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Popular Tracer Gas Leak Rate Summary

Specifications Grams (oz)/Year	R-12 Leak Rate	Equivalent Helium Leak Rate for R-12	R-22 Leak Rate	Equivalent Helium Leak Rate for R-22	R-134a Leak Rate	Equivalent Helium Leak Rate for R-134a	SF ₆ Leak Rate	Equivalent Helium Leak Rate for SF ₆	Time Required for One Bubble to Form (Immersion Test)
0.5 (0.018)	3.21 x 10 ⁻⁶	2.15 x 10 ⁻⁶	4.48 x 10 ⁻⁶	2.88 x 10 ⁻⁶	3.80 x 10 ⁻⁶	2.32 x 10 ⁻⁶	2.65 x 10 ⁻⁶	2.07 x 10 ⁻⁶	135.0 min
1.0 (0.035)	6.41 x 10 ⁻⁶	4.30 x 10 ⁻⁶	8.97 x 10 ⁻⁶	5.76 x 10 ⁻⁶	7.60 x 10 ⁻⁶	4.64 x 10 ⁻⁶	5.31 x 10 ⁻⁶	4.15 x 10 ⁻⁶	69.0 min
2.0 (0.071)	1.28 x 10 ⁻⁵	8.60 x 10 ⁻⁶	1.79 x 10 ⁻⁵	1.15 x 10 ⁻⁵	1.52 x 10 ⁻⁵	9.29 x 10 ⁻⁶	1.06 x 10 ⁻⁵	8.28 x 10 ⁻⁶	34.0 min
2.8 (0.1)	1.80 x 10 ⁻⁵	1.21 x 10 ⁻⁵	2.51 x 10 ⁻⁵	1.61 x 10 ⁻⁵	2.13 x 10 ⁻⁵	1.30 x 10 ⁻⁵	1.49 x 10 ⁻⁵	1.16 x 10 ⁻⁵	24.0 min
7.0 (0.25)	4.49 x 10 ⁻⁵	3.01 x 10 ⁻⁵	6.28 x 10 ⁻⁵	4.03 x 10 ⁻⁵	5.32 x 10 ⁻⁵	3.25 x 10 ⁻⁵	3.72 x 10 ⁻⁵	2.91 x 10 ⁻⁵	10.0 min
14 (0.50)	8.98 x 10 ⁻⁵	6.02 x 10 ⁻⁵	1.26 x 10 ⁻⁴	8.09 x 10 ⁻⁵	1.06 x 10 ⁻⁴	6.48 x 10 ⁻⁵	7.43 x 10 ⁻⁵	5.80 x 10 ⁻⁵	290.0 sec
28 (1.0)	1.80 x 10 ⁻⁴	1.21 x 10 ⁻⁴	2.51 x 10 ⁻⁴	1.61 x 10 ⁻⁴	2.13 x 10 ⁻⁴	1.30 x 10 ⁻⁴	1.49 x 10 ⁻⁴	1.16 x 10 ⁻⁴	145.0 sec
56 (2.0)	3.60 x 10 ⁻⁴	2.42 x 10 ⁻⁴	5.02 x 10 ⁻⁴	3.22 x 10 ⁻⁴	4.26 x 10 ⁻⁴	2.60 x 10 ⁻⁴	2.98 x 10 ⁻⁴	2.32 x 10 ⁻⁴	72 sec
112 (4.0)	7.20 x 10 ⁻⁴	4.84 x 10 ⁻⁴	1.00 x 10 ⁻³	6.44 x 10 ⁻⁴	8.56 x 10 ⁻⁴	5.20 x 10 ⁻⁴	5.96 x 10 ⁻⁴	4.64 x 10 ⁻⁴	36 sec
224 (8.0)	1.44 x 10 ⁻³	9.68 x 10 ⁻⁴	2.01 x 10 ⁻³	1.29 x 10 ⁻³	1.70 x 10 ⁻³	1.04 x 10 ⁻³	1.19 x 10 ⁻³	9.28 x 10 ⁻⁴	18 sec
448 (16.0)	2.88 x 10 ⁻³	1.94 x 10 ⁻³	4.02 x 10 ⁻³	2.58 x 10 ⁻³	3.41 x 10 ⁻³	2.08 x 10 ⁻³	2.38 x 10 ⁻³	1.86 x 10 ⁻³	9.0 sec
896 (32.0)	5.76 x 10 ⁻³	3.88 x 10 ⁻³	8.03 x 10 ⁻³	5.15 x 10 ⁻³	6.82 x 10 ⁻³	4.16 x 10 ⁻³	4.77 x 10 ⁻³	3.71 x 10 ⁻³	4.5 sec
1792 (64.0)	1.15 x 10 ⁻²	7.76 x 10 ⁻³	1.61 x 10 ⁻²	1.03 x 10 ⁻²	1.36 x 10 ⁻²	8.32 x 10 ⁻³	9.54 x 10 ⁻³	7.24 x 10 ⁻³	2.25 sec

