2025 PARTNER EXCHANGE
35th Anniversary

Strategies for Sustainable Refrigerant Solutions

Paul Dombroski, Service Operations Refrigerant Manager
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May 2025

WAVES of INNOVATION
TOGETHER WE RISE

TRANE

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Today’s Presenters

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Agenda

- Regulatory Landscape
- Servicing and How it Affects Your Business
- Chilled Water Applications
- DX Applications

Learning Objectives

After this presentation participants will be able to:

1. Identify the dates that will pose the greatest challenges to my business.
2. Investigate the prerequisites for technician preparedness when working with low-flammability refrigerants.
3. Summarize the requirements for chiller rooms using A2L refrigerants.
4. Analyze the advantages of having a non-A2L chiller in your machinery room.
5. Examine the factors to consider for DX applications using A2L refrigerants.

Regulatory Landscape

Standards, Codes, and Regulations

Transition to low GWP refrigerants

ASHRAE®

- Building standards for codes
- Allowable charge amounts

EPA & SNAP

- Manufacturing dates
- Installation Dates
- GWP Limits

DOT

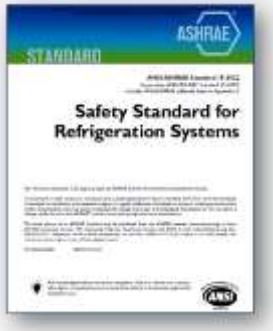
- Service vehicle limits
- Unit transport limits

UL®

- Appliance standards
- Appliance component compliance

OSHA

- Storage outline for cylinders and units



Standard

Model Code

State Law

Need to Know Definitions

These definitions apply to high-GWP appliances, EPA GWP limit of 700

Product

- An appliance that comes pre-charged from the manufacturer and can be set, wired, and started
- R-410A charged appliances can be manufactured through 2024 and distributed for 3 years thereafter

Component

- Components are the pieces of the System
- Will be manufactured for the foreseeable future and are used for repairs, NOT for making a System
- CANNOT cross classes, an A1 designed component can not be used in an A2L System
- If failures reach 75% of the System, then System must be replaced

System

- Components that are built up together, joined by a line-set (and possibly wiring) and charged in the field
- Sold as complete package, not as separate “components”
- Can be purchased through 2025, MUST be installed by end of 2025

US EPA Technology Transitions Program Rule Fact Sheet

Dropdead Dates

December 31, 2024
- High-GWP A/C appliance production ceases (applied units and systems)
- Dry component production continues indefinitely

December 31, 2025
- High-GWP A/C systems must be installed

December 31, 2026
- High-GWP VRF production ceases

December 31, 2027
- High-GWP products can no longer be sold, shipped, or installed

Servicing and How it Affects Your Business

Service Impacts

Vacuum Pump

Leak Detector

Recovery Unit

- **Tools change**
  - Recovery machine, vacuum pump, leak detector all need to be A2L compatible (the new tools are compatible with all refrigerants, no need for multiple sets)
  - Existing manifolds, scales, hoses work with A2Ls
- **Time to service changes**
  - Nitrogen sweep after recovery is mandated to perform any hot work on appliance (circuit)
  - Additional time needed for recovery process and nitrogen sweep will vary depending on appliance size (how big is the circuit)
  - Additional time required for new installation (pressure and vacuum testing piping)
- **Technician will need to change**
  - Habits and processes will need to be learned so that they are safe first and foremost but also competent about what the future of refrigerants hold (A2Ls are here to stay)

Service Impacts

- **Training changes**
  - Low-GWP Certification is highly recommended, not just for safe servicing but also the possibility of the EPA requiring it for a 608 License
  - Get Techs certified, small price for a big upside
- **Transport changes**
  - Service vehicles can only carry 225 lbs. of an A2L (going against their 440 lbs. Materials Of Trade allotment)
- **Trade changes**
  - Cannot store A2Ls at the shop/office (look up AHJ here)
    - Offices can utilize a propane storage cabinet
  - Reclaim all refrigerant to keep viable stock for future servicing and compliance, 2029 on the reclaim mandates
  - Recordkeeping for refrigerant handling
    - Currently 50 lbs. plus that changes to 15 lbs. plus starting in 2028, 5 lbs. plus for disposal and start-up
  - Quoting repairs will take more thoughtfulness to ensure accuracy

EPA Rules on Repair and Replacement Limits

Common questions the EPA have recieved

CAN I REPLACE A BROKEN R-410A OUTDOOR CONDENSING UNIT WITH ONE THAT USES A LOWER GWP REFRIGERANT?

