New Refrigerants and Building Design

Webinar – February 26, 2025

nbi new buildings institute

SAN DIEGO LEARN

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New Refrigerants and Building Design

In today's webinar we'll discuss:

- New and upcoming regulations: timing and what is going on in this space
- What refrigerants are changing: implications and how to get ready
- Flammability of new refrigerants: best practices for how to approach them
- Implications of new refrigerants on high performance building design

Today’s Panelists

Helen Walter-Terrinoni

Trane

John Milkint

Chemour

Ben Burnett

PAE

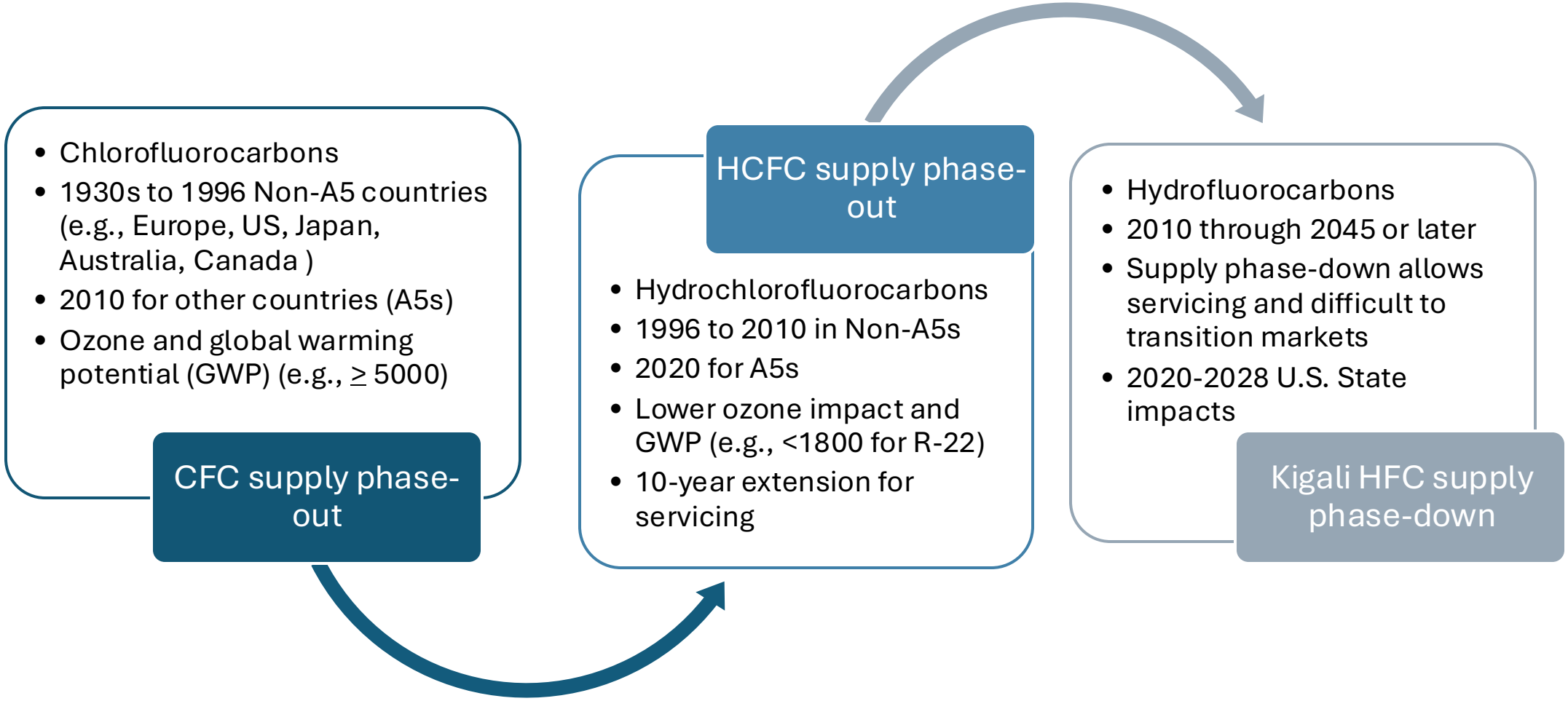
Refrigerant Policy Update

Helen Walter-Terrinoni

February 2025

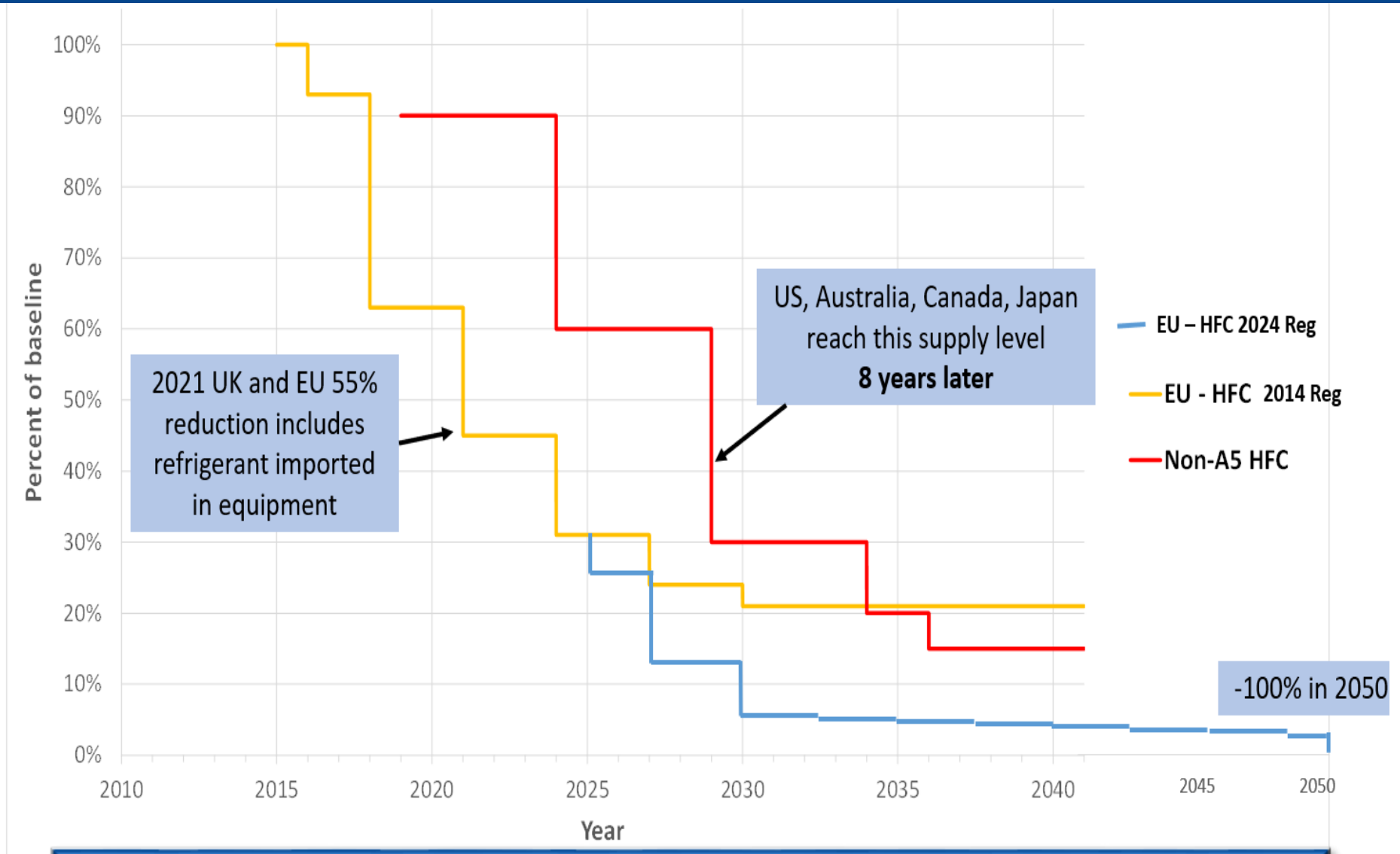
TRANE TECHNOLOGIES

United Nations Montreal Protocol (Universally Ratified) Global Halocarbon Supply Regulatory History



Long history of supply-based refrigerant policy

Refrigerant Supply Phase-Down and Other Policy Drivers



The American Innovation and Manufacturing (AIM) Act aligns with the Kigali Amendment supply phase-down

TRANE TECHNOLOGIES

The American Innovation and Manufacturing (AIM) Act

Mandated phase down of hydrofluorocarbon (HFC) supply

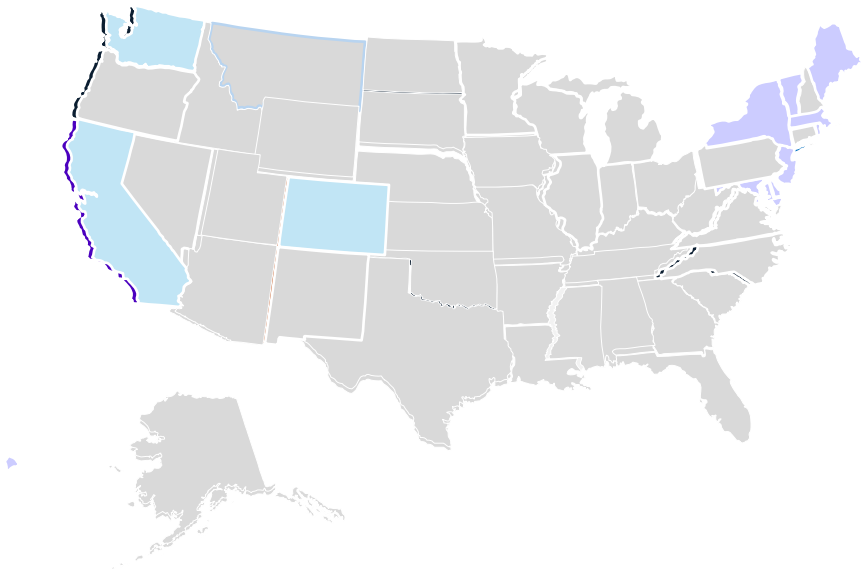
- Production and consumption (production plus import minus export) allocation on a set schedule
- EPA bases quota on historic baseline aligned with Montreal Protocol and allocates allowances based on suppliers historic (<2020) import and production

Subsection i: Authorizes Environmental Protection Agency (EPA) to set global warming potential(GWP) limits or to ban HFCs for specific end-uses

- Technology Transition (TT) regulation details on following slides
- Some states have also regulated HFCs

Subsection h: authorizes EPA to develop policies to minimize emissions and maximize reclaiming of refrigerants.

