

# Refrigerant Detection Alarm Levels

The question often arises of what alarm levels should be set to adequately detect for a system refrigerant leak before too much refrigerant is lost. There are two main motivations to detect for refrigerant: meet local health & safety codes, and find early leaks before the system loses efficiency. The latter is the hardest to determine. What level do I need to alarm at to adequately find a leak?

## Alarm Levels

### Early Detection (Pre-Alarm)

Pre-alarm is not required by code, but is often sought after to reduce leak costs.

The question we want to answer is; what is an adequate pre-alarm level setpoint?

### Code Requirements (Full Alarm)

Alarm level requirements are specified in ASHRAE 15 and 34 to alarm at the Occupational Exposure Limit (OEL). For most A1 refrigerants is 1000PPM. At this level, the system alarms and ventilates.



## Early Detection... PPM to LB Relationship

Converting this helps visualize sensitivity of alarm levels in terms of refrigerant weight.



$$\frac{g}{m^3} = \frac{\text{Molar Mass of Ref} \left(\frac{g}{mol}\right) \cdot PPM}{\text{Molar Volume of Air (L)}} \quad (\text{Reference 1})$$

$$\frac{g}{m^3} = \frac{\left(\frac{102.03g}{mol}\right) \cdot 200PPM}{24.45L} = 834.6 \frac{g}{mol} = 0.0000521 \frac{lb \text{ of } 134a}{ft^3}$$



$$200PPM \text{ of } 134a = 0.0000521 \frac{lb \text{ of } 134a}{ft^3}$$



## How Large Is The Leak? Using a hypothetical system...

SYSTEM CHARGE

2,500LB

ANNUAL LEAK

10%

LEAK RATE

250 LB/YR

0.68 LB / DAY

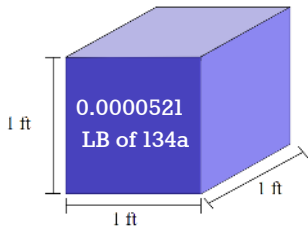
0.029 LB / HOUR

0.0000079 LB / SEC



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## Evaluation... What does this mean?



≡ 200 Parts Per Million

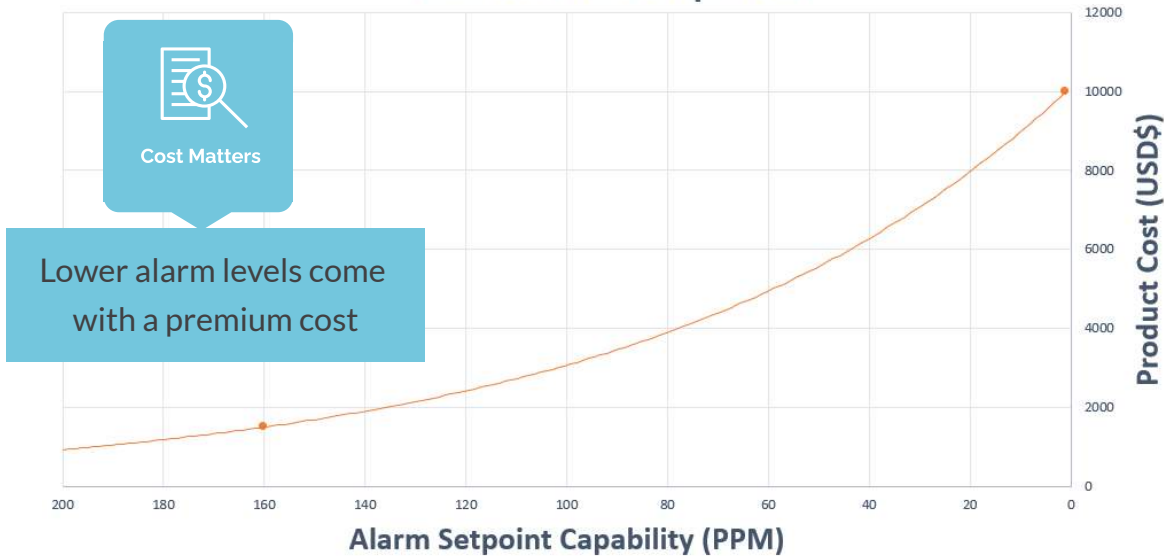
10% Annual Leak In a 2,500LB System would take

**6.57  
Seconds**

to reach 200PPM in a 1 cubic foot area.

How long would our 10% leak rate take to fill the 1 cubic foot space with enough gas to alarm at 200PPM?

Cost to PPM Comparison



## Alarm Level Conclusion

Anything under 500PPM can be used to adequately detect for a leak at a reasonable cost. Once alarm setpoints get under 500PPM, what matters the most is catching the **TRAVEL** of the gas. Refrigerant gas will travel in slugs in concentrations high enough to set off any reasonable alarm setpoint.

Detector location becomes the most important factor. Place one sensor at each chiller 1FT A.F.F. for the best chances of catching the travel of the refrigerant after a leak. Placing a sensor near the ventilation fan can help detect gas that's being exhausted out.

### Resources

[https://www.cdc.gov/niosh/docs/2004-101/calc.html#:~:text=Y%20mg%2Fm3%20%3D%20\(press%20the%20%E2%80%9CCalculate%E2%80%9D%20button.](https://www.cdc.gov/niosh/docs/2004-101/calc.html#:~:text=Y%20mg%2Fm3%20%3D%20(press%20the%20%E2%80%9CCalculate%E2%80%9D%20button.)