The 2023 Technology Transitions Rule does not address this issue, but it may be possible depending on the circumstances. EPA's Significant New Alternatives Policy (SNAP) Program and industry standards prohibit the use of flammable or mildly flammable refrigerants such as HFC-32 or R-454B in systems that were not designed to use them. There may also be engineering and design considerations that could prevent the use of non-flammable refrigerants (e.g., pressures).

IS THERE A POINT AT WHICH REPLACING COMPONENTS TRIGGERS THE GWP LIMITS FOR NEW SYSTEMS?

Yes. Replacing 75% or more of the evaporators (by number) and 100 percent of the compressor racks, condensers, and connected evaporator loads of an existing system would trigger the requirements of new systems. Any other modifications that could increase capacity or considering the system as "new" would also trigger this requirement.

CAN I REPLACE A FAILED R-22 CONDENSER WITH A R-410A ONE?

No. In this situation the R-22 indoor coil would not be compatible with R-410A due to the difference in pressures. R-410A is also not listed as acceptable by the SNAP Program as a retrofit for R-22 systems.

New Equipment (RACHP)

Restrictions apply to new equipment

Modifying an existing system can result in it being considered "new"

1. Increasing the total cooling capacity in BTU
2. Complete replacement of all components within a system at once or over time
3. Replacing 75% or more of the evaporators (by number) and 100% of the compressor racks, condensers, and connected evaporator loads of an existing system would trigger the requirements of new systems.

HFC Phasedown

Possible Options for built up AHUs

Updating an existing system from an A1 refrigerant to an A2L

- SNAP 23 does not allow retrofits to an A2L refrigerant, however, there is a path to possibly making this happen

- **Step 1**
  - Start a conversation with your AHJ, which could lead to them using the Alternative Means and Methods (AMM) process to approve the retrofit
  - This process is data driven and requires time and analysis, such as Engineers, Testing Labs, Installing Contractor and Building owner

- **Step 2**
  - Retrofit must comply with ASHRAE 15 and UL 60355 2-40 requirements for a new install with Field testing taking place
  - Written instructions from National Recognized Testing Laboratory or Licensed Professional Engineer
  - May require 2 or more visits from UL, where old testing labels are removed and new ones affixed

- VERY COSTLY and DIFFICULT path to take, so repairs or chilled water retrofit may be cheaper and easier

Chilled Water Applications with A2L Refrigerants

System Probability Classification

ASHRAE® Standard 15 - 2022

- **High probability:** Location of components is such that leaked refrigerant from components **WILL** enter an occupied space

  E.g., DX split, DX RTU, VRF

- **Low Probability:** Location of components is such that leaked refrigerant from components **CANNOT** enter an occupied space

  E.g., Outdoor chiller, chiller in a machinery room

ASHRAE® Standard 15, Spaces Definition

Definitions

“occupied space”	That portion of the premises accessible to, or occupied by, people, excluding machinery rooms.
“machinery room”	A designated space meeting the requirements of Sections 8.9, 8.10, and 8.11, that contains one or more refrigerating systems or portions thereof, such as compressors and pressure vessels.

