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Popular Tracer Gases Leak Rate Summary

Specifications Grams/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 oz/yr)	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 oz/yr)	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 oz/yr)	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 oz/yr)	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 oz/yr)	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 oz/yr)	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 oz/yr)	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 oz/yr)	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 oz/yr)	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 oz/yr)	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 oz/yr)	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 sec
896 (32.0 oz/yr)	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 oz/yr)	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/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 oz/yr)	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 oz/yr)	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 oz/yr)	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 oz/yr)	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 oz/yr)	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 oz/yr)	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 oz/yr)	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 oz/yr)	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 oz/yr)	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 oz/yr)	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 oz/yr)	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 sec
896 (32.0 oz/yr)	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 oz/yr)	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 @ 25^0C and assumes same pressure differential is used in all cases.

Specifications Grams/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	Time Required for One Bubble to Form (Immersion Test)
0.5 (0.018 oz/yr)	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	135.0 min
1.0 (0.035 oz/yr)	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 x10-6	69.0 min
2.0 (0.071 oz/yr)	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	34.0 min
2.8 (0.1 oz/yr)	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	24.0 min
7.0 (0.25 oz/yr)	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	10.0 min
14 (0.50 oz/yr)	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	290.0 sec
28 (1.0 oz/yr)	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	145.0 sec
56 (2.0 oz/yr)	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	72 sec
112 (4.0 oz/yr)	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	36 sec
224 (8.0 oz/yr)	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	18 sec
448 (16.0 oz/yr)	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	9 sec
896 (32.0 oz/yr)	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	4.5 sec
1792 (64.0 oz/yr)	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	2.25 sec

NOTE: All Leak Rates in Atm-cc/sec @ 25^0C and assumes same pressure differential is used in all cases.

How are the leak rates in the above table calculated?

1. XLeakRate = (grams/year) x (1yr/3.15^7) x (22.4 Atm-liter/mole) x (1000 cc/liter) x (298^0K/273^0K) x (1/XMW)
   Which when simplified; XLeakRate = (grams/year) x (775.3^{-6}) x (1/XMW)
2. Equivalent He. Leak Rate = (XLeakRate) x (Xviscosity/He. viscosity)
   - R-12, MW = 120.93, Viscosity = 13.42
   - R-22, MW = 86.48, Viscosity = 12.82
   - R-134A, MW = 102.03, Viscosity = 12.20
   - SF_6, MW = 146.054, Viscosity = 15.60
   - Helium, MW = 4.0006, Viscosity = 19.97
   - R-404A, MW = 97.6, Viscosity = 12.07
   - R-508B, MW = 95.39, Viscosity = 14.55
   - R-410A, MW = 72.6, Viscosity = 13.85
   - CO_2, MW = 44.01, Viscosity = 14.90
   - R-507, MW = 98.9, Viscosity = 12.30
   - R-407C, MW = 86.2, Viscosity = 12.83
   - R-123, MW = 152.93, Viscosity = 10.75

   (Viscosity values extrapolated from 1993 Ashrae Handbook Fundamental I-P Edition and Allied Signal Genetron Physical Properties Report)

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3. When changing PSI pressures use the following formula to calculate new leak rate.
   - [(new pressure + 14.7)^2 – (14.7)^2] / [(existing pressure + 14.7)^2 – (14.7)^2] = 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] / [(existing pressure + 14.7)^2 – (14.7)^2 = conversion factor

4. When changing mix % of helium, multiply the leak rate at 100% by the new %.
   - ex: leak rate is 5 x 10^{-5} @ 100% He.; at 20% He. the new leak rate = 1.0 x 10^{-5}.
5. Generally helium flow through small leaks, 1 x 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.

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