- Leak management, including repair requirements
- End-of-life recovery
- Reporting
- Reclaim mandates for some refrigeration sectors



- Twelve states have adopted HFC policies based on the Significant New Alternatives Policy (SNAP) program planned rules
- New York, Washington, and California have added additional requirements, including refrigerant management and reporting requirements.

The American Innovation and Manufacturing (AIM) legislation and regulations, also align with the ratified treaty.

EPA Timeline

What is the timing for this transition to refrigerants with less than 700 GWP?

*The EPA prohibits "**systems",** equipment charged in the field, to be installed after the manufacture deadline. The EPA allows **"products"**, equipment charged in the factory, to be sold up to 3 years after manufacture deadline.*

Application	Manufacture Deadline < 700 GWP	Install & Sell-Through Deadlines > 700 GWP
All chillers for comfort cooling and heating in the states of CA*, CO, DE, MA*, MD, ME, NJ, NY RI, VA, VT, WA (EPA refrigerant bans)	Jan 1, 2024	Install products before Jan 1, 2024*
All chillers for comfort cooling and heating	Jan 1, 2025	Install systems before Jan 1, 2025 Sell products before Jan 1, 2028
Ice rinks	Jan 1, 2025	Install systems before Jan 1, 2025 Sell products before Jan 1, 2028
Packaged units (AC/HP) and other AC (refrigerant loop closed in factory)	Jan 1, 2025	Sell products before Jan 1, 2028 No install deadline
Split systems, including ductless split systems (refrigerant loop closed in field)	Jan 1, 2025	Install systems before Jan 1, 2026
Room/wall/window AC, PTACs, PTHPs, portable AC, and residential dehumidifiers	Jan 1, 2025	Sell products before Jan 1, 2028 No install deadline
VRF >65,000 BTU/hr	Jan 1, 2026	Install before Jan 1, 2026**
Industrial process chillers with temperatures of chilled fluid >-22°F***	Jan 1, 2026	Install systems before Jan 1, 2026 Sell products before Jan 1, 2029
Data center equipment***	Jan 1, 2027	Install systems before Jan 1, 2027 Sell products before Jan 1, 2030
Industrial process refrigerant chillers with temperatures of chilled fluid -58°F to -22°F*** (no mandate if <-58°F)	Jan 1, 2028	Install systems before Jan 1, 2028 Sell products before Jan 1, 2031

**CA and MA require building permits approved in 2023*

**On 12/26/23 the EPA published an interim final rule extending the installation date of unitary split systems. EPA is considering an extension for VRF as quoted below. We expect the EPA to complete this rule by the end of 2024.

"In this interim final rule, the Agency is not considering the January 1, 2026, installation compliance date applicable to VRF systems; however, EPA intends to consider VRF systems in a separate notice and comment action."

****CA (replacement and new installations) and WA (new installations) transition January 1, 2025.*
IPR (Industrial Process Refrigeration) – CA has different requirements starting in 2024, Contact Account Manager for more information

Sources:
https://www.epa.gov/system/files/documents/2023-10/technology-transitions-final-rule-fact-sheet-2023.pdf

https://www.federalregister.gov/documents/2023/12/26/2023-28500/phasedown-of-hydrofluorocarbons-technology-transitions-program-residential-and-light-commercial-air

California Air Resources Board (CARB) Timeline

What is the timing in California for this transition to lower-GWP refrigerants?

Application	GWP Limit	CA Manufacture Deadline	Installation Deadline > 750 GWP
All chillers for comfort cooling and heating*	750	Jan 1, 2024	Install before Jan 1, 2024 (unless permit preapproved in 2023)
Data center chillers**	750		
Ice rinks	150 for new rinks and 750 for replacements		
750 Industrial process Refrigeration (IPR) chillers with temperatures of chilled fluid >35°F	750		
1500 IPR chillers with temperatures of chilled fluid ≤ +35°F (2 °C) and > -10 °F (-23 °C)**	1500		
1500 IPR chillers with temperatures of chilled fluid ≤ -10°F (-23 °C) and > -22 °F (-30 °C)**	1500		
2200 IPR chillers with temperatures of chilled fluid ≤ -22°F (-30 °C) and > - 58 °F (-50 °C)**	2200		
Room/wall/window AC, PTACs, PTHPs, portable AC, and residential dehumidifiers	750	Manufacture: Jan 1, 2023 EPA: sell before Jan 1, 2028	No installation deadline
Split systems, including ductless split systems (new condensing unit triggers 750 GWP limit.)	750	Jan 1, 2025	No California installation date EPA install by Jan 1, 2026
Packaged units (AC/HP) and other AC	750	Manufacture: Jan 1, 2025 EPA sell before Jan 1, 2028	No installation deadline
VRF >65,000 BTU/hr	750	Jan 1, 2026	No California installation date EPA install before Jan 1, 2026*

** CA requires building permits approved in 2023*
***CA (replacement and new installations) transition January 1, 2025.*
IPR (Industrial Process Refrigeration) – CA has different requirements starting in 2024, Contact Account Manager for more information

Sources:
https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2020/hfc2020/frorevised.pdf

Source:
https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2020/hfc2020/frorevised.pdf

New York (NY) Department of Environmental Conservation (DEC) Part 494 Hydrofluorocarbon (HFC) Regulations Updated Dec 2024

Application	Refrigerant Bans	Date	GWP Limit	Date	20-yr GWP	Jan 1
Other residential			700 GWP	1-Jan-2025	10	2027
Data centers			2690 (20-yr)	1-Jan-2026		2030
VRF Systems			700 GWP			
Residential and light commercial air conditioning and heat pumps						2034
Other commercial (e.g., packaged units)				1-Jan-2025		
Heat pump chillers	SNAP bans	1-Jan-24			20	
Positive displacement chillers						2030
Centrifugal chillers						

**The prohibition date is extended one year for the installation of a system with a prohibition date that occurs prior to January 1, 2027, when an approved building permit issued prior to the effective date of this Part specifies the use of a restricted regulated substance, or blend containing a regulated substance, in a system detailed in that permit.*

***NY (replacement and new installations) transition January 1, 2025.*

IPR (Industrial Process Refrigeration) – NY has different requirements starting in 2026, Contact Account Manager for more information

New York only allows a one-year sell through compared to the EPA three-year allowance.

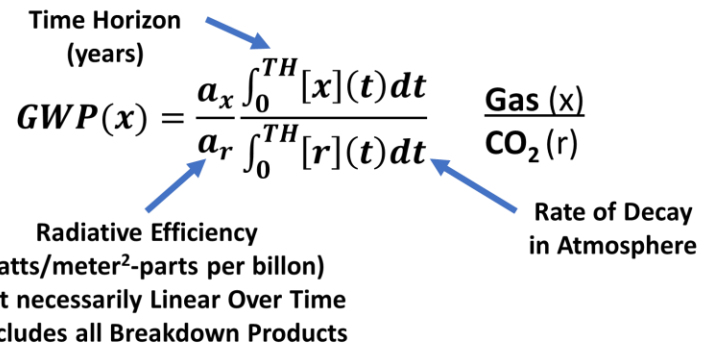
Sources:
https://dec.ny.gov/sites/default/files/2024-09/part490expressterms.pdf

GWP_{100} and GWP_{20} for Select Refrigerants

	ASHRAE Safety Class	$GWP_{AR4\text{-}100yr}$	$GWP_{AR6\text{-}100yr}$	$GWP_{AR6\text{-}20yr}$
CO_2	A1	1	1	1
R-410A	A1	2088	2256	4715
R-32	A2L	675	771	2690
R-454B	A2L	467	531	1854
R-290	A3	3	0.02	0.07
R-513A	A1	631	673	1823
R-1234yf	A2L	4	0.5	1.8
R-515B	A1	293	322	525
R-1234ze(E)	A2L	7	1.4	4.9
R-1233zd(E)	A1	1	3.9	14
R-514A*	B1	<2	<2	<6

*R-514A is a blend of R-1336mzz(Z) and R-1130(E). R-1130(E) does not have a reported AR GWP value, but atmospheric life exceptional short and thus GWP is very low (<1).