“mechanical space” “mechanical room” “equipment room” “MER”

≠

“machinery room”

Mechanical Room vs Machinery Room for A2L

Requirement	Mechanical Room	Machinery Room
Non-combustible construction	Not required	**Required**
Mechanical ventilation to the outdoors	Not required	**Required**
Mechanical ventilation operation	For mitigation Activated by refrigerant detector S 7.6.4	Run continuous or activated by refrigerant monitor Level 1 and Level 2 S 8.11.11
Refrigerant detection system	Not required unless mechanical ventilation is a mitigation action	**Required**
Remote control equipment shutdown	Not required	**Required**
Audible and visual alarm	Not required	**Required**

Machinery Room Requirements Per Refrigerant Class

Designated space that complies with the requirements listed in Sections 8.9, 8.10, and 8.11 of ASHRAE® Standard 15

Machinery Room Requirement	A1, B1	A2L, B2L
Mechanical ventilation	**Required**	**Required** (5x~6x or more)
Non-combustible construction	Not Required	**Required**
Exterior doors not under fire escape	Not Required	**Required**
Remote control equipment shutdown	Not Required	**Required**

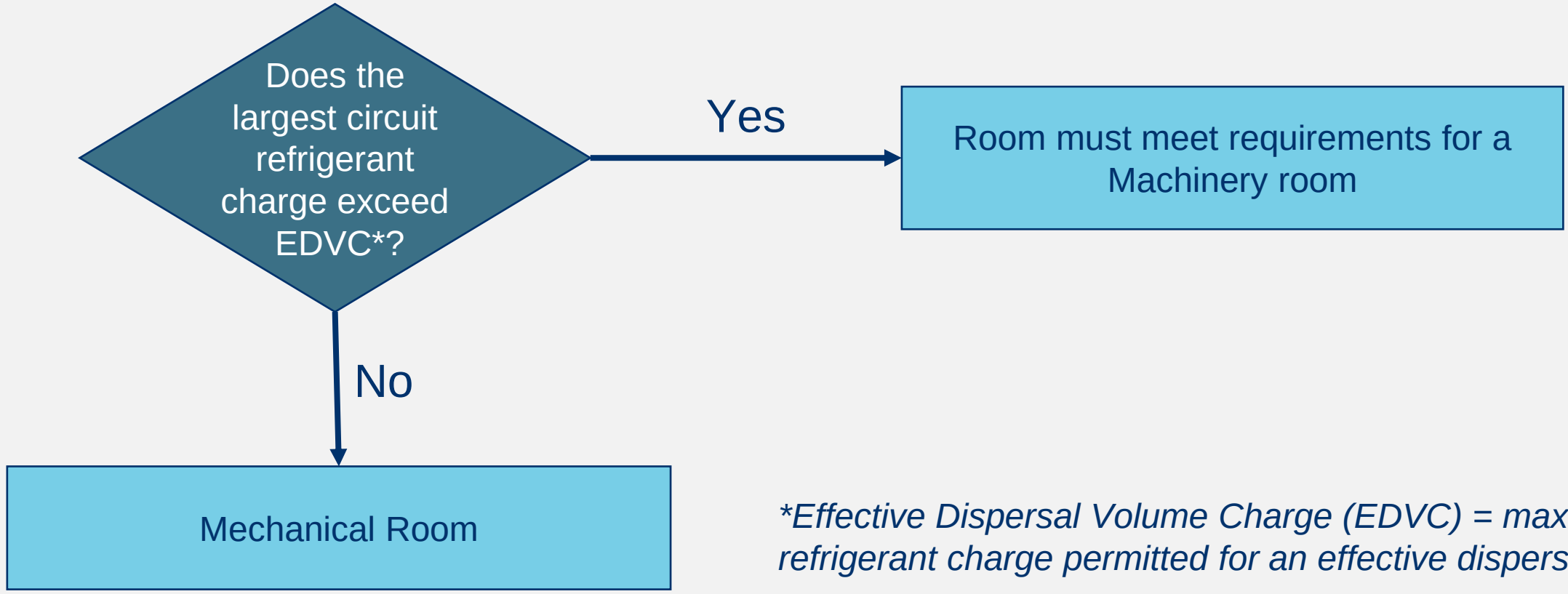
Machinery Room Chiller Replacement

Example: Analysis for a 500-ton water-cooled chiller replacement

Refrigerant	Refrigerant safety classification	Refrigerant charge, G (single refrigeration circuit)	Alarm (level 2) ventilation rate, Q
R-134a	A1	750 lbs	2740 cfm
R-123	B1	500 lbs	2240 cfm
R-514A	B1	850 lbs	2920 cfm
R-1234ze	A2L	1200 lbs	18,000 cfm

Is My A2L Chiller in a Mechanical Room or Machinery Room?

