Refrigerant Regulations

Design Implications

Speaker:

Jason Filler / *FW Webb*

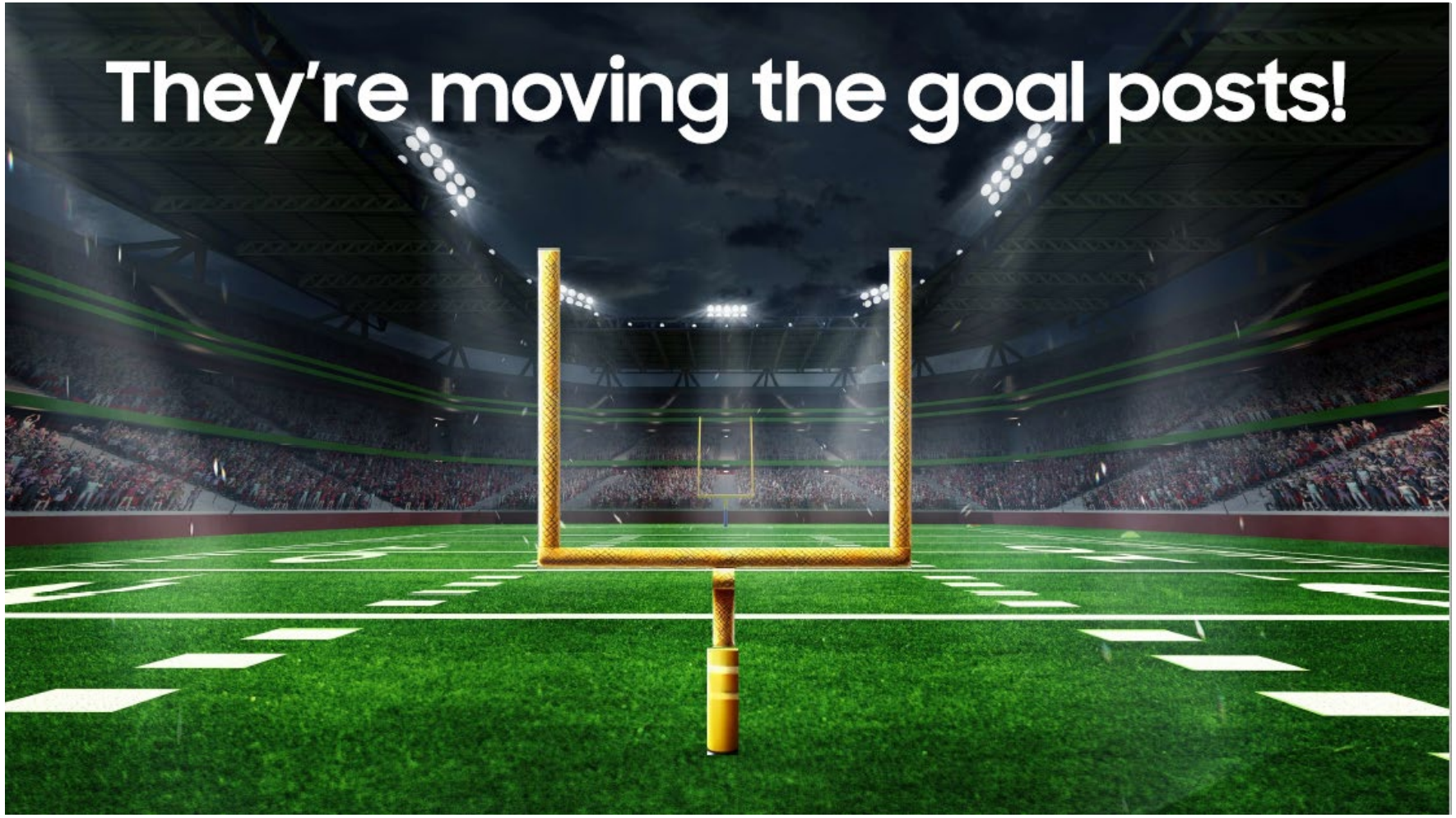
F.W. WEBB COMPANY

A Wholesale Distributor and More

Agenda

- Refrigerant Updates
- A2L Refrigerants
- ASHRAE 34/15
- A2L Equipment
- Applying ASHRAE 15
- VRF Designs
- Design Examples

Regulations Update



Make Refrigerant Great Again!

BREAKING NEWS

Updated: EPA Reconsiders Refrigerant Rule

The Agency is Reevaluating the AIM Act's Technology Transition Rule

By Joanna R. Turpin

Bottom Line

Changes to Technology Transition Rule Take Time

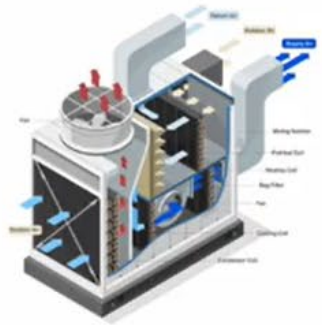
Current Timeline

