



WMU Design Guidelines Instructions: These guidelines are to be used by the Design Professional to inform the design process and outline WMU-specific desires for all University projects. These guidelines have been edited to reflect WMU preferences, and the intent is for the Design Professional to use this information to guide their normal specifications-writing process. Straying from what is indicated in the guidelines is not prohibited, but shall be discussed with WMU during the development of the project.

SECTION 28 3500 - REFRIGERANT DETECTION AND ALARM

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes refrigerant monitors and notification appliances.
- B. This Section includes refrigerant monitors, **[and]**notification appliances**[, and SCBA]**.

1.2 DEFINITIONS

- A. CMOS: Complementary metal-oxide semiconductor.
- B. LCD: Liquid-crystal display.
- C. LED: Light-emitting diode.
- D. MOS: Metal-oxide semiconductor.
- E. NDIR: Non-dispersive infrared.
- F. PIR: Photoacoustic infrared.
- G. **[SCBA]**: Self-contained breathing apparatus.

1.3 ACTION SUBMITTALS

- A. Product Data:
 - 1. For each type of refrigerant monitor, include refrigerant sensing range in ppm, temperature and humidity range, alarm outputs, display range, furnished specialties, installation requirements, and electric power requirement.
 - 2. For **[SCBA]**, include mounting details, service requirements, and compliance with authorized Federal agency.
- B. Shop Drawings:
 - 1. Air-Sampling Tubing: Size, routing, and termination including elevation above finished floor.
 - 2. Wiring Diagrams: Power, signal, and control wiring.



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1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Include machinery-room layout showing location of monitoring devices and air-sampling tubing with filter/inlet locations in relation to refrigerant equipment.
- B. Product Certificates: For monitoring devices and **[SCBA]**, signed by product manufacturer.
- C. Field quality-control test reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. One calibration kit including clean air calibration gas bottle for zero calibration and specific refrigerant calibration gas for span calibration, minimum 58-L capacity, pressure regulator, and tubing.

1.7 COORDINATION

- A. Coordinate refrigerant detection and alarm system with refrigeration equipment supplier for compatibility.

PART 2 - PRODUCTS

DESIGNER NOTE: The Consultant shall coordinate the specific detection technology with the refrigerants being monitored.

2.1 **[CMOS] [MOS]** REFRIGERANT MONITOR

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Chillgard Refrigerant Monitors; MSA; Instrument Division.
 - 2. Genesis International Inc.
 - 3. Toxalert, Inc.
- B. Description: Sensor shall be factory tested, calibrated, and certified to continuously measure and display the specific gas concentration and shall be capable of indicating, alarming, **[shutting down fuel-fired equipment,**]and automatically activating ventilation system.
- C. ASHRAE: Monitoring system shall comply with ASHRAE 15.



D. Performance:

1. Refrigerant to Be Monitored: **[R-22] [R-134a] [R-407C] [R-410A]**.
2. Range: 0 to 1000 ppm.
3. Minimum Detectability: 50 ppm.
4. Accuracy: Maximum 10 percent of full scale.
5. Repeatability: Maximum plus or minus 2 percent of full scale.
6. Response: Maximum 150 seconds for 90 percent of full scale, and 20-second step change.
7. Detection Level Set Points:
 - a. Detection Level 1: **[50] <Insert value>** ppm.
 - b. Detection Level 2: **[250] <Insert value>** ppm.
8. Operating Temperature: 32 to 104 deg F.
9. Relative Humidity: 20 to 95 percent, noncondensing over the operating temperature range.
10. Site Elevation: Maximum **[6560 feet]** <Insert elevation>.

E. Input/Output Features:

1. Maximum Power Input: 120-V ac, 60 Hz, 75 W.
2. Number of Sensor/Transmitter Points: **[One] [Four] <Insert number>**.
3. Alarm Relays: Minimum 3 relays at a minimum of 5-A resistive load each.
4. Alarm Set Points: Displayed and adjustable through keypad on front of meter.
5. Alarm Silence Switch: Mount in the front panel of the monitor to stop audible and visual notification appliances, but alarm LED remains illuminated.
6. Alarm Manual Reset: Momentary-contact push button in the front panel of the monitor stops audible and visual notification appliances, extinguishes alarm LED, and returns monitor to detection mode at current detection levels.
7. Display: Alphanumeric LCD, LED indicating lights for each detection level; acknowledge switch and test switch mounted on front panel; alarm status LEDs and service fault/trouble LEDs.
8. Audible Output: Minimum 75 dB at 10 feet.
9. Visible Output: Strobe light.
10. Analog Output: 0- to 10-V dc into 2k ohms, or 4- to 20-mA into 1k ohms.
11. Serial Output: RS-232 or RS-485[**compatible with HVAC controls**].
12. Enclosure: NEMA 250, **[Type 1] [Type 12] <Insert type>**, with locking quarter-turn latch and key.