A chiller is initially classified as a “high-probability” system



**Effective Dispersal Volume Charge (EDVC) = maximum refrigerant charge permitted for an effective dispersal volume*

Mechanical Ventilation for Mechanical Room

- Mechanical ventilation to remove excess charge that can't be dissipated
- Ventilation rates
  - Table 7-4 or
  - Equation 7-11a,b
- Continuous ventilation or
- Activated by a refrigerant detector

Table 7-4 Required Ventilation for A2L Systems

Excluded Charge $(m_s - EDVC)^b$		Q_{req}		Excluded Charge $(m_s - EDVC)^b$		Q_{req}	
lb	kg	ft^3/min	m^3/h	lb	kg	ft^3/min	m^3/h
3.8	1.7	100	170	91.8	41.6	2400	4080
7.6	3.5	200	340	95.6	43.4	2500	4250
11.5	5.2	300	510	99.4	45.1	2600	4420
15.3	6.9	400	680	103.2	46.8	2700	4590
19.1	8.7	500	850	107.1	48.6	2800	4760
22.9	10.4	600	1020	110.9	50.3	2900	4930
26.8	12.1	700	1190	114.7	52.0	3000	5100
30.6	13.9	800	1360	118.5	53.8	3100	5270
34.4	15.6	900	1530	122.4	55.5	3200	5440
38.2	17.3	1000	1700	126.2	57.2	3300	5610
42.1	19.1	1100	1870	130.0	59.0	3400	5780
45.9	20.8	1200	2040	133.8	60.7	3500	5950
49.7	22.5	1300	2210	137.6	62.4	3600	6120
53.5	24.3	1400	2380	141.5	64.2	3700	6290
57.4	26.0	1500	2550	145.3	65.9	3800	6460
61.2	27.7	1600	2720	149.1	67.6	3900	6630
65.0	29.5	1700	2890	152.9	69.4	4000	6800
68.8	31.2	1800	3060	156.8	71.1	4100	6970
72.6	32.9	1900	3230	160.6	72.8	4200	7140
76.5	34.7	2000	3400	164.4	74.6	4300	7310
80.3	36.4	2100	3570	168.2	76.3	4400	7480
84.1	38.1	2200	3740	172.1	78.0	4500	7650
87.9	39.9	2300	3910	175.5	79.6	4590	7803

Excess Refrigerant Charge Ventilation Required

Standard 15 - A2L Application Examples

Direct Systems

Field Pipe Testing

9.13.6.1 Leak Testing Protocol

- *Strength test with inert gas 10 minutes to nameplate pressure*
- *Pressurize with inert gas to 500 psi for duration specified in Table 9-7*
- *Vacuum test to 500 microns for duration specified in Table 9-7*
- *System charges larger than 55 lbs requires section 9.13.7 Contractor or Engineer Declaration*

Leak Testing Protocol

Table 9-7 Duration of Leak Test

Leak Test	Pipe Length, L		Maximum Nominal Pipe Size		Minimum Period of Test
	(ft)	(m)	NPS (in.)	DN (mm)	hours
Pressure Test	*L ≤ 100*	*L ≤ 30*	NPS ≤ 3/4	DN ≤ 20	0.25
			3/4 < NPS ≤ 3	20 < DN ≤ 75	1.0
			3 < NPS	75 < DN	24
	100 < L ≤ 200	*30 < L ≤ 61*	NPS ≤ 3	DN ≤ 75	1.0
			3 < NPS	75 < DN	24
	200 < L	*61 < L*	Any	Any	24
Vacuum Test	*L ≤ 100*	*L ≤ 30*	NPS ≤ 3/4	DN ≤ 20	1.0
			3/4 < NPS ≤ 3	20 < DN ≤ 75	8.0
			3 < NPS	20 < DN ≤ 75	24
	100 < L ≤ 200	*30 < L ≤ 61*	NPS ≤ 3	DN ≤ 75	8.0
			3 < NPS	75 < DN	24
	200 < L	*61 < L*	Any	Any	24

Informative Note: The maximum nominal pipe size is the largest interconnecting field piping installed.