Specifications Grams (oz)/Year	R-404A Leak Rate	Equivalent Helium Leak Rate for R-404A	R-508B Leak Rate	Equivalent Helium Leak Rate for R-508B	R-410A Leak Rate	Equivalent Helium Leak Rate for R-410A	CO ₂ Leak Rate	Equivalent Helium Leak Rate for CO ₂	Time Required for One Bubble to Form (Immersion Test)
0.5 (0.018)	3.97 x 10 ⁻⁶	2.40 x 10 ⁻⁶	4.07 x 10 ⁻⁶	2.96 x 10 ⁻⁶	5.35 x 10 ⁻⁶	3.71 x 10 ⁻⁶	8.80 x 10 ⁻⁶	6.55 x 10 ⁻⁶	135.0 min
1.0 (0.035)	7.94 x 10 ⁻⁶	4.80 x 10 ⁻⁶	8.13 x 10 ⁻⁶	5.92 x 10 ⁻⁶	1.07 x 10 ⁻⁵	7.42 x 10 ⁻⁶	1.76 x 10 ⁻⁵	1.31 x 10 ⁻⁵	69.0 min
2.0 (0.071)	1.59 x 10 ⁻⁵	9.6 x 10 ⁻⁶	1.63 x 10 ⁻⁵	1.18 x 10 ⁻⁵	2.14 x 10 ⁻⁵	1.48 x 10 ⁻⁵	3.52 x 10 ⁻⁵	2.62 x 10 ⁻⁵	34.0 min
2.8 (0.1)	2.22 x 10 ⁻⁵	1.34 x 10 ⁻⁵	2.28 x 10 ⁻⁵	1.66 x 10 ⁻⁵	3.00 x 10 ⁻⁵	2.08 x 10 ⁻⁵	4.93 x 10 ⁻⁵	3.67 x 10 ⁻⁵	24.0 min
7.0 (0.25)	5.56 x 10 ⁻⁵	3.36 x 10 ⁻⁵	5.69 x 10 ⁻⁵	4.14 x 10 ⁻⁵	7.49 x 10 ⁻⁵	5.19 x 10 ⁻⁵	1.23 x 10 ⁻⁴	9.17 x 10 ⁻⁵	10.0 min
14 (0.50)	1.11 x 10 ⁻⁴	6.72 x 10 ⁻⁵	1.14 x 10 ⁻⁴	8.29 x 10 ⁻⁵	1.50 x 10 ⁻⁴	1.04 x 10 ⁻⁴	2.46 x 10 ⁻⁴	1.83 x 10 ⁻⁴	290.0 sec
28 (1.0)	2.22 x 10 ⁻⁴	1.34 x 10 ⁻⁴	2.28 x 10 ⁻⁴	1.66 x 10 ⁻⁴	3.00 x 10 ⁻⁴	2.08 x 10 ⁻⁴	4.93 x 10 ⁻⁴	3.67 x 10 ⁻⁴	145.0 sec
56 (2.0)	4.45 x 10 ⁻⁴	2.69 x 10 ⁻⁴	4.55 x 10 ⁻⁴	3.32 x 10 ⁻⁴	5.99 x 10 ⁻⁴	4.16 x 10 ⁻⁴	9.86 x 10 ⁻⁴	7.34 x 10 ⁻⁴	72 sec
112 (4.0)	8.89 x 10 ⁻⁴	5.38 x 10 ⁻⁴	9.11 x 10 ⁻⁴	6.63 x 10 ⁻⁴	1.20 x 10 ⁻³	8.31 x 10 ⁻⁴	1.97 x 10 ⁻³	1.47 x 10 ⁻³	36 sec
224 (8.0)	1.78 x 10 ⁻³	1.08 x 10 ⁻³	1.82 x 10 ⁻³	1.33 x 10 ⁻³	2.40 x 10 ⁻³	1.66 x 10 ⁻³	3.94 x 10 ⁻³	2.93 x 10 ⁻³	18 sec
448 (16.0)	3.56 x 10 ⁻³	2.15 x 10 ⁻³	3.64 x 10 ⁻³	2.65 x 10 ⁻³	4.80 x 10 ⁻³	3.32 x 10 ⁻³	7.89 x 10 ⁻³	5.87 x 10 ⁻³	9.0 sec
896 (32.0)	7.11 x 10 ⁻³	4.30 x 10 ⁻³	7.29 x 10 ⁻³	5.30 x 10 ⁻³	9.59 x 10 ⁻³	6.65 x 10 ⁻³	1.58 x 10 ⁻²	1.17 x 10 ⁻²	4.5 sec
1792 (64.0)	1.42 x 10 ⁻²	8.60 x 10 ⁻³	1.46 x 10 ⁻²	1.06 x 10 ⁻²	1.92 x 10 ⁻²	1.33 x 10 ⁻²	3.15 x 10 ⁻²	2.35 x 10 ⁻²	2.25 sec

NOTE: All Leak Rates in Atm-cc/sec @ 25°C and assumes same pressure differential is used in all cases.

