

Refrigerant Codes

Requirements, Guidelines & How AGS Meets Code



ASHRAE 34 Room Volume Requirements:

ASHRAE 34 defines the maximum amount of refrigerant that is allowed to be used within a single volume of space by defining Refrigerant Concentration Limits (RCL) for each type of refrigerant. The RCL is given in units of LB/1000ft³, and serves as a limit to how much refrigerant is allowed in pounds per volume of the space.

The RCL is the concentration in which each refrigerant becomes immediately hazardous to humans and is often significantly higher than the Occupational Exposure Limit (OEL), which is the chronic exposure limit. The way the code can be conceptualized is if all the refrigerant in your in your chiller leaks out into the volume in which it sits, and it rises above the RCL limit, then you must have a detection system.

7.4 Location in a Machinery Room or Outdoors. All components containing refrigerant shall be located either in a machinery room or outdoors, where the quantity of refrigerant needed exceeds the limits defined by sections 7.2 and 7.3. Refrigerant systems located outdoors shall comply with section 8.12. (2022 Standard).

Section 7.2 offers details calculating the volume (effective dispersal volume), and section 7.3 offers details on calculating the maximum amount of charge allowed in the system.

7.2.1 General. The effective dispersal volume identified in section 7.3 into which refrigerant will disperse in the event of a release shall be calculated in accordance with this section. Volume calculations shall evaluate each space or connected spaces relevant to each refrigerant system. The smallest volume into which refrigerant disperses shall be used to determine the refrigerant quantity limit in the system. (2022 Standard).

Example:

$$\text{Total Refrigerant Charge (lb)} \times 1000 \div RCL \left(\frac{LB}{1000FT^3} \right) = \text{Minimum Chiller Room Volume Allowed}$$

$$\text{Chiller Room Volume (ft}^3\text{)} \times RCL \left(\frac{LB}{1000FT^3} \right) \div 1000 = \text{Total Refrigerant Charge Allowed}$$

The "total charge allowed" is referred to in ASHRAE 15 as the effective dispersal volume charge (EDVC). The correction factor of 1000 is used in the calculations, because ASHRAE 34 gives the RCL limit in LB/1000FT³, rather than LB/FT³.

If your system exceeds these limitations, then you must locate your refrigeration equipment outdoors, or inside of a Machinery Room. It is in the Machinery Room Requirements that the detection system is outlined.

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ASHRAE 15 Detection System **Requirements:**

Class A1 and B1 Refrigerants Follow Section 8.9

Class A2, A3, B2, and B3 Refrigerants Follow 8.9 & 8.10

Class A2L or B2L and do NOT contain any A2, A3, B2, B3 refrigerants follow 8.9.1 – 8.9.4 & 8.11

Per ASHRAE code (section 7.4.2-7.4.3), all refrigerants other than A2L and B2L shall follow section 8.9 for refrigerant detection alarm guidelines. A2, A3, B2, B3 refrigerants also must follow section 8.11, but 8.11 does not mention any detection guidelines, which leaves the 8.9 guidelines apply to all of those gases. For the sake of simplicity, this guideline focuses on the section 8.9 requirements first.

8.9.5: Each refrigerating machinery room shall contain a detector, located in an area where refrigerant from a leak will concentrate, that actuates an alarm and mechanical ventilation in accordance with Section 8.9.7 at a set point not greater than the occupational exposure limit (OEL) value as published in ASHRAE standard 34. For refrigerants that do not have a published OEL value in standard 34, a set point determined in accordance with the OEL as defined by Standard 34 shall be approved by the AHJ. The alarm shall annunciate visual and audible alarms inside the refrigerating machinery room and outside each entrance to the refrigerating machinery room. The alarms required in this section shall be of the manual reset type with the reset located inside the refrigerating machinery room. Alarms set at other levels (such as IDLH) and automatic reset alarms are permitted in addition to those required by this section. The meaning of each alarm shall be clearly marked by signage near the annunciators, elaborating on each of these items:

Located in an area where refrigerant from a leak will concentrate: Check for the weight of the refrigerant gas, and if it will rise or fall. Check the installation heights in the AGS detector manual, or in the charts below. The detectors can be placed on a wall near the chillers or hung from the ceiling next to a high-risk point on the chiller.

Actuates an alarm and mechanical ventilation:

The system must connect to a ventilation system and ventilate the refrigerant upon a leak at a rate of 100 times the square root of the system refrigerant charge. (8.9.8.1).

Set Point (Alarm Levels). Occupational Exposure Limit (OEL):

The time-weighted-average (TWA) concentration for a normal eight-hour workday and a 40-hour workweek to which nearly all works can be repeatedly exposed without adverse effect, based on the OSHA PEL, ACGIH TLV-TWA, TERA OARS-WEEL, or consistent value. These values are given in ASHRAE 34, and in the table below for the gases detectable by American Gas Safety.