Source: ANSI/ASHRAE Addendum e to ANSI/ASHRAE Standard 15-2019

Leak Testing Protocol

7.2.3.1.1 Exempted Spaces

The areas that contain only continuous refrigerant piping, or contain only joints and connections that have been tested in accordance with Section 9.13, are exempt from the effective dispersal volume calculation unless these areas are part of connected spaces per Section 7.2.3.2.

If the evaporator or condenser is located in the connected space, you still must calculate the EDVC

7.2.3.3 Connected Spaced via Ducted Air Distribution System

Where a refrigeration system, or a part thereof, is located within an air distribution duct system, or in a space served by an air distribution duct system…

Requirements for A2L Occupied Space

$$EDVC = V_{eff} \times LFL \times CF \times F_{occ} \quad (7\text{-}8)$$

where

EDVC = effective dispersal volume charge, lb (kg)

V_{eff} = *effective dispersal volume*, ft^3 (m^3)

LFL = lower flammability limit, lb/ft^3 (kg/m^3)

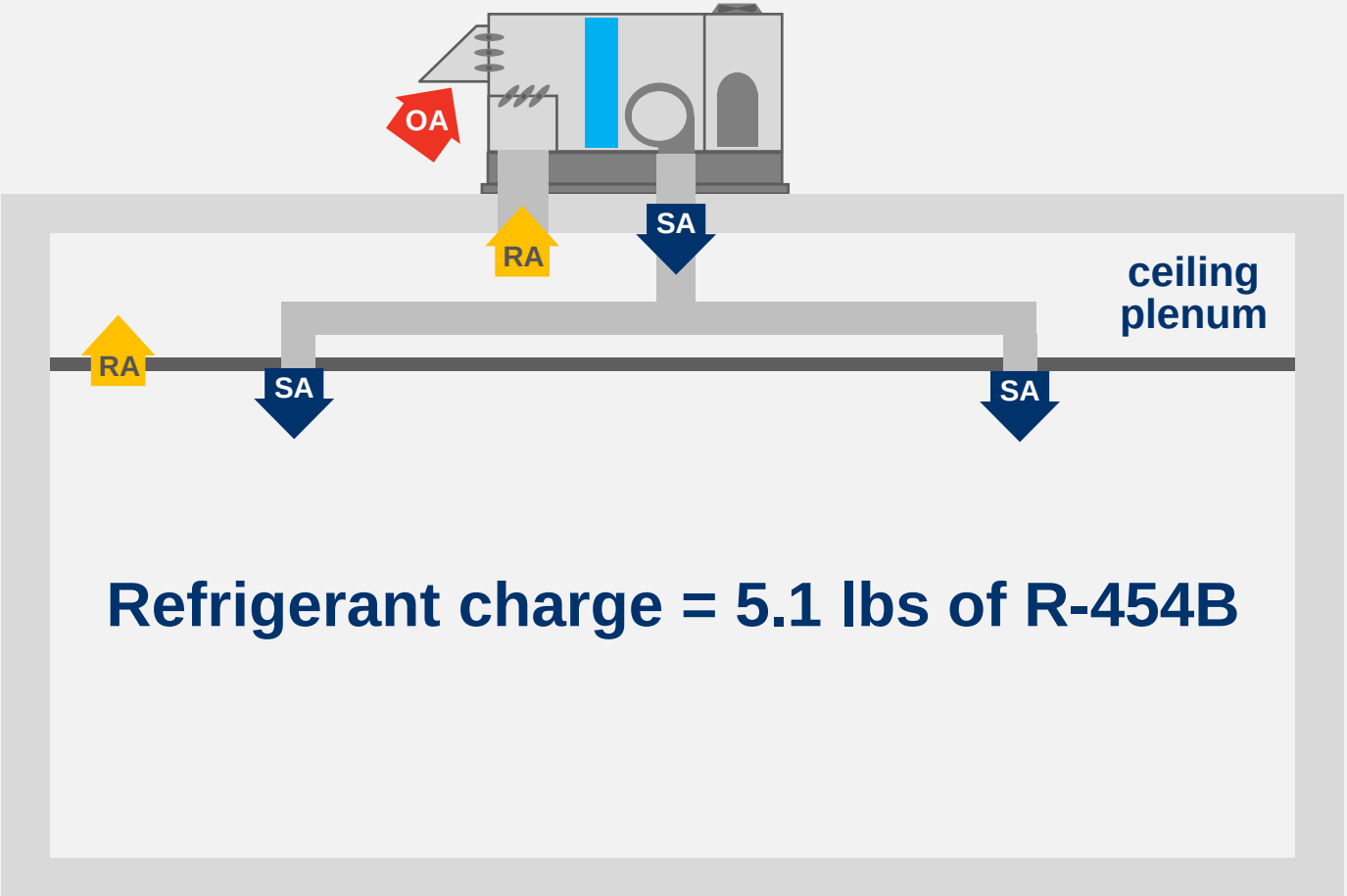
CF = concentration factor, value of 0.5

F_{occ} = *occupancy* adjustment factor; (For all *occupancies* other than *institutional occupancies*, F_{occ} has a value of 1. For *institutional occupancies*, F_{occ} has a value of 0.5.)

Packaged Rooftop Unit Serving Classroom

$$EDVC = V_{eff} \times LFL \times 0.50 \times F_{occ}$$

Space	Volume (ft^3)
Classroom	10,000
Ceiling plenum	1500
Sum	**11,500**



$$EDVC = 11{,}500\ ft^3 \times 0.0185\ lbs/ft^3 \times 0.5 \times 1.0 = 106\ lbs$$