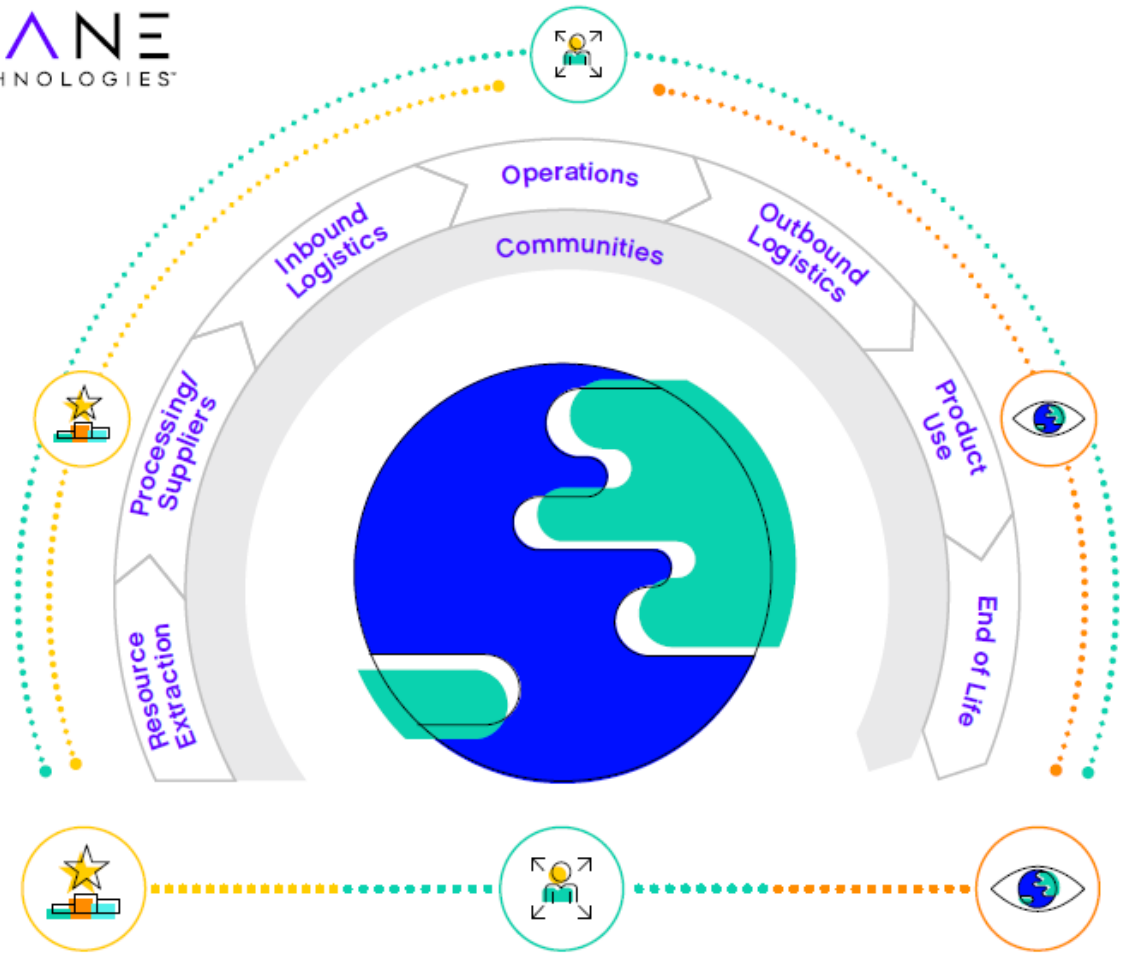
- GWP by different time horizons provide conflicting answer even though desirable refrigerants appear to have dramatic increases in GWP_{20} vs GWP_{100}
- Issue: GWP of CO_2 remains 1 regardless of time horizon even though the total atmospheric heating requires >500 years.
- CO_2 impacts the GWP calculation of short-lived refrigerants, like HFOs and some HFCs heavily because CO_2 atmospheric heating is drastically lower over the given time-period while the short lived refrigerant atmospheric heating is fully realized



"What we do today will create a better, stronger world tomorrow."

--Dave Regnery, Chair & CEO Trane Technologies

THANK YOU



Leading by Example

Caron neutrality
Zero waste to landfill
Net positive water
Absolute energy reduction

Opportunity for All

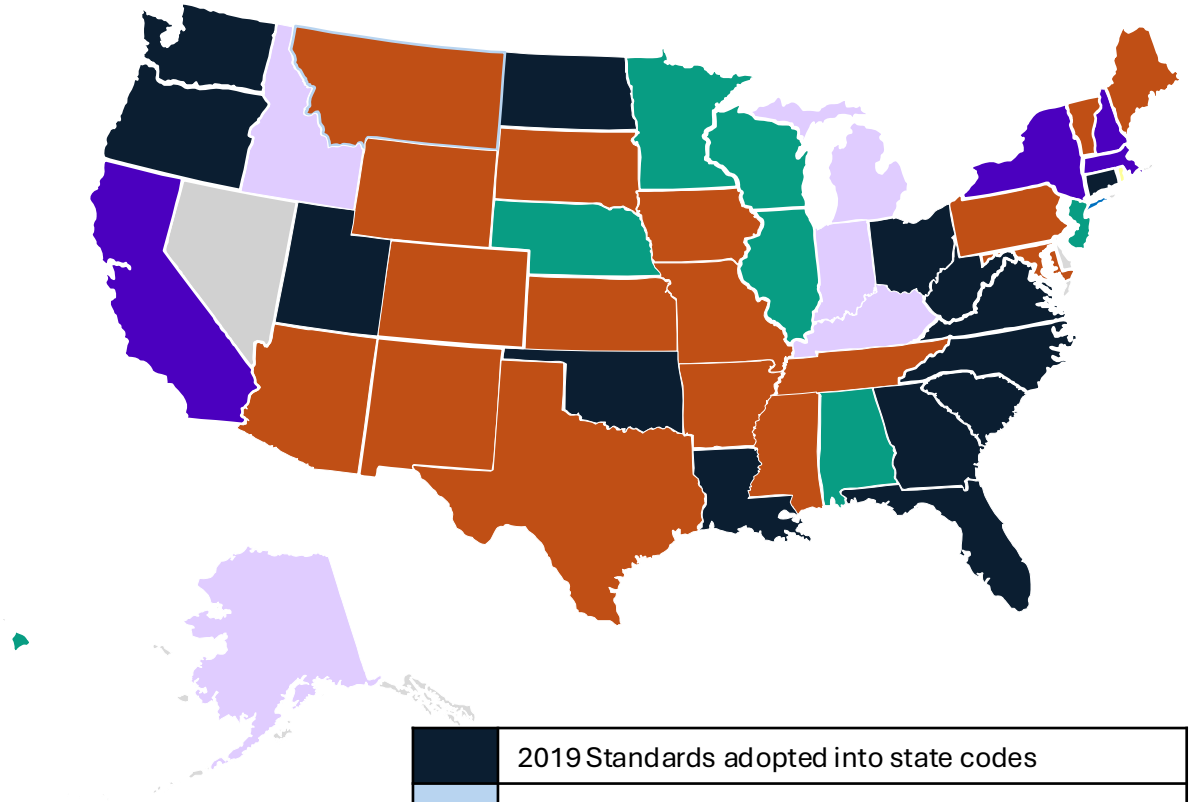
Diversity & Inclusion
Gender equality
World-class safety
Corporate citizenship
Competitive wages, benefits & wellness globally

Gigaton Challenge

Reduce customer footprint by 1 gigaton
Design systems for circularity
Provide access to comfort & fresh food

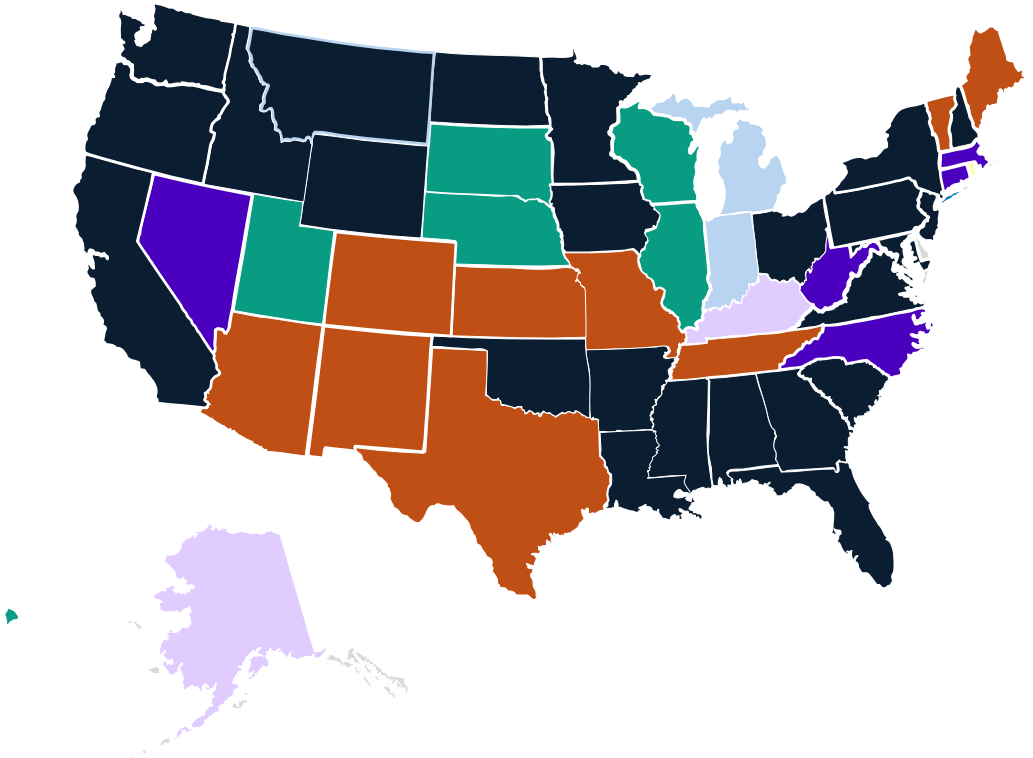
States that have Enabled A2L Refrigerants in Unitary Equipment:
Adoption of UL 60335-2-40