Annunciate Visual and Audible Alarms: The visual and audible alarms outside of the room can be accomplished using remote alarm strobes installed outside of each entrance and wired back into the control panel. The alarms inside of the room can be accomplished by the control panel and detectors built in visual and audible alarms, or by adding a redundant alarm strobe inside of the space.

Shall be of the manual reset type: The AGS MerlinGuard requires a manual reset after high alarm, which is located on the control panel. By mounting the control panel inside of the chiller room, it satisfies this section of code.

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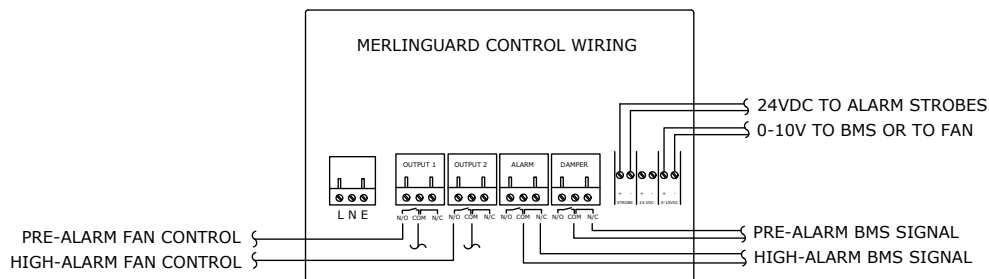
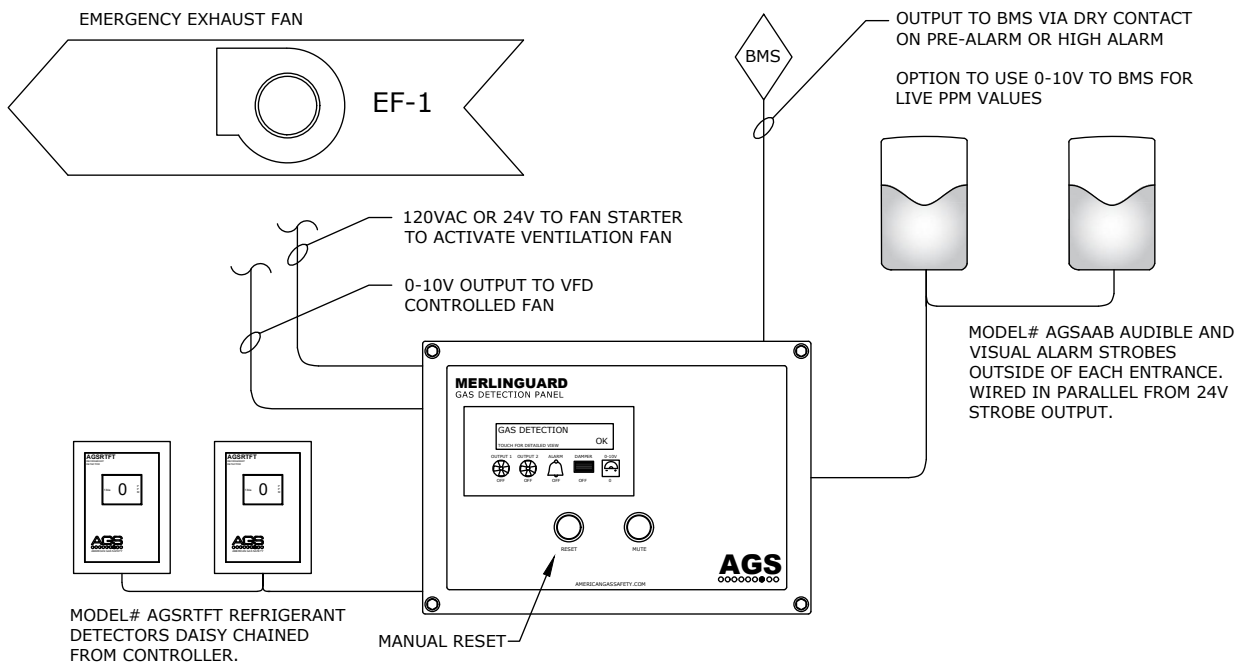
How AGS Meets Code



MerlinGuard Fan Control

You have two options for fan control with the AGS MerlinGuard:

1. Use the high alarm relay (output 2) to send 120VAC or 24VAC power to the fans to activate them. This design would require two fans. One fan would cover your standby airflow rate, and the second fan would turn on during a gas detected scenario and increase the ventilation rate to the emergency extraction rate defined by ASHRAE of 100X the standby rate. Use ASHRAE 8.9.8.1 to calculate ventilation rate.
2. Use the 0-10V output to signal a VFD control fan, and have it run at a continuous standby rate and ramp up to the emergency extraction rate upon detection. The 0-10V output will send a linear voltage signal to the VFD based on the sensing range of the detector.



BMS Connectivity

The AGS control panel can send signals to the BMS system on pre-alarm and high-alarm condition. It also contains a 0-10V output that can be utilized by the BMS to give a PPM readout.

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Alarm Levels

Should I use a %LFL sensor or a PPM sensor (OEL).

Per 8.9.5, the detector shall alarm at no greater than the OEL limit set by ASHRAE 34. For almost all these refrigerants, even the class 2 & 3 combustible refrigerants, the OEL ppm limit is often much lower than 25% LFL.

The only time ASHRAE calls for a different alarm method is in 8.11 which applies to A2L & B2L refrigerants.

If the levels go over 25% LFL, then the system must shut down the equipment in the machinery room. If the OEL limit for the A2L or B2L refrigerant is lower than 25% LFL, you can tie the high alarm to that level, and shut the equipment down, and activate the ventilation fans at the same time. Alternatively, you have a two-stage system, where you activate ventilation at the OEL limit, and shut the equipment down at 25% LFL (if the ventilation doesn't adequately exhaust the space).

For A2L & B2L, there must be an alarm when the ventilation system stops working, so it is often good to have a fan fault mechanism built into your alarm system.

Pre-Alarm Levels

See the AGS alarm level case study for pre-alarm levels, and the chart below for the levels that are set in the AGS detectors.

Detectable Gases

Gases are ordered from the factory for the specified refrigerant.

GAS	Model#	Pre Alarm (PPM)	High Alarm (PPM)	Mounting Height
R-1233zd	RTFT-PRO-1233ZD	75	1000	1ft A.F.F.
R-1234yf	RTFT-LITE-1234YF	175	1000	1ft A.F.F.
R-1234ze	RTFT-LITE-1234ZE	175	1000	1ft A.F.F.
R-123	RTFT-PRO-123		50	1ft A.F.F.
R-125	RTFT-PRO-125	75	1000	1ft A.F.F.
R-134a	RTFT-LITE-134A	175	1000	1ft A.F.F.
R-143a	RTFT-PRO-143A	75	1000	1ft A.F.F.
R-227ea	RTFT-PRO-227EA	75	1000	1ft A.F.F.
R-22	RTFT-PRO-22	75	1000	1ft A.F.F.
R-32	RTFT-LITE-32	350	1000	1ft A.F.F.
R-404a	RTFT-LITE-404A	175	1000	1ft A.F.F.
R-407a	RTFT-PRO-407A	75	1000	1ft A.F.F.
R-407c	RTFT-LITE-407C	175	1000	1ft A.F.F.
R-407f	RTFT-PRO-407F	75	1000	1ft A.F.F.
R-410a	RTFT-LITE-410A	350	1000	1ft A.F.F.
R-417a	RTFT-PRO-417A	75	1000	1ft A.F.F.
R-422a	RTFT-PRO-422A	75	1000	1ft A.F.F.
R-422d	RTFT-PRO-422D	75	1000	1ft A.F.F.
R-424a	RTFT-PRO-424A	75	990	1ft A.F.F.

GAS	Model#	Pre Alarm (PPM)	High Alarm (PPM)	Mounting Height
R-427a	RTFT-PRO-427A	75	1000	1ft A.F.F.
R-434a	RTFT-PRO-434A	75	1000	1ft A.F.F.
R-438a	RTFT-PRO-438A	75	990	1ft A.F.F.
R-442a	RTFT-PRO-442A	75	1000	1ft A.F.F.
R-448a	RTFT-PRO-448A	75	860	1ft A.F.F.
R-449a	RTFT-LITE-449A	175	800	1ft A.F.F.
R-450a	RTFT-PRO-450A	75	880	1ft A.F.F.
R-452a	RTFT-PRO-452A	75	790	1ft A.F.F.
R-452b	RTFT-PRO-452B	75	870	1ft A.F.F.
R-453a	RTFT-PRO-453B	75	1000	1ft A.F.F.
R-454a	RTFT-PRO-454A	75	690	1ft A.F.F.
R-454b	RTFT-PRO-454B	75	850	1ft A.F.F.
R-454c	RTFT-PRO-454C	75	620	1ft A.F.F.
R-455a	RTFT-PRO-455A	75	650	1ft A.F.F.
R-507	RTFT-PRO-507	75	1000	1ft A.F.F.
R-513a	RTFT-PRO-513A	75	650	1ft A.F.F.
R-514a	RTFT-PRO-514A	75	320	1ft A.F.F.
R-515a	RTFT-PRO-515A	75	810	1ft A.F.F.
R-515b	RTFT-PRO-515B	75	810	1ft A.F.F.

