. Sensor warranty shall be 24 months from date of installation or 30 months from date of shipment to jobsite. Electrochemical doped metal oxide sensing technology employing short-term life sensors, which deplete as a normal part of their operation or storage shelf life, shall not be acceptable. Sensor shall be mounted at 12" above finished floor. Provide SafeAir, Dräger Safety, O.I. Analytical or MSA.

- B. Air Flow Switch; AFS. Provide general-purpose airflow switch to verify purge ventilation fan operation, differential type, as required for monitoring of area continuous and intermittent exhaust fans. Provide fan status indication at control panel.
- C. Alarm Horns and Beacons. Provide stackable beacon assembly equal to Federal Signal / Edwards Triliptical / Allen Bradley; incandescent style, inside and outside of each area being monitored and at each entrance into monitored area. Provide Edwards horn assembly or equal rated per Building Code of New York State for db levels present; volume level shall be adjustable. Beacon and horns shall be general purpose, NEMA 4 for outdoors, Class 1, Div. 1 rated explosion proof as required; red, amber and blue. Outdoor strobes shall be visible in daylight conditions. All remote visual and audible devices shall be 120 VAC and powered from main control panel and emergency back up power source. Beacons and horns in occupied general-purpose areas exposed to general public shall be decorative, flush wall mount type, with High Intensity LED and decorative finish. Beacons shall be viewable throughout area being monitored.
- D. Warning Signs and Tagging. Provide "Lamacoid" sign, red background with 1" high white letters at each remote visual and audible device. Anchor sign to wall adjacent to wall mounted devices, suspend with brass security chain adjacent to ceiling mounted devices.
- E. Signs located inside and outside mechanical room shall be inscribed as follows:
 - 1. RED – DANGER LEVEL / R - _____
 - 2. AMBER – WARNING LEVEL / R - _____
 - 3. BLUE – MALFUNCTION
- F. Signs located at each entrance to mechanical room shall be inscribed as follows:
 - 1. UPON REFRIGERANT ALARM / UNSAFE TO ENTER ROOM WITHOUT PROPER BREATHING APPARATUS.
- G. Remote Reset. Provide minimum (1) remote reset pushbutton assembly at or near main entrance to mechanical room and additional where indicated on drawings to allow reset / silence from safe location. Remote pushbutton station shall be compatible with room decor. Signs at remote reset assembly shall denote "safe and unsafe" response action relating to local beacons

and entrance to monitored area upon depressing remote reset pushbutton. Upon reset, if area monitored has been purged to safe level, beacons shall be deactivated and safe entry shall be permitted.

- H. Owner shall provide SCBA equipment for this system.
- I. Provide "Lamicoid" tag above carrying case, yellow background with 3" high black letters inscribed: SELF CONTAINED BREATHING APPARATUS.

2.5 CALIBRATION GAS AND HARDWARE

- A. Provide all necessary calibration gas and hardware for two years operation in a portable case. Turn over to owner after successful system start up.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Electrical Installation. Contractor shall provide for necessary installation permits. Install control panels and electrical field devices in accordance with applicable codes and manufacturer's printed instructions. Install conduit and wire for all interlocks to each remote system. Make final electrical terminations. Installer must be familiar with division 16 installation practices and applicable code requirements for installation of emergency alarm systems.
- B. Install equipment in accordance with applicable codes and manufacturer's printed instructions.
- C. Route conduits and tubing as required making neat and operating system.

3.2 TESTING AND ACCEPTANCE

- A. General:
 - 1. Prior to project completion and when directed by Owner's Representative, manufacturers factory trained representative shall program, start up, thoroughly test and calibrate, set alarm threshold levels, and verify system operation to be in compliance with approved sequence of operation and code requirements. Should corrections be required, and after corrections have been completed, system shall be re-tested.
 - 2. Fire Marshal Acceptance Testing. Prior to receipt of certificate of occupancy from local Fire Marshal, Fire Marshal acceptance testing shall be performed. Contractor shall provide operational performance testing for Fire Marshal and owner representative. Contractor shall provide all necessary test gas, a minimum of two alarm system personnel, a pair of two-way radios and all necessary equipment to provide complete testing of each alarm system device and system interlock. Acceptance testing shall also include Gas Leak Simulation Test that emulates actual properties of hazards present to prove gas leak will come into contact with proposed sensor locations under actual ventilation conditions. Local AHJ, Fire Marshall and owner representative to witness test and sign off.

3. Provide training of Owner personnel on both system operation and routine maintenance procedures. Training shall be provided for all devices in the system outlined above. Provide three (3) complete operations and maintenance manuals in 3-ring binders, including parts list and as-built drawings. Documentation to be maintained on site for AHJ review per code requirements.
4. Permanent Site Records. After system acceptance, provide building safety manager with "Permanent Site Records Manual" for this system to be maintained on site for Fire Department/ Fire Marshall accessibility. Include Fire Marshal approved system design information as detailed above including; "As Built" system drawings, calibration reports, annual inspection reports, service records, emergency power system load calculation data, ventilation airflow profile testing data, code compliant system design data and justification information, code references, sequence of operation, etc. and any additional information as required by AHJ.

B. Code Compliance Certification:

1. Contractor shall provide Owner and Municipality with a certified document stating that alarm systems are installed in compliance with all MBC/IFC and NFPA codes and standards and that all required acceptance tests have been completed. Mount approved inspection certificate at main control panel location.

C. As Built Drawings:

1. Deviations from original shop and installation submittal drawings shall be corrected and submitted in operations and maintenance manuals as "As Built" drawings.
2. As-built alarm shop drawings shall be submitted for final review of AHJ / Fire Marshall. All field changes shall be shown on as-built drawings.

3.3 INSPECTION AND SERVICING

A. On Site Service:

1. Each three (3) months (quarterly) after final acceptance, until warranty expires, systematically inspect, examine, clean, calibrate and adjust detector, panels, relays, self-contained breathing apparatus, and accessories pertaining to system. Provide updated reports for owner permanent site records.
2. Annual System Inspection and Certification. During the warranty period, provide required annual certification inspection and operation testing. Mount updated approved certificate at main control panel location. Include, but not limited to, emergency power supply testing, ventilation interlock operation, interlocks to 24 hour supervised station, alarm signaling device operation, etc. and all interface operation as required per governing code. Provide updated certification reports to owner and municipal AHJ.
3. Near end of warranty period of operation, provide similar service as described above complete with written report. Should a control or device be suspect in its operation or function, this deficiency shall be reported to operating personnel, documented in report and replaced.

4. System shall be provided with a two (2) year warranty and all applicable recommended spare and consumable parts for two (2) years of operation.

END OF SECTION

Revision History	
Date	Rev. No.
C	0
E	0
F	0
02-19-09	0

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