Codes or legislation are complete:
Adoption of UL 60335-2-40



	2019 Standards adopted into state codes
	Codes allow listed equipment or technical bulletin clarifies allowance
	Legislation in effect prevents exclusion of EPA approved refrigerants
	Codes or legislation needed

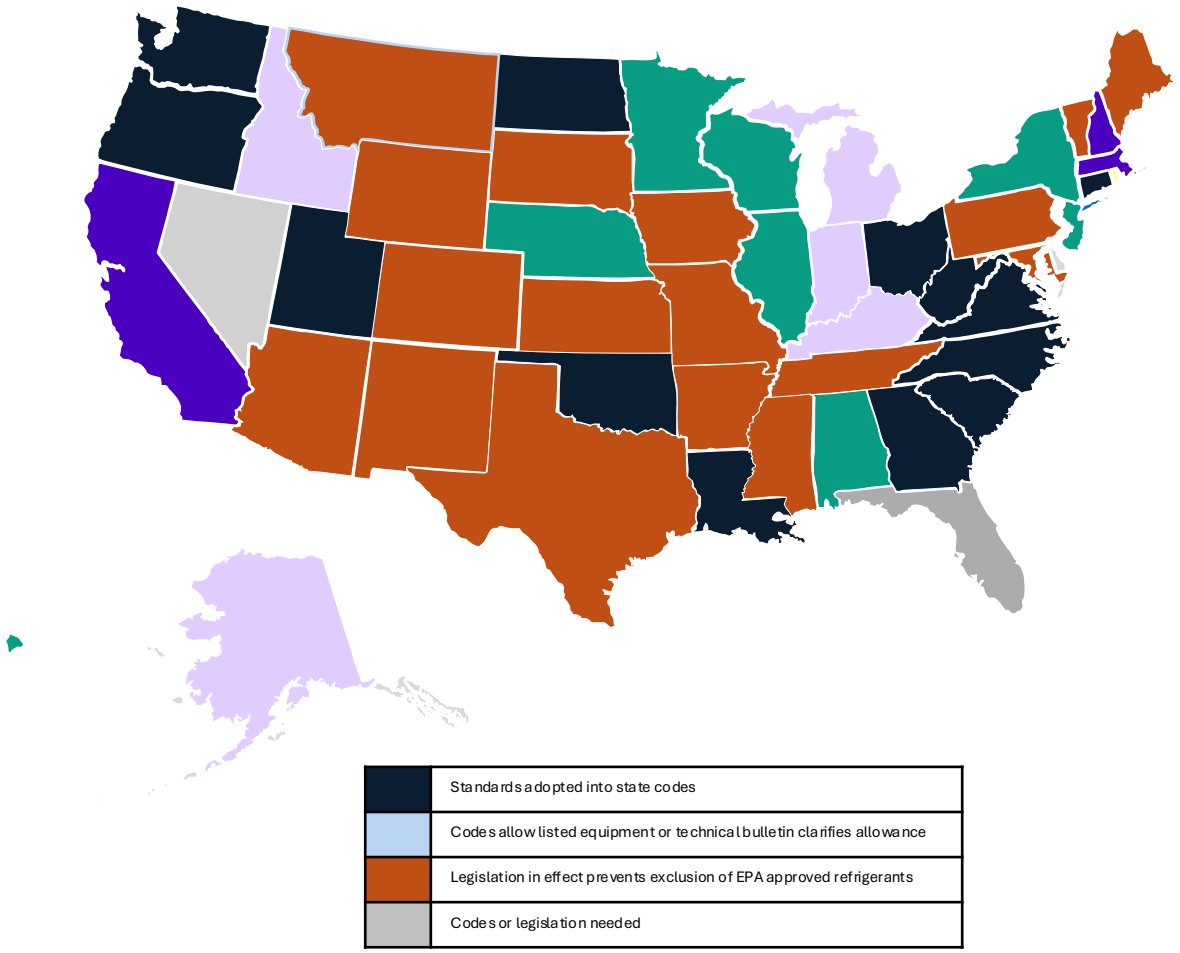
Codes or legislation are complete:
Chillers enabled.



Enabled A2L Refrigerants (cont.)

Adoption of UL 60335-2-89

Reference: AHRI

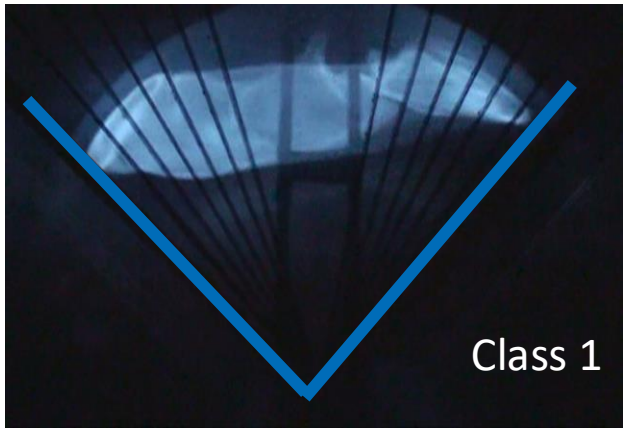


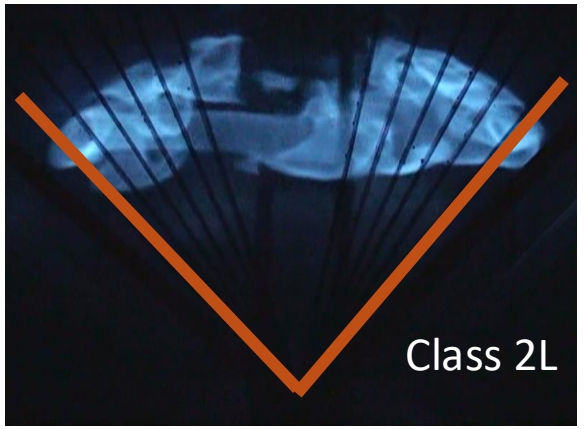
U.S. Department of Transportation: Charged Equipment

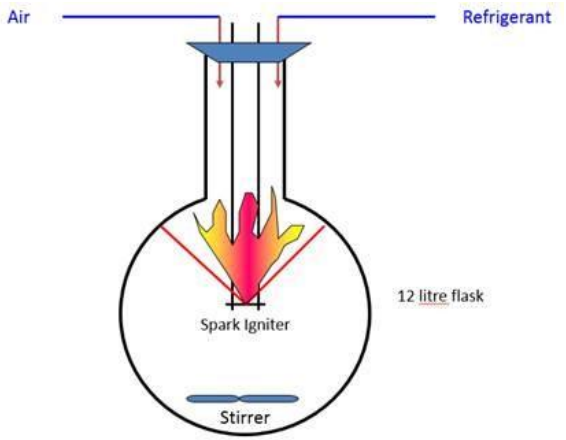
Charge Limit by Land	**Requirements**
Up to 12 kg (25 lbs.)	Same requirements as A1 refrigerant
Up to 50 lbs. per circuit and 100 lbs. per unit	Paperwork, placard, no special driver
Special Permits	**Requirements**
Up to 20kg	Same requirements as A1 refrigerant; equivalency granted in Canada
Up to 5000 lbs	Paperwork, placard, no special driver
Charge Limit by Air	**Requirements**
Up to 100 g	Same requirements as A1 refrigerant

ASTM E681 Test Examples

- Flame spread **< 90°** indicates “no flame propagation”
- Flame spread **> 90°** indicates “flammability”
- An A2L classification means the flame exceeded the **90°** parameter and the flame spread is slow

