



Application Note A6

ASHRAE R-series refrigerant compounds

This Application note applies to **Models: 2006AFS, 2012, 2012B, 2023, 2023SD, 2024 and 2024SD**

We gas calibrate the units using refrigerant compound **R-22**. It has a relative response of 1.00 because we adjust the span response for 1 volt = 3000 ppm. From the chart you can see that the relative response to R-12 is 1.18. A relative response of 1.18 (relative to 1.00 for R-22) means that 2542 ppm (2542 = 3000/1.18) of R-12 will give a full scale response of 1.000 volt as compared to 3000 ppm of **R-22**.

R-11 has a relative response of 0.49 (relative to 1.00 for **R-22**). This means that it would take 6122 ppm (6122 x 0.49 = 3000) of **R-11** to give a full scale response of 1.000 volt. Another way of understanding the relative response is to ask the question, what will the voltage output be for 3000 ppm for each gas? The answer is 1.000 V for **R-22**, 0.490 V for **R-11**, and 1.180 V for **R-12**. The Model **2012** has a 0 to 1 volt output and the Model **2024** (see page 2) has a 0 to 5 volt output.

Refer to the American Society of **Heating, Refrigerating and Air Conditioning Engineers, Inc.(ASHRAE)** standard **ASHRAE 15-1992**.

The air conditioning industry ASHRAE designations for refrigerants, the chemical names and their formulas are:

<u>Designation</u>	<u>Chemical Name</u>	<u>Chemical Formula</u>	<u>Relative Response, Std. Filter.</u>
GROUP A1			Fil #860005 Normalized to R-22
R-11	Trichlorofluoromethane	CCl ₃ F	Compound
R-12	Dichlorodifluoromethane	CCl ₂ F ₂	Relative Response
R-13	Chlorotrifluoromethane	CClF ₃	1-1-1 Trichloroethane
R-13B1 (1301)	Bromotrifluoromethane	CBrF ₃	R-11
R-14	Tetrafluoromethane (Carbon tetrafluoride)	CF ₄	R-21
R-22	Chlorodifluoromethane	CHClF₂	R-507
R-113	Trichlorotrifluoroethane	CCl ₂ FCFCF ₂	R-123
R-114	Dichlorotetrafluoroethane	CClF ₂ CClF ₂	R-134a
R-115	Chloropentafluoroethane	CClF ₂ CF ₃	R-22
R-124	2-Chloro-1,1,1,3-tetrafluoroethane	CHClFCF ₃	R-125
R-125	Pentafluoroethane	CHF ₂ CF ₃	R-113
R-134a	1,1,1,2-Tetrafluoroethane	CH ₂ FCF ₃	R-12
R-143	1,1,2-trifluoroethane	CHF ₂ CH ₂ F	R-13B1
R-143a	Trifluoroethane	CH ₃ CF ₃	R-114
R-C318	Octafluorocyclobutane	C ₄ F ₈	
R-400	R-12 and R-114	CCl ₂ F ₂ / CClF ₂ CClF ₂	
R-407C	R-32 / 125 / 134a (23% / 25% / 52%)	CH ₂ F ₂ / CHF ₂ CF ₃ / CH ₂ FCF ₃	
R-500	R-12 / 152a (73.8% / 26.2%)	CCl ₂ F ₂ / CH ₃ CHF ₂	
R-502	R-22 / 115 (48.8% / 51.2%)	CHClF ₂ / CClF ₂ CF ₃	
R-503	R-23 / 13 (40.1% / 59.9%)	CHF ₃ / CClF ₃	
R-507	R-125 / R-143a (50% / 50%)	CHF ₂ CF ₃ / CH ₃ CF ₃	
R-744	Carbon Dioxide	CO ₂	
GROUP A2			
R-142b	1-Chloro-1,1,-Difluoroethane	CH ₃ CClF ₂	
R-152a	1,1-Difluoroethane	CH ₃ CHF ₂	
GROUP A3			
R-170	Ethane	C ₂ H ₆	
R-290	Propane	C ₃ H ₈	
R-600	Butane	C ₄ H ₁₀	
R-600a	2-Methyl propane (Isobutane)	CH(CH ₃) ₃	
R-1150	Ethene (Ethylene)	C ₂ H ₄	
R-1270	Propene (Propylene)	C ₃ H ₆	
GROUP B1			
R-123	2,2-Dichloro-1,1,1-Trifluoroethane	CHCl ₂ CF ₃	
R-764	Sulfur Dioxide	SO ₂	
GROUP B2			
R-40	Chloromethane (Methyl Chloride)	CH ₃ Cl	
R-611	Methyl Formate	HCOOCH ₃	
R-717	Ammonia	NH ₃	