Popular Tracer Gas Leak Rate Summary (continued)

Specifications Grams (oz)/Year	R-507 Leak Rate	Equivalent Helium Leak Rate for R-507	R-407C Leak Rate	Equivalent Helium Leak Rate for R-407C	R-123 Leak Rate	Equivalent Helium Leak Rate for R-123	R-1234yf Leak Rate	Equivalent Helium Leak Rate for R-1234yf	Time Required for One Bubble to Form (Immersion Test)
0.5 (0.018)	3.92 x 10 ⁻⁶	2.42 x 10 ⁻⁶	4.50 x 10 ⁻⁶	2.89 x 10 ⁻⁶	2.54 x 10 ⁻⁶	1.37 x 10 ⁻⁶	3.40 x 10 ⁻⁶	1.82 x 10 ⁻⁶	135.0 min
1.0 (0.035)	7.84 x 10 ⁻⁶	4.83 x 10 ⁻⁶	8.99 x 10 ⁻⁶	5.78 x 10 ⁻⁶	5.07 x 10 ⁻⁶	2.73 x 10 ⁻⁶	6.8 x 10 ⁻⁶	3.63 x 10 ⁻⁶	69.0 min
2.0 (0.071)	1.57 x 10 ⁻⁵	9.66 x 10 ⁻⁶	1.80 x 10 ⁻⁵	1.16 x 10 ⁻⁵	1.01 x 10 ⁻⁵	5.46 x 10 ⁻⁶	1.36 x 10 ⁻⁵	7.27 x 10 ⁻⁶	34.0 min
2.8 (0.1)	2.20 x 10 ⁻⁵	1.35 x 10 ⁻⁵	2.52 x 10 ⁻⁵	1.62 x 10 ⁻⁵	1.42 x 10 ⁻⁵	7.64 x 10 ⁻⁶	1.9 x 10 ⁻⁵	1.05 x 10 ⁻⁵	24.0 min
7.0 (0.25)	5.49 x 10 ⁻⁵	3.38 x 10 ⁻⁵	6.29 x 10 ⁻⁵	4.05 x 10 ⁻⁵	3.55 x 10 ⁻⁵	1.91 x 10 ⁻⁵	4.76 x 10 ⁻⁵	2.54 x 10 ⁻⁵	10.0 min
14 (0.50)	1.10 x 10 ⁻⁴	6.76 x 10 ⁻⁵	1.26 x 10 ⁻⁴	8.09 x 10 ⁻⁵	7.09 x 10 ⁻⁵	3.82 x 10 ⁻⁵	9.5 x 10 ⁻⁵	5.08 x 10 ⁻⁵	290.0 sec
28 (1.0)	2.20 x 10 ⁻⁴	1.35 x 10 ⁻⁴	2.52 x 10 ⁻⁴	1.62 x 10 ⁻⁴	1.42 x 10 ⁻⁴	7.64 x 10 ⁻⁵	1.9 x 10 ⁻⁴	1.02 x 10 ⁻⁴	145.0 sec
56 (2.0)	4.39 x 10 ⁻⁴	2.71 x 10 ⁻⁴	5.03 x 10 ⁻⁴	3.24 x 10 ⁻⁴	2.84 x 10 ⁻⁴	1.53 x 10 ⁻⁴	3.81 x 10 ⁻⁴	2.04 x 10 ⁻⁴	72 sec
112 (4.0)	8.78 x 10 ⁻⁴	5.41 x 10 ⁻⁴	1.01 x 10 ⁻³	6.47 x 10 ⁻⁴	5.68 x 10 ⁻⁴	3.06 x 10 ⁻⁴	7.62 x 10 ⁻⁴	4.07 x 10 ⁻⁴	36 sec
224 (8.0)	1.76 x 10 ⁻³	1.08 x 10 ⁻³	2.01 x 10 ⁻³	1.30 x 10 ⁻³	1.14 x 10 ⁻³	6.12 x 10 ⁻⁴	1.52 x 10 ⁻³	8.12 x 10 ⁻⁴	18 sec
448 (16.0)	3.51 x 10 ⁻³	2.16 x 10 ⁻³	4.03 x 10 ⁻³	2.59 x 10 ⁻³	2.27 x 10 ⁻³	1.22 x 10 ⁻³	3.05 x 10 ⁻³	1.63 x 10 ⁻³	9.0 sec
896 (32.0)	7.03 x 10 ⁻³	4.33 x 10 ⁻³	8.06 x 10 ⁻³	5.18 x 10 ⁻³	4.54 x 10 ⁻³	2.45 x 10 ⁻³	6.09 x 10 ⁻³	3.25 x 10 ⁻³	4.5 sec
1792 (64.0)	1.41 x 10 ⁻²	8.66 x 10 ⁻³	1.61 x 10 ⁻²	1.04 x 10 ⁻²	9.09 x 10 ⁻³	4.89 x 10 ⁻³	12.2 x 10 ⁻³	6.51 x 10 ⁻³	2.25 sec