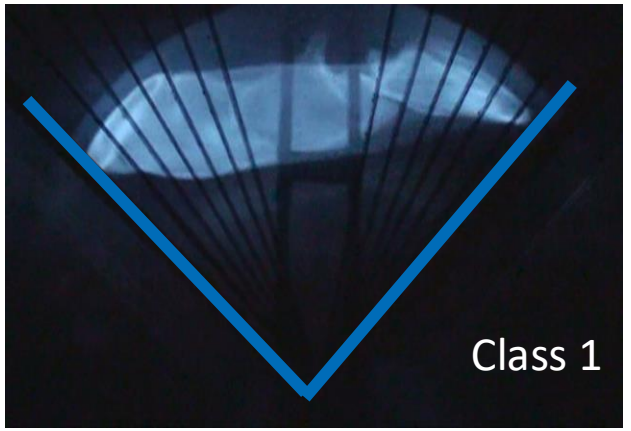


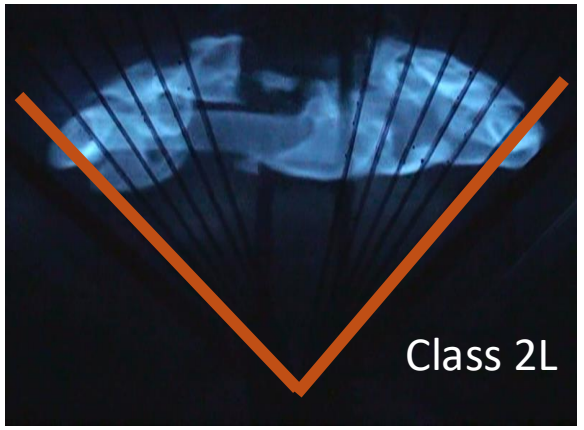


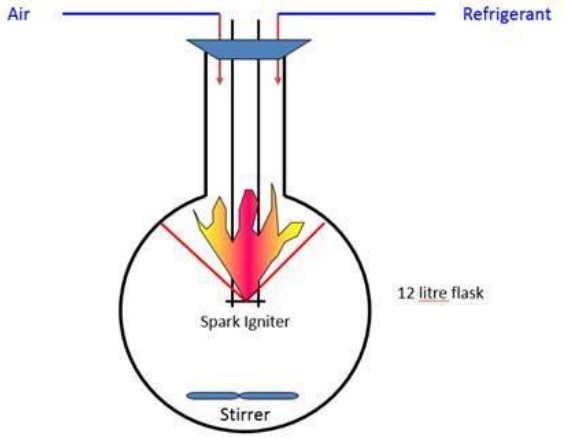


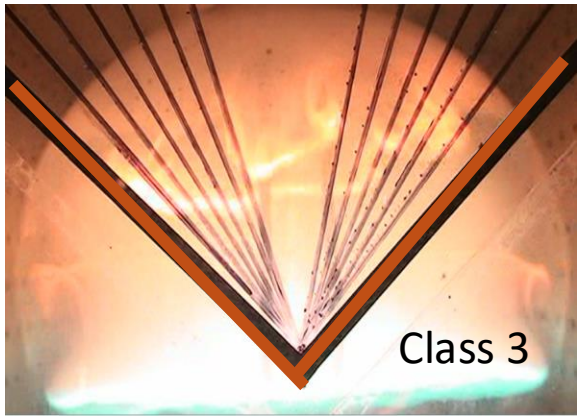
ASTM E681 Test Examples

- Flame spread **> 90°** indicates “flammability”
- Based on the spread beyond **90°**, as well as the **speed at which the flame spreads**, defines the degrees of ‘flammability’
  - 2L – lower flammability
  - 2 – flammable
  - 3 – higher flammability










A1
A2L
A3

The Solutions
A1 and A2L Refrigerants

- Air Conditioning Refrigerants
- R-410A [50% R-32: 50% R-125] (2,087 GWP), POE 32
- R-32 (675 GWP), POE 46, PVE 46
- R-454B [68.9% R-32: 31.1% R-1234yf] (466 GWP), POE 32

Opteon™

Chemours™

AR4 / 100-yr GWP

Storage Classifications

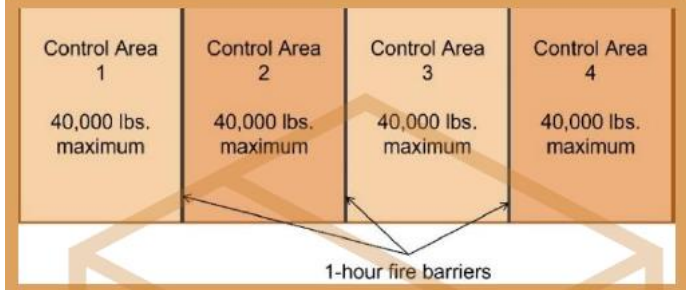
1) Shelf Storage

2) Rack Storage

3) Solid Pile

Maximum Allowable Quantities/Control Areas

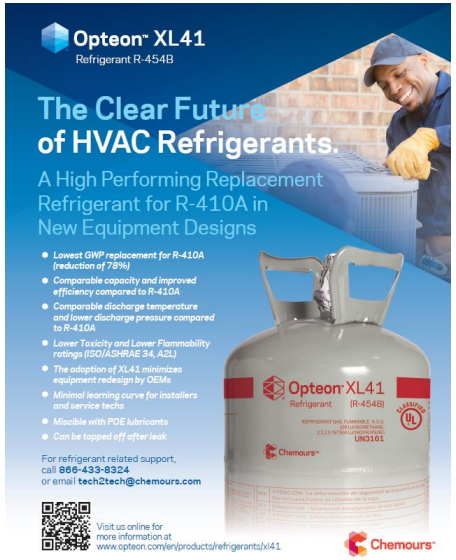
A building protected with fire sprinklers can include 1-hour fire-resistance-rated walls to create 4 separate control areas. Each control area can store up to 40,000 lbs. of liquefied Group A2L refrigerants. See graphic for control areas.



Construction of a 1-hour fire barrier can be as simple as a wood stud wall covered with fire-resistant gypsum board. All entrances through the 1-hour fire barriers must be protected with a fire-rated device, such as roll-down shutters or fire doors.

Maximum Allowable Quantity (MAQ) in a Single Control Area		
Occupancy Classification	Non-sprinklered	Sprinklered
	Liquefied gas in cylinders	Liquefied gas in cylinders
M – mercantile	20,000 lbs.	40,000 lbs.
S – storage/warehouse	20,000 lbs.	40,000 lbs.
F – factory/filling facility	10,000 lbs.	20,000 lbs.

A2L Refrigerants: *Safety, Installation, and Service*

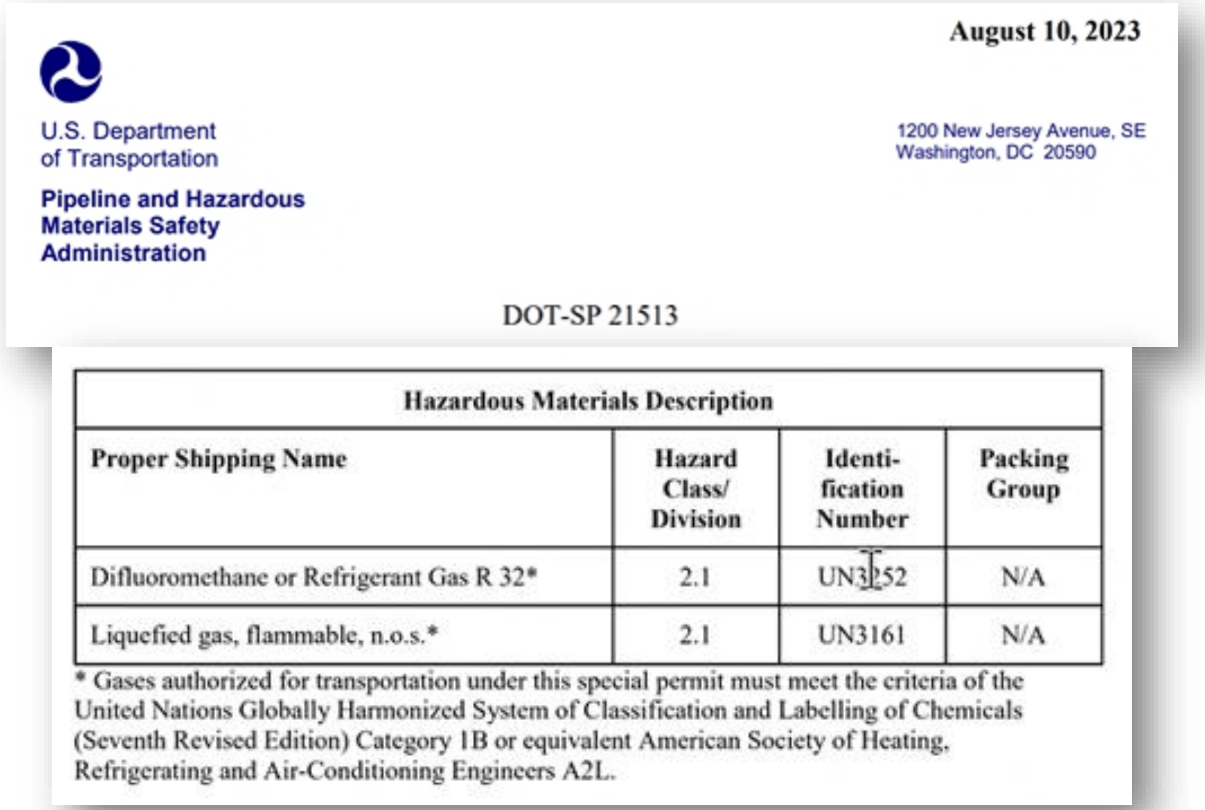


Transportation: DOT

Service Vehicles:

- **Under the “materials of trade,” it’s business as usual.**
- **Same restrictions in place 440 pounds, regardless of the hazard.**
- **Federally no placards are required for *service vehicles*. For transportation there is.**

DOT “Chemours” Special Permit



August 10, 2023

U.S. Department of Transportation

Pipeline and Hazardous Materials Safety Administration

1200 New Jersey Avenue, SE
Washington, DC 20590

DOT-SP 21513

Hazardous Materials Description			
Proper Shipping Name	**Hazard Class/ Division**	**Identi-fication Number**	**Packing Group**
Difluoromethane or Refrigerant Gas R 32*	2.1	UN3252	N/A
Liquefied gas, flammable, n.o.s.*	2.1	UN3161	N/A

* Gases authorized for transportation under this special permit must meet the criteria of the United Nations Globally Harmonized System of Classification and Labelling of Chemicals (Seventh Revised Edition) Category 1B or equivalent American Society of Heating, Refrigerating and Air-Conditioning Engineers A2L.