2.2 NDIR REFRIGERANT MONITOR

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. Bacharach, Inc.
 2. Genesis International Inc.
- B. Description: Sensor shall be factory tested, calibrated, and certified to continuously measure and display the specific gas concentration and shall be capable of indicating, alarming, shutting down fuel-fired equipment, and automatically activating ventilation system.



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- C. ASHRAE: Monitoring system shall comply with ASHRAE 15.
- D. Performance:
1. Refrigerant to Be Monitored: **[R-22] [R-123] [R-134a] [R-407C] [R-410A]**.
 2. Refrigerant to Be Monitored: As required by furnished chiller.
 3. Range: 0 to 1000 ppm.
 4. Sensitivity:
 - a. Minimum Detectability: 10 ppm.
 - b. Accuracy: 0 to 100 ppm; plus or minus 10 ppm. 100 to 1000 ppm; plus or minus 10 percent of reading.
 - c. Repeatability: Plus or minus 1 percent of full scale.
 - d. Response: Maximum 10 seconds per sample.
 - e. Detection Level Set Points:
 - 1) Detection Level 1: 10 ppm.
 - 2) Detection Level 2: 50 ppm.
 - 3) Detection Level 1: **[1] <Insert value>** ppm.
 - 4) Detection **[Level 2] [Level 1]: [10] [50] <Insert value>** ppm.
 - 5) Detection **[Level 3] [Level 2]: [50] [250] <Insert value>** ppm.
 5. Sensitivity:
 - a. Minimum Detectability: 20 ppm.
 - b. Minimum Detectability: **[20] <Insert value>** ppm.
 - c. Accuracy: 0 to 100 ppm; plus or minus 20 ppm, 100 to 1000 ppm; plus or minus 5 percent of reading.
 - d. Repeatability: Plus or minus 1 percent of full scale.
 - e. Response: 50 percent of a step change in 60 seconds.
 - f. Detection Level Set Points:
 - 1) Detection Level 1: 50 ppm.
 - 2) Detection Level 2: 250 ppm.
 - 3) Detection Level 1: **[20] <Insert value>** ppm.
 - 4) Detection **[Level 2] [Level 1]: [50] <Insert value>** ppm.
 - 5) Detection **[Level 3] [Level 2]: [250] <Insert value>** ppm.
 6. Operating Temperature: 32 to 104 deg F.
 7. Relative Humidity: 20 to 95 percent, noncondensing over the operating temperature range. Compensate sensor for relative humidity.
 8. Site Elevation: Maximum **[6560 feet] <Insert elevation>**.
- E. Input/Output Features:
1. Maximum Power Input: 120-V ac, 60 Hz, 75 W.
 2. Number of Air-Sampling Points: As required.
 3. Number of Air-Sampling Points: **[One] [Four] [Eight] [16] <Insert number>**.
 4. Air-Sampling Point Inlet Filter: 0.10-micron filter element for each sampling point.
 5. Air-Sampling Point Analog Output: 0- to 10-V dc into 2k ohms, or 4- to 20-mA into 1k ohms matched to sensor output.
 1. Alarm Relays: Minimum 3 relays at a minimum of 5-A resistive load each.
 2. Alarm Relays: Minimum **[3] [4]** relays at a minimum of 5-A resistive load each.