Note: The term "**FREON**" is a Dupont trademark for a variety of nonflammable gaseous or liquid fluorinated hydrocarbons. **HALON** may be any of several halocarbons (a compound such as a fluorocarbon or carbon & one or more halogens) used as **fire-extinguishing agents**. Examples are **Halon 1211** (Trichlorofluoromethane CF₂ClBr) and **Halon 1301** (Bromotrifluoromethane CBrF₃) or **Halon 2402** (Dibromotetrafluoromethane)



The Model 2024 has a linear 0 to 5 volt full scale. The chart below shows the response of a **Model 2024 CFC** monitor to **R-12** with a stock **IR band pass filter** after it has been gas calibrated with 3000 ppm of **R-22**. Since it is 1.18 times more responsive to **R-12** than it is to **R-22** the output voltage readings (and 4-20 mA current loop readings) will be 1.18 times higher if stimulated with **R-12**. Another way of using this information would be to gas calibrate a Model 2024 CFC unit with 3000 ppm of **R-12** by adjusting the SPAN to 5.90 volts. This would in effect calibrate it for 3000 ppm of **R-22** to be equal to 5.00 volts. Custom **IR band pass filters** may be ordered for the gases shown in the table below.

VALTRONICS Filter	Calibration Gas	Other gases that it will respond to	Full Scale	Models
Stock # 860005 standard	R-12 or R-22	R-11, 21, 123, 134a 142b, 1211, 1301, 113, & 114	3000 or 5000 ppm	2006, 2012, 2024
Stock # 860005 standard	R-227	Has no known interferences at the 3000 ppm level	100,000 ppm (10%)	2024SD-10%FM200
SF ₆	SF ₆	R-12 and less than 10% of FS from R-11, 134a, 113, & 114	10,000 ppm	2024-1%SF6
R-11	R-11	Less than 10% of FS from R113, & 114	3000 or 5000 ppm	2024R-11
R-12	R-12	Less than 10% of FS from R113, 114, 22 & 134a	3000 or 5000 ppm	2024R-12
R-1301 (13B1)	R-1301 (13B1)	Less than 10% of FS from R113, 143a	3000 or 5000 ppm	2024R-1301
R-143a	R-143a	Has no known interferences	3000 or 5000 ppm	2024R-143a

Fil #860005 Normalized to R-22	
Compound	Relative Response
1-1-1 Trichloroethane	0.20
R-11	0.49
R-21	0.50
R-507	0.52
R-123	0.75
R-134a	0.97
R-22	1.00
R-125	1.04
R-113	1.13
R-12	1.18
R-13B1	1.34
R-114	1.47

- Notes:
- R-227 is also known as FM-200. The relative response of 3000 ppm R-227 on a std 2024 will be determined.
 - The Model 2024 units made to measure R-227 are calibrated to 10% R-227 full scale.
 - The relative responses of R-142b and 1211 to the Stock Filter are yet to be determined also.
 - The Model 2024R-12 unit uses a narrow bandpass filter and the Standard Model 2024 uses a wider bandpass
 - R-507 consists of 50% R-125 and 50% R-143a

Fil. #860005 Normalized to R-12	
Compound	Relative Response
1-1-1 Trichloroethane	0.17
R-11	0.42
R-21	0.42
R-507	0.44
R-123	0.64
R-134a	0.82
R-22	0.85
R-125	0.88
R-113	0.96
R-12	1.00
R-13B1	1.14
R-114	1.25

• **Normalized to R-12** means that it is gas calibrated to R-12 where 3000 ppm = 1.0 volt output response
 (A Model 2024 has a 0 to 5 volt output so 3000 ppm R-12 = 5.0 volt output response)
 (Models 2006 and 2012 have a 0 to 1 volt output)

	0 to 5V rel response	4-20 mA response
1-1-1 Trichloroethane (3000 ppm)	0.847	6.71
R-11 (3000 ppm)	2.076	10.64
R-21 (3000 ppm)	2.119	10.78
R-507 (3000 ppm)	2.203	11.05
R-123 (3000 ppm)	3.178	14.17
R-134a (3000 ppm)	4.110	17.15
R-22 (3000 ppm)	4.237	17.56
R-125 (3000 ppm)	4.407	18.10
R-113 (3000 ppm)	4.788	19.32
R-12 (3000 ppm)	5.000	20.00
R-13B1 (3000 ppm)	5.678	22.17
R-114 (3000 ppm)	6.229	23.93