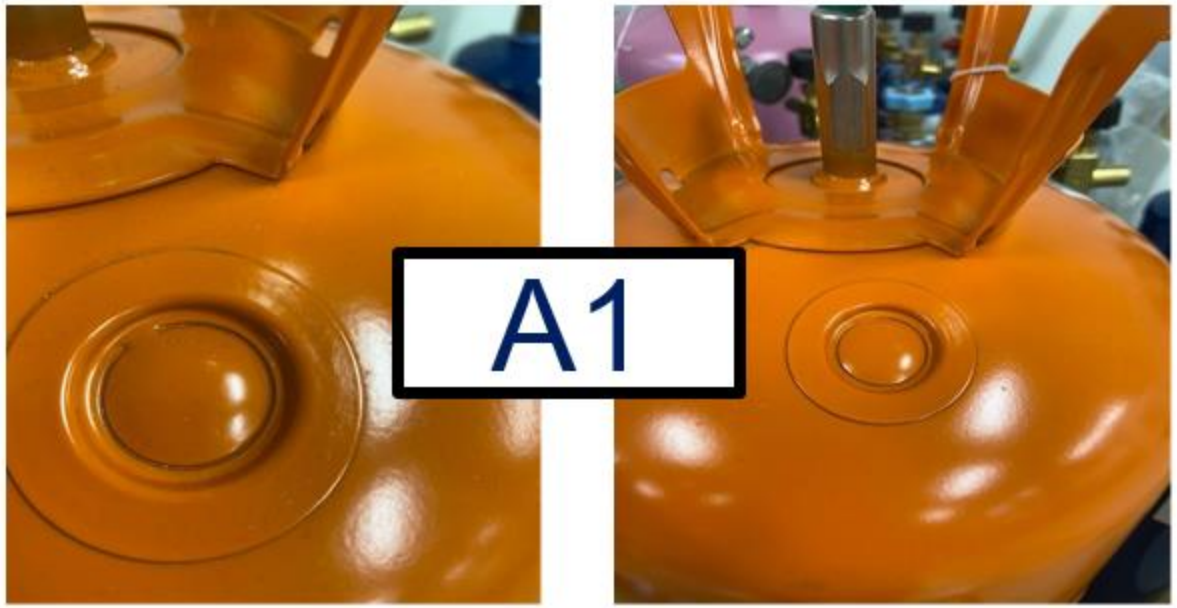
Allows for GHS7 1B gases and ASHRAE A2L refrigerants to be stored horizontally

A2L refrigerants will only be used in new equipment; they are not to be used in existing A1 systems.

Tank Pressure Safety: What's New?

Rupture DISC (CG-1). Used for ASHRAE 34 A1. Set pressure defined by cylinder working pressure and **burst with all contents released.**

Spring-loaded relief (CG-7). Used for ASHRAE 34 A2L. Set pressure are defined by cylinder working pressures, and the **valve only releases enough gas to return below the cylinder's max pressure.**



What's New Continued

Main differences between A1 and A2L cylinders

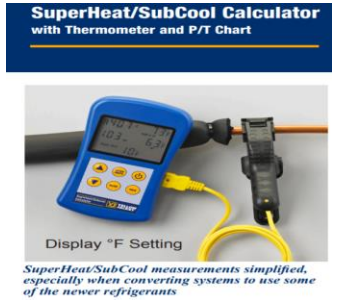
- A2L Cylinder will have a **Red Band**
- A2L cylinders have a resettable pressure disc.
- Chemours will go with left-handed threads.
- There will be an anti-counterfeit shrink wrap on the head.

Installation, Service, and Repair Considerations

ACTION	A1s	A2Ls
Safely remove refrigerant following local & national regulations	Required	Required
Purge circuits with inert gas (e.g., oxygen-free nitrogen)	Best Practice	Required
Evacuate circuits	Best Practice	Required
Opening a circuit by cutting or brazing	Required	Required
Make repairs, purging with nitrogen while brazing	Required	Required
Leak and Pressure Test	Best Practice	Required
System Evacuation	Required	Required
Cylinder Threads	Right-Handed	Left-Handed

Service Equipment For A2L Refrigerants

Service Item	A2L (e.g. R-454B) vs A1 (e.g. R-410A)
Gauge Manifold / Charging Hoses	RH threads (based on equipment service ports)
Refrigerant Recovery Cylinder	Designed for A2Ls (GHS label, left-handed threads)
Vacuum Pump	Check with Manufacturer (switch located away from work zone)
Recovery Machines	2L compatible
Electronic Leak Detector	2L compatible
Scales	No changes
Ventilation Fan	Similar* (*may be differences in machine rooms)
Electrical Hand Tools	Non-sparking preferred (AHRI – 8017)
Torque wrench, flare tool, pipe cutter, pipe bender, hex wrench	No changes
Dry Chemical / CO_2 Fire Extinguisher	Chemical compatible



A2L Equipment: Servicing

Many installation & service tools are being upgraded to include A2L refrigerants

- APPION
- YELLOW JACKET
- NAVAC
- **<u>When in doubt, check with component manufacturer</u>.**

NAVAC
Empowering you to work smarter

SERVICE NOTICE

Subject	A2L Usage
Date	1/1/2020
Product	DC Pumps, DC Recovery Units & Station
Relevant Models	NP2DLM NP4DLM NRP6Di NRP6DV NRP8Di NRP8DV NP12DM NRRD NRDC4M NRC62D

The recent increase of the HVACR industry using lower Global Warming Potential (GWP) refrigerants means the markets for those refrigerants, and tools to service equipment equipped with these refrigerants are rapidly growing. These refrigerants fall into the safety classification of A2/A2L/A3.

In North America, the rise of A2L mildly flammable refrigerants such as R32, R454B, R1234ZE/YF, etc. has necessitated the need for recovery machines and vacuum pumps that may be used with mildly flammable refrigerants.

NAVAC's **NRDD** and **NRDC4M** refrigerant recovery machines and the **NP2DLM, NP4DLM, NRP6Di, NRP8Di, NRP6DV, NRP8DV,** and **NP12DM** vacuum pumps and the **NRC62D** charging machine are compatible with A2L refrigerant systems.

Appion

Safety Alert

A2L Refrigerant Recovery Suitability

A2L "mildly flammable" refrigerants, such as R32 and R1234yf, are becoming increasingly popular due to better efficiencies and lower ODP/GWP numbers than other refrigerants. However, due to the mildly flammable nature of these refrigerants, it is important to ensure proper technical training and compatible equipment is in place prior to recovering these refrigerants.

With proper training and technical procedures, the G5Twin and G1Single units can safely be used to recover A2L refrigerants, in accordance with relevant regulatory guidance.