3. Alarm Set Points: Displayed on front of meter and adjustable through keypad on front of meter.
4. Alarm Acknowledge Switch: Mount in the front panel of the monitor to stop audible and visual notification appliances, but alarm LED remains illuminated.
5. Alarm Manual Reset: Momentary-contact push button in the front panel of the monitor stops audible and visual notification appliances, extinguishes alarm LED, and returns monitor to detection mode at current detection levels.
6. Display: Alphanumeric LCD, LED indicating lights for each detection level; acknowledge switch and test switch mounted on front panel; alarm status LEDs and service fault LEDs.
7. Audible Output: Minimum 75 dB at 10 feet.
8. Visible Output: Strobe light.
9. Sensor Analog Output: 0- to 10-V dc into 2k ohms, or 4- to 20-mA into 1k ohms.
10. Serial Output: RS-232 or RS-485 compatible with HVAC controls.
1. Enclosure: NEMA 250, Type 1, with locking quarter-turn latch and key.
2. Enclosure: NEMA 250, [Type 1] [Type 12] <Insert type>, with locking quarter-turn latch and key.

2.3 PIR REFRIGERANT MONITOR

2.4 MONITOR ALARM SEQUENCE

- A. Detection Level 1: Notify HVAC control workstation of detection in the refrigeration equipment room on a rise or fall of refrigerant concentration to this level. Start ventilation system at low speed to allow occupancy by maintenance technicians to identify leaks. Cycle blue strobe lights.
- B. Detection Level 1: Notify the HVAC control workstation of the detection in the refrigeration equipment room on a rise or fall of refrigerant concentration to this level. Run ventilation system on high speed due to a rise in concentration to this level, and return ventilation system to low speed on a reduction in concentration below this level. Operate the ventilation system for a minimum of five minutes. Cycle amber strobe lights.
- C. Detection Level 1: Notify the HVAC control workstation of the detection in the refrigeration equipment room on a rise or fall of refrigerant concentration to this level. Run ventilation system at high speed on a rise in concentration to this level, and change to low speed on a reduction in concentration below this level. Operate the ventilation system at high speed for a minimum of five minutes. Cycle amber strobe lights.
- D. Detection Level 2: Notify the HVAC control workstation of the detection in the refrigeration equipment room on a rise or fall of refrigerant concentration to this level. Sound alarm horns and cycle red strobe lights inside and outside refrigeration equipment room. Terminate operation of any combustion-process equipment located in the refrigeration equipment room. Provide manual reset for this detection level.
- E. Detection Level 2: Notify the HVAC control workstation of the detection in the refrigeration equipment room on a rise or fall of refrigerant concentration to this level. Sound alarm horns and cycle red strobe lights inside and outside refrigeration equipment room. Terminate operation of any combustion-process equipment located in the refrigeration equipment room. Provide manual reset for this detection level.



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- F. Sensor Fault/Trouble: Notify HVAC control workstation of fault/trouble detection in monitor.

2.5 NOTIFICATION APPLIANCES

- A. Horns: Comply with UL 464; electric-vibrating-polarized type, listed by a qualified testing agency with provision for housing the operating mechanism behind a grille. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet from the horn.
- B. Visible Alarm Devices: Comply with UL 1971; three color xenon strobe lights, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The words "REFRIGERANT DETECTION" printed in minimum 1/2-inch- high letters on the lens.
- C. Visible Alarm Devices: Comply with UL 1971; three color xenon strobe lights, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The words "REFRIGERANT DETECTION" printed in minimum 1/2-inch- high letters on the lens. Rated light output is [75] [110] <Insert number> candela.

2.6 AIR-SAMPLING TUBING

- A. Annealed-Temper Copper Tubing: ASTM B 88, Type L.
- B. Polyethylene Tubing: ASTM D 2737, flame-retardant, nonmetallic tubing rated for ambient temperature range of 10 to 150 deg F.

2.7 SCBA

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. MSA; Safety Products Division.
 - 2. Scott Health & Safety; a division of Tyco Safety Products.
 - 3. Survivair
- B. Description: Open-circuit, pressure-demand, compressed-air SCBA; includes completely assembled, portable, self-contained devices designed for application in hazardous breathing environment. Tested and certified by the National Institute for Occupational Safety and Health and the Mine Safety and Health Administration according to 42 CFR 84, Subpart H.
- C. Face Piece: Silicon, EPDM, or nitrile rubber, one-size-fits-all with double-sealing edge, stainless-steel speaking diaphragm and lens retainer, five adjustable straps to hold face piece to head (two straps on each side and one on top), exhalation valve in mask, close-fitting nose piece to ensure no CO₂ buildup, and perspiration drain to avoid skin irritation and prevent lens fogging.
- D. Backplate: Ergonomically designed of glass fiber, aluminum, or thermoset plastic.
- E. Harness and Carrier Assembly: Large triangular back pad, with backplate and adjustable waist and shoulders straps. Modular design, detachable components, easy to clean and maintain.