VRF System in “Commercial” Occupancy

private office

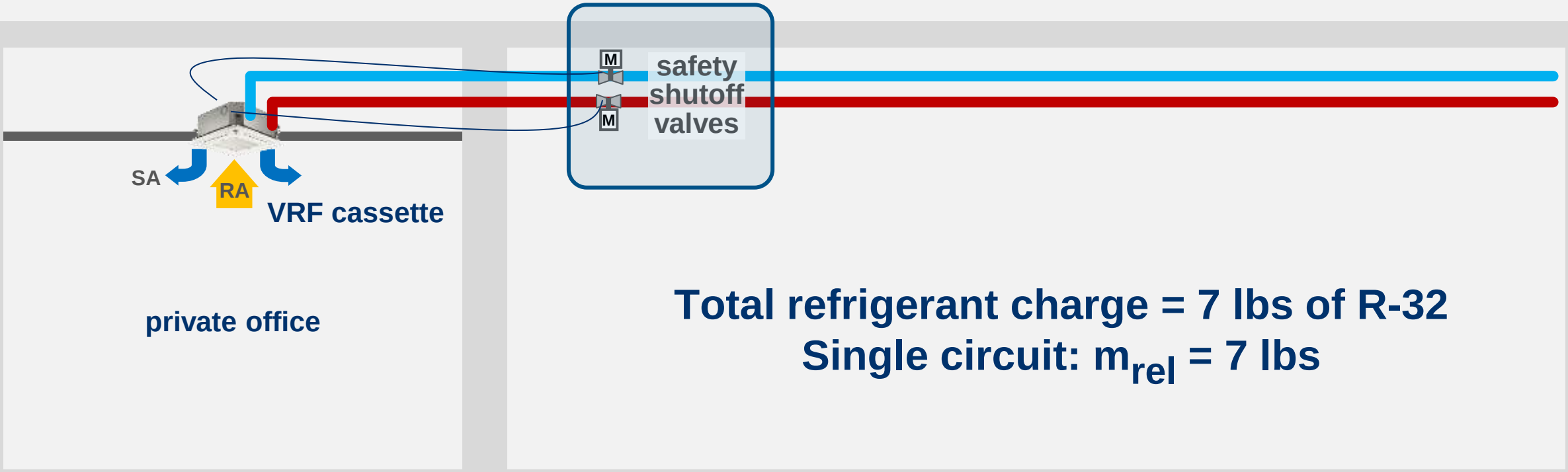
1000 ft^3

$$EDVC = V_{eff} \times LFL \times 0.50 \times F_{occ}$$

Total refrigerant charge = 27 lbs of R-32
Single circuit: m_{rel} = 27 lbs

EDVC = 1000 ft3×0.0191 lbs/ft3×0.5×1.0 = 9.6 lbs

Standard Allows for Safety Shutoff Valves



Total refrigerant charge = 7 lbs of R-32
Single circuit: m_{rel} = 7 lbs

EDVC = 1000 ft3×.0191 lbs/ft3×0.5×1.0 = 9.6 lbs

Use safety shut off valves, natural ventilation.

Shaft Ventilation

9.12.2.2 Shaft Ventilation

Refrigerant pipe shafts with refrigeration systems using only Group A2L or B2L refrigerants shall be naturally or mechanically ventilated. Refrigerant pipe shafts with one or more refrigeration systems using any Group A2, A3, B2, or B3 refrigerant shall be continuously mechanically ventilated and shall include a refrigerant detector. The shaft ventilation exhaust outlet shall comply with the discharge location requirement specified in Section 9.7.8.2.

Options Include:

a. *4.0 inch opening in shaft to outside*
b. *Mechanically ventilated shaft*
c. *Double wall pipe vented to outside*

Factory Certified Leak Detectors

- Trane factory detectors if more than 3.92 lbs. of refrigerant
- Certified location on evaporator coil or indoor compressor
- Factory installed controller activates minimum circulation within 15 seconds (optional on large AHUs)
- Deactivates compressor
- Has an auxiliary contact for additional BAS sequences

Sources of Ignition

7.6.3 Ignition Sources Located in Ductwork

7.6.3.3 Refrigeration Systems with Ductwork. Devices containing hot surfaces exceeding 1290°F (700°C) shall not be located in the ductwork that serves the space unless there is an average airflow velocity not less than 200 ft/min (1.0 m/s) across the heating device(s) and there is proof of airflow before the heating device(s) is energized. Average airflow velocity shall be determined by volumetric airflow rate divided by duct flow area.*

Where to Learn More on ASHRAE® Standard 15

→ **Trane Engineers Newsletter LIVE: ASHRAE® Standard 15-2022**

→ **Trane Engineers Newsletter: A2L Refrigerants and ASHRAE® Standard 15**

→ **Applications Engineering Manuals and Guides**

Additional Resources

- **EPA Technology Transition Program Final Rule:**
  - Restrictions on the Use of Certain HFCs under Subsection (i) of the AIM Act(epa.gov)
  - US EPA AIM Ruling - Unitary FAQ
  - EPA Decoder: Unitary EPA Code Made Easy
  - Report Environmental Violations | ECHO | US EPA
  - Basic Information on Enforcement | US EPA
  - EPA Frequent Questions on the Phasedown of Hydrofluorocarbons

- **Trane.com:**
  - Refrigerant Transition Management
  - HVAC Industry Update on Refrigerants (REFR-PRB001M-EN)
  - Applications Engineering Manual: Refrigeration Systems and Machinery Rooms (APP-APM001G-EN)

- **ESCO**: Low GWP Refrigerant Safety: Flammable and Mildly Flammable Refrigerants
- **Air Conditioning Contractors of America (ACCA):** A2L Refrigerant Safety Training
- **AHRI:** A2L Cylinder Storage Options

Thank you!

If you would like to receive PDH credit for this session, please be sure to provide your feedback in the applicable session survey.
(Also available via the event App!)

**Surveys close 6/4/25*

Breakout Workshops

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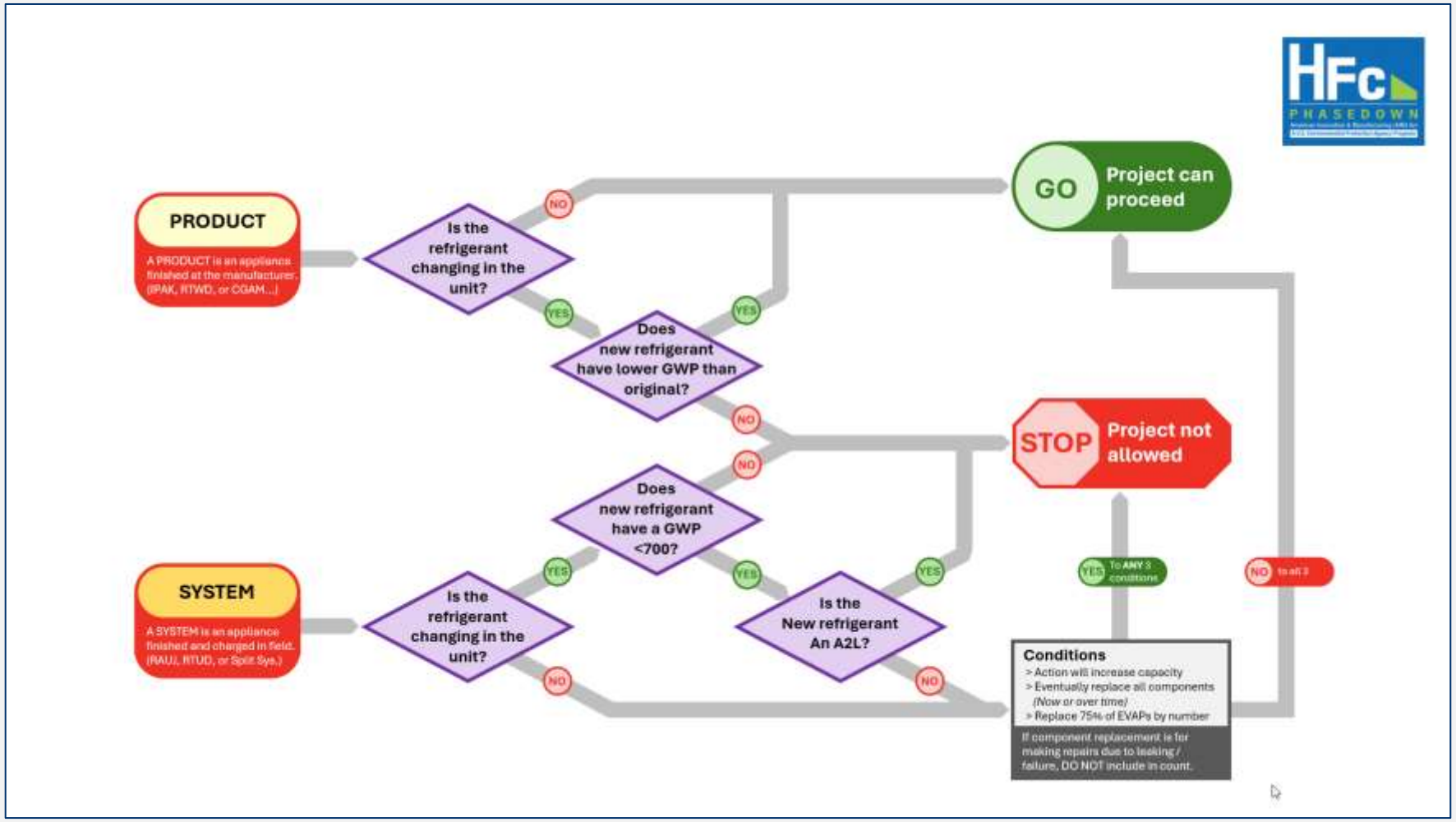
Repair or Conversion Flow Chart per SNAP 23 and Tech. Transfer Rule



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