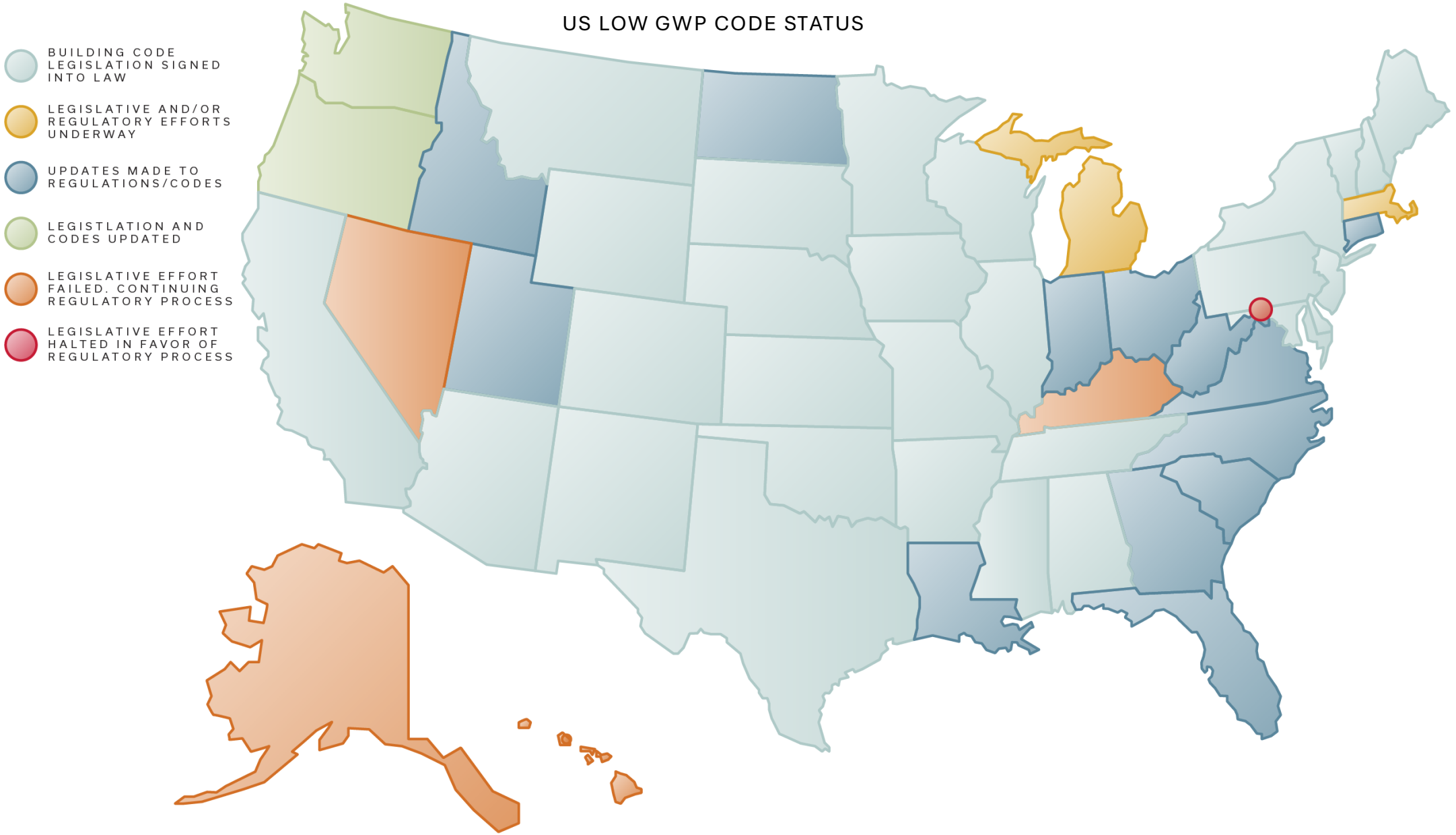
Refrigerant Webinar

PRESENTER | BEN BURNETT

PAE

Codes and Standards

US LOW GWP CODE STATUS

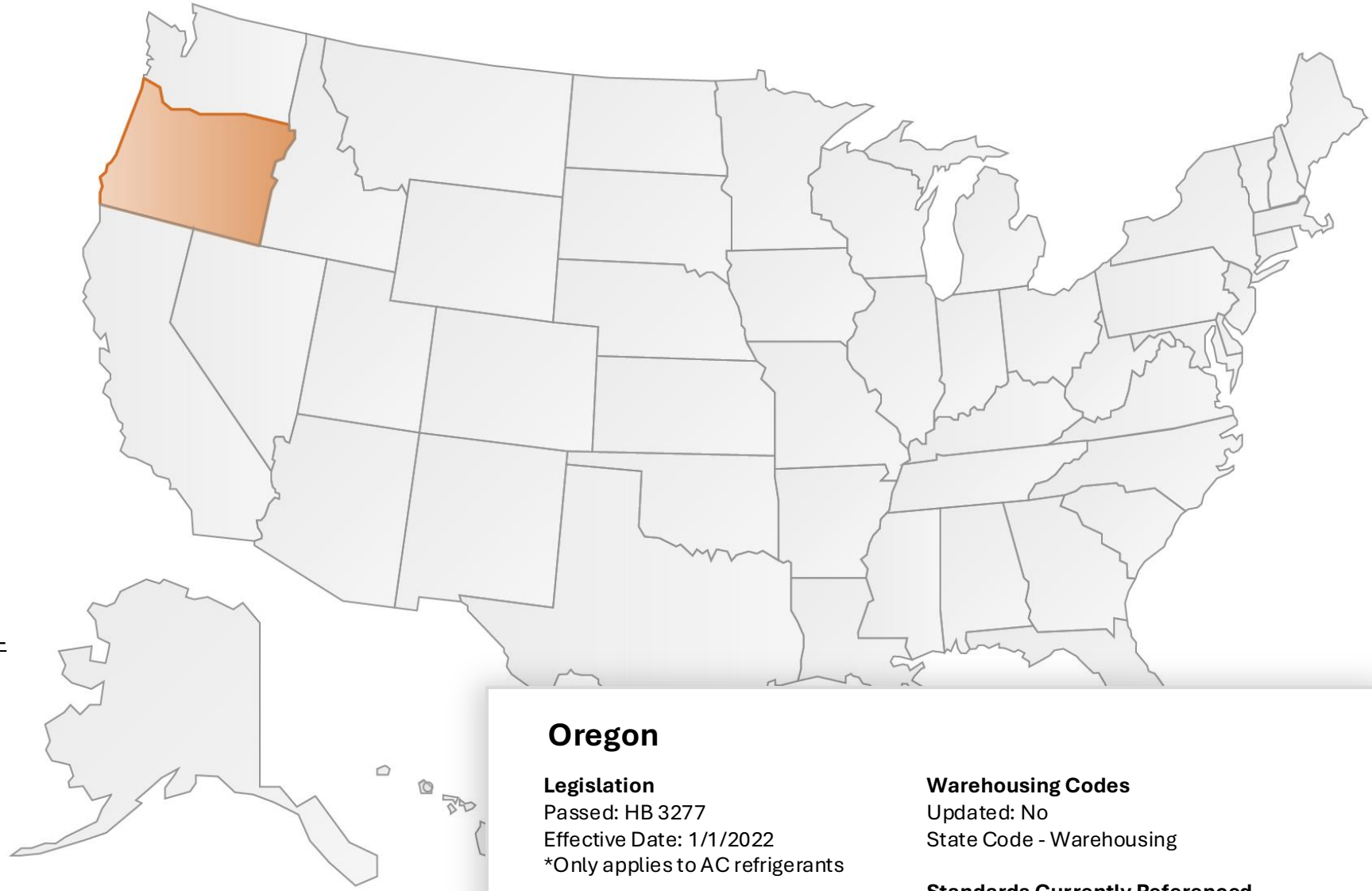


Codes and Standards

MECHANICAL CODES
ASHRAE 15: Safety Standard for Refrigeration Systems

ASHRAE 34: Designation and Safety Classification of Refrigerants

https://www.ahrinet.org/a2l-refrigerant-building-code-map-us



Oregon

Legislation
Passed: HB 3277
Effective Date: 1/1/2022
*Only applies to AC refrigerants

AC Codes
Updated: Yes
Effective Date: 9/1/2023
State Code - Refrigeration

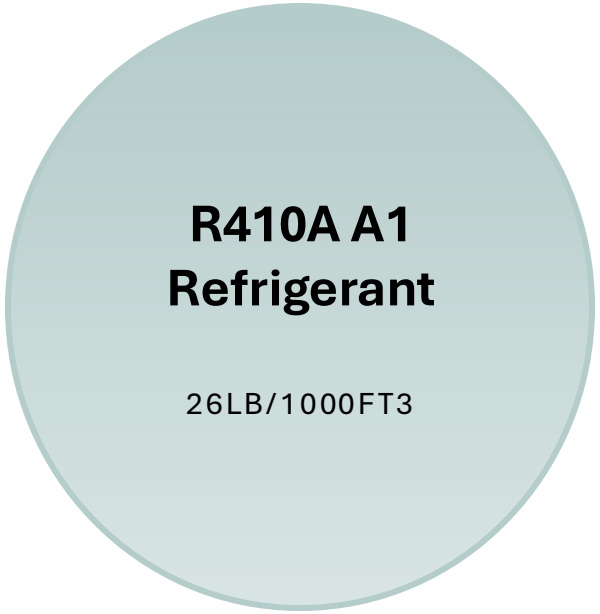
Warehousing Codes
Updated: No
State Code - Warehousing

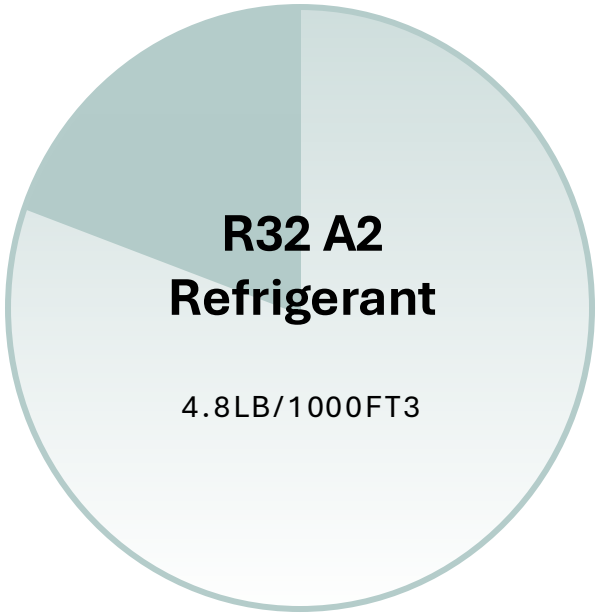
Standards Currently Referenced
ASHRAE 15: 2022
ASHRAE 34: 2022
UL 60335 2-40: 2022
UL 60335 2-89:2021

Codes and Standards

REFRIGERANT CONCENTRATION LIMITS
A1 CLASSIFICATION:
Refrigerant Concentration Limits (RCLs) based on occupant health hazards, usually Oxygen Deprivation Limit (ODL) or Acute Toxicity Exposure Limit (ATEL).