Shoulder straps are padded with flame-resistant material, reinforced with stainless-steel cable, and attached with T-nuts, washers, and screws.

- F. Air Cylinder, Regulator, and Pressure Gages: [30] [45] [60]-minute, low-pressure 2216-psig, carbon-fiber composite, fiberglass composite, or all- aluminum cylinders fitted with quick-fill assembly for refilling and air transfer. Two-stage regulator, and gage with end of service time whistle signal.
- G. Wall-Mounted Case: Watertight, high visibility orange or yellow, corrosion-resistant, tough, lockable plastic case.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with ASHRAE 15.
- B. Comply with ASHRAE 15[**and ASHRAE 147**].
- C. Install air-sampling inlets, or diffusion type monitors in pits, tunnels, or trenches in machinery room that are accessible to personnel.
- D. Floor mount diffusion-type monitor, sensor/transmitters, or air-sampling inlets on slotted channel frame 12 to 18 inches above the floor in a location near the refrigerant source or between the refrigerant source and the ventilation duct inlet.
- E. Wall mount air-sampling multiple-point monitors with top of unit 60 inches above finished floor.
- F. Run air-sampling tubing from monitor to air-sampling points, in size as required by monitor manufacturer. Install tubing with maximum unsupported length of 36 inches, for tubing exposed to view. Terminate air-sampling tubing at sampling points with filter recommended by monitor manufacturer.
- G. Install air-sampling tubing with sufficient slack and flexible connections to allow for vibration of tubing and movement of equipment.
- H. Purge air-sampling tubing with dry, oil-free compressed air before connecting to monitor.
- I. Number-code or color-code air-sampling tubing for future identification and service of air-sampling multiple-point monitors.
- J. Extend air-sampling tubing from exhaust part of multiple-point monitors to outside.
- K. Extend air-sampling tubing from outdoors to outdoor inlet connection of NDIR monitors. Terminate air-sampling tubing at outdoor inlet location with filter recommended by monitor manufacturer.
- L. Install warning signs, labels, and nameplates to identify detection devices according to Division 23 Section "Identification for HVAC Piping and Equipment."



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- M. Install warning signs, labels, and nameplates to identify detection devices **[and SCBA]** according to Division 23 Section "Identification for HVAC Piping and Equipment."
- N. Place warning signs inside and outside each door to the refrigeration equipment room. Sample wording: "AUDIBLE AND VISUAL ALARM SOUNDING INDICATES REFRIGERANT DETECTION - ENTRY REQUIRES SCBA."
- O. Audible Alarm-Indicating Devices: Install at each entry door to refrigeration equipment room, and position not less than 6 inches below the ceiling. Install horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.
- P. Visible Alarm-Indicating Devices: Install adjacent to each alarm horn at each entry door to refrigeration equipment room, and position at least 6 inches below the ceiling.
- Q. Mount primary**[and secondary backup]** **[SCBA]** on wall outside **[each]** interior door to refrigeration equipment room.

3.2 FIELD QUALITY CONTROL

- A. Testing Agency: **[Owner will engage]** **[Engage]** a qualified testing agency to perform tests and inspections and prepare test reports.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.
- C. Perform tests and inspections and prepare test reports.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- D. Tests and Inspections:
 - 1. Inspect field-assembled components, equipment installation, and electrical connections for compliance with requirements.
 - 2. Test and adjust controls and safeties.
 - 3. Test Reports: Prepare a written report to record the following:
 - a. Test procedures used.
 - b. Test results that comply with requirements.
 - c. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- E. Repair or replace malfunctioning units and retest as specified above.



3.3 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain refrigerant detection devices. Refer to requirements in Division 01 Section "Demonstration and Training."
- B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain refrigerant detection devices [and SCBA]equipment. Refer to requirements in Division 01 Section "Demonstration and Training."
- C. SCBA Training: Provide an instructional video that details operating procedures of equipment.

END OF SECTION **28 3500**