Specifications Grams (oz)/Year	R-600a Leak Rate	Equivalent Helium Leak Rate for R-600	Time Required for One Bubble to Form (Immersion Test)
0.5 (0.018)	6.59 x 10 ⁻⁶	2.27 x 10 ⁻⁶	135.0 min
1.0 (0.035)	1.32 x 10 ⁻⁵	4.55 x 10 ⁻⁶	69.0 min
2.0 (0.071)	2.64 x 10 ⁻⁵	9.1 x 10 ⁻⁶	34.0 min
2.8 (0.1)	3.69 x 10 ⁻⁵	1.27 x 10 ⁻⁵	24.0 min
7.0 (0.25)	9.23 x 10 ⁻⁵	3.18 x 10 ⁻⁵	10.0 min
14 (0.50)	1.85 x 10 ⁻⁴	6.38 x 10 ⁻⁵	290.0 sec
28 (1.0)	3.69 x 10 ⁻⁴	1.27 x 10 ⁻⁴	145.0 sec
56 (2.0)	7.38 x 10 ⁻⁴	2.54 x 10 ⁻⁴	72 sec
112 (4.0)	1.48 x 10 ⁻³	5.10 x 10 ⁻⁴	36 sec
224 (8.0)	2.95 x 10 ⁻³	1.02 x 10 ⁻³	18 sec
448 (16.0)	5.90 x 10 ⁻³	2.04 x 10 ⁻³	9.0 sec
896 (32.0)	11.8 x 10 ⁻³	4.07 x 10 ⁻³	4.5 sec
1792 (64.0)	2.36 x 10 ⁻²	8.14 x 10 ⁻³	2.25 sec

Table-1

Gas	MW (g/mol)	Viscosity (µP)
CO ₂	44.01	14.90
Helium	4.0006	19.97
R-12	120.93	13.42
R-123	152.93	10.75
R-1234yf	114	10.67
R-134a	102.03	12.20
R-22	86.48	12.82
R-404A	97.6	12.07
R-407C	86.2	12.83
R-410A	72.6	13.85
R-507	98.9	12.30
R-508B	95.39	14.55
R-600a	58	6.89
SF ₆	146.054	15.60

NOTE: All Leak Rates in Atm-cc/sec @ 25°C and assumes same pressure differential is used in all cases.

How the leak rates are calculated in the above table:

- $xLeakRate = (grams/year) \times (1yr/3.15^7) \times (22.4 \text{ Atm-liter/mole}) \times (1000 \text{ cc/liter}) \times (298^0K/273^0K) \times (1/xMW)$.
Which when simplified; $xLeakRate = (grams/year) \times (775.3^6) \times (1/xMW)$.
- Equivalent He. Leak Rate = $(xLeakRate) \times (xViscosity/He. Viscosity)$ (ref. Table-1 above)
(Viscosity values extrapolated from 1993 Ashrae Handbook Fundamental I-P Edition and Allied Signal Genetron Physical Properties Report.)
- When changing PSI pressures use the following formula to calculate new leak rate.
 - $[(\text{new pressure} + 14.7)^2 - (14.7)^2] / [(\text{existing pressure} + 14.7)^2 - (14.7)^2] = \text{conversion factor}$.
 - The conversion factor is multiplied against existing leak rate to find new leak rate value.
- * - Unless you are changing a PSI pressure to an evacuation and spray method use the following formula to calculate new leak rate.
 - $[(0)^2 - (14.7)^2] / [(\text{existing pressure} + 14.7)^2 - (14.7)^2] = \text{conversion factor}$.
- When changing mix % of helium, multiply the leak rate at 100% by the new %.
 - ex: leak rate is 5×10^{-5} @ 100% He.; at 20% He. the new leak rate = 1.0×10^{-5} .
- Generally Helium flow through small leaks, 1×10^{-6} std-cc/sec or less, is 2.73 times the air leakage rate. Helium flow through larger leaks is generally 1.4 times the air flow rate.