A2L CLASSIFICATION:
RCLs are also limited to 25% of the Lower Flammability Limit (LFL), which is typically much lower than the limit for A1 refrigerants.





Refrigerant Data and Safety Classifications

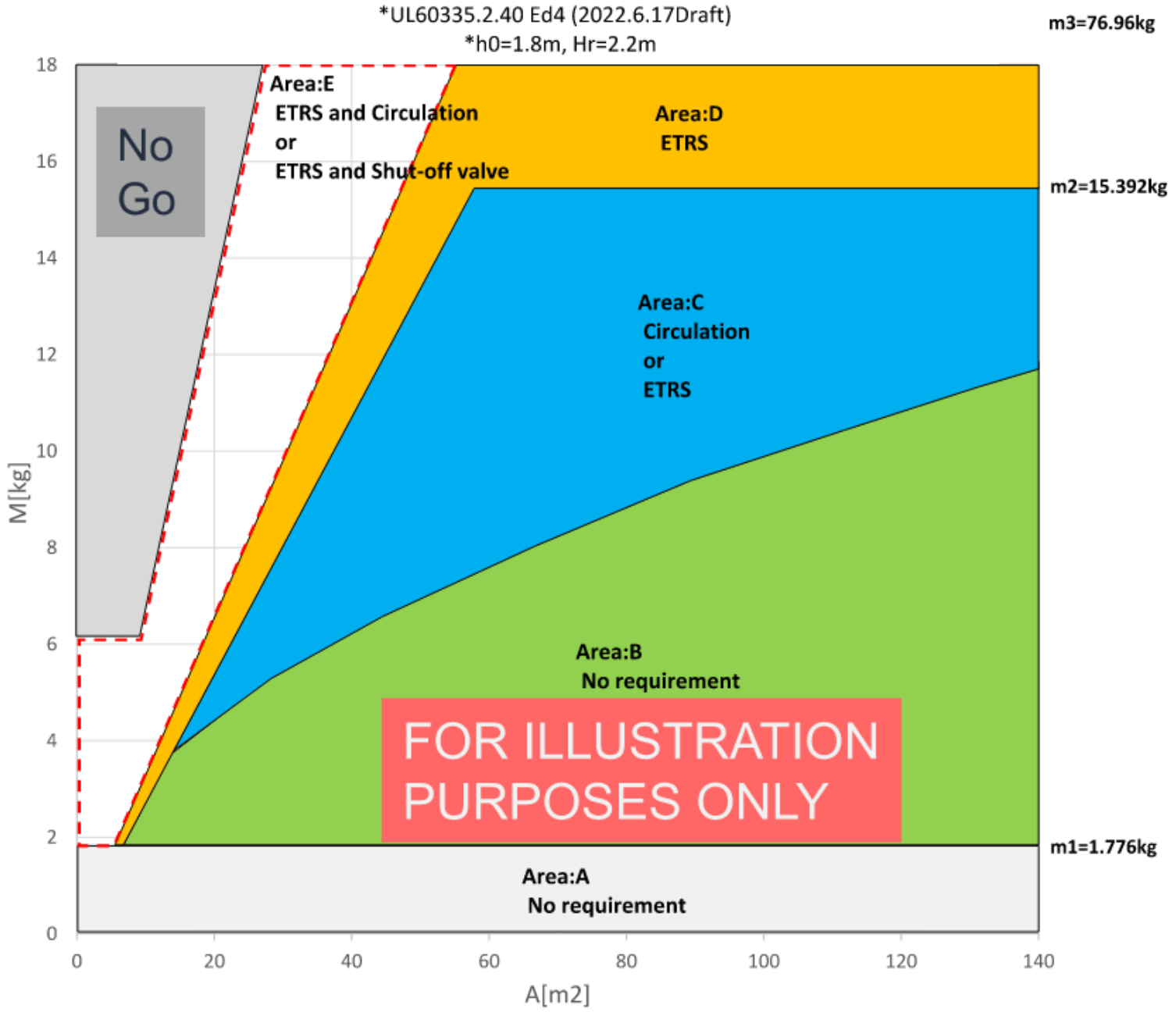
Refrigerant #	Chemical Name[a,b]	Chemical Formula[a]	OEL[1], ppm v/v	Safety Group	Ppm v/v	RCL[c] Lb/1000ft^3	g/m^3
32	Difluoromethane (methylene Fluoride)	CH2F2	1000	A2L	36,000	4.8	77
410A	R-32/125 (50.0/50.0) (+0.5,-1.5/+1.5,-0.5)		1000	A1	140,000	26	420

Codes and Standards

Safety Mitigation – Refrigerant Concentration Limits

MITIGATION STRATEGIES:

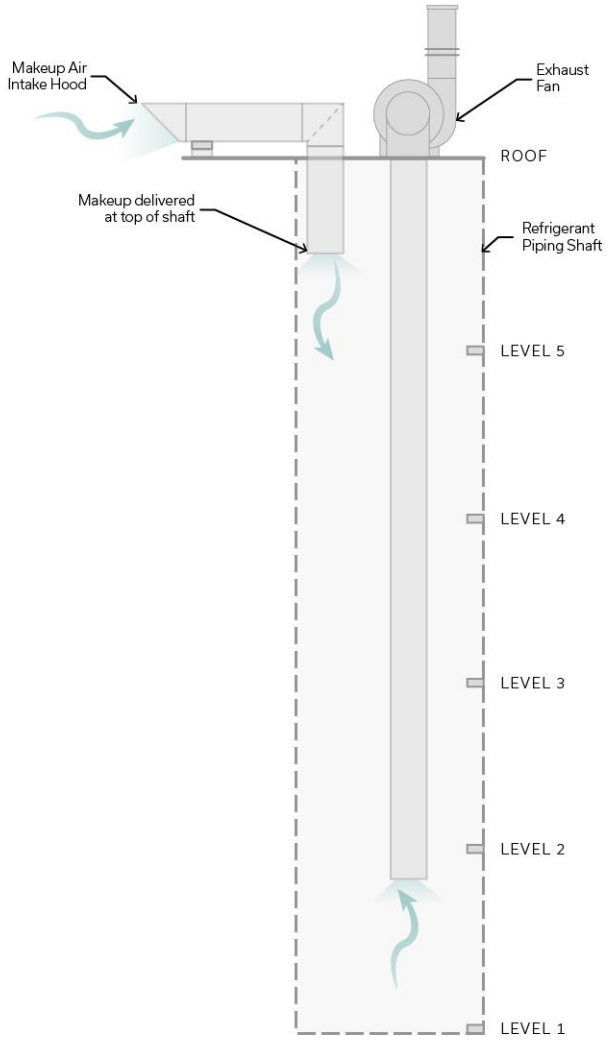
- Circulation
- Refrigerant Detection
- Ventilation/Exhaust
- Refrigerant Shutoff Valves



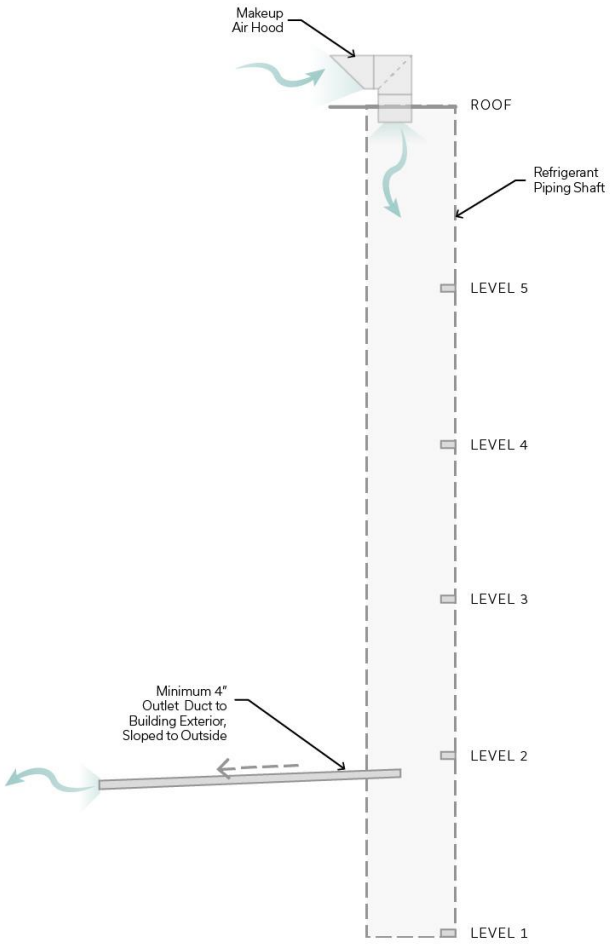
Codes and Standards

SHAFT VENTILATION REQUIREMENT:

- When piping penetrates two or more floor/ceiling assemblies
- Mechanical Ventilation
  - Minimum velocity requirement
  - Always on or enabled by refrigerant detector at shaft bottom
- Natural Ventilation
  - Requires outlet at shaft bottom, sloped to exterior



MECHANICAL SHAFT VENT



NATURAL SHAFT VENT