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:

Designation	***Chemical Name***	***Chemical Formula***
GROUP A1		
R-11	Trichlorofluoromethane	CCl_3F
R-12	Dichlorodifluoromethane	$\mathbf{CCl_2F_2}$
R-13	Chlorotrifluoromethane	$CClF_3$
R-13B1 (1301)	Bromotrifluoromethane	$CBrF_3$
R-14	Tetrafluoromethane (Carbon tetrafluride)	CF_4
R-22	**Chlorodifluoromethane**	$\mathbf{CHClF_2}$
R-113	Trichlorotrifluoroethane	CCl_2FCClF_2
R-114	Dichlorotetrafluoroethane	$CClF_2CClF_2$
R-115	Chloropentafluoroethane	$CClF_2CF_3$
R-124	2-Chloro-1,1,1,3-tetrafluoroethane	$CHClFCF_3$
R-125	Pentafluoroethane	CHF_2CF_3
R-134a	1,1,1,2-Tetrafluoroethane	CH_2FCF_3
R-143	1,1,2-trifluoroethane	CHF_2CH_2F
R-143a	Trifluoroethane	CH_3CF_3
R-C318	Octafluorocyclobutane	C_4F_8
R-400	R-12 and R-114	CCl_2F_2 / $CClF_2CClF_2$
R-407C	R-32 / 125 / 134a (23% / 25% / 52%)	CH_2F_2 / CHF_2CF_3 / CH_2FCF_3
R-500	R-12 / 152a (73.8% / 26.2%)	CCl_2F_2 / CH_3CHF_2
R-502	R-22 / 115 (48.8% / 51.2%)	$CHClF_2$ / $CClF_2CF_3$
R-503	R-23 / 13 (40.1% / 59.9%)	CHF_3 / $CClF_3$
R-507	R-125 / R-143a (50% / 50%)	CHF_2CF_3 / CH_3CF_3
R-744	Carbon Dioxide	CO_2
GROUP A2		
R-142b	1-Chloro-1,1,-Difluroethane	CH_3CClF_2
R-152a	1,1-Difluroethane	CH_3CHF_2
GROUP A3		
R-170	Ethane	C_2H_6
R-290	Propane	C_3H_8
R-600	Butane	C_4H_{10}
R-600a	2-Methyl propane (Isobutane)	$CH(CH_3)_3$
R-1150	Ethene (Ethylene)	C_2H_4
R-1270	Propene (Propylene)	C_3H_6
GROUP B1		
R-123	2,2-Dichloro-1,1,1-Trifluoroethane	$CHCl_2CF_3$
R-764	Sulfur Dioxide	SO_2
GROUP B2		
R-40	Chloromethane (Methyl Chloride)	CH_3Cl
R-611	Methyl Formate	$HCOOCH_3$
R-717	Ammonia	NH_3

Relative Response, Std. Filter.

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

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** (Trichloroflurometha ne CF_2ClBr) and **Halon 1301** (Bromotrifluoromethane $CBrF_3$) or **Halon 2402** (Dibromotetrafluoromethane)

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VALTRONICS

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

- **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)

Fil. #860005 Normalized to R-12				
Compound	Relative Response		**0 to 5V rel response**	4-20 mA response
1-1-1 Trichloroethane	0.17	1-1-1 Trichloroethane (3000 ppm)	0.847	6.71
R-11	0.42	R-11 (3000 ppm)	2.076	10.64
R-21	0.42	R-21 (3000 ppm)	2.119	10.78
R-507	0.44	R-507 (3000 ppm)	2.203	11.05
R-123	0.64	R-123 (3000 ppm)	3.178	14.17
R-134a	0.82	R-134a (3000 ppm)	4.110	17.15
R-22	0.85	R-22 (3000 ppm)	4.237	17.56
R-125	0.88	R-125 (3000 ppm)	4.407	18.10
R-113	0.96	R-113 (3000 ppm)	4.788	19.32
R-12	**1.00**	**R-12 (3000 ppm)**	**5.000**	**20.00**
R-13B1	1.14	R-13B1 (3000 ppm)	5.678	22.17
R-114	1.25	R-114 (3000 ppm)	6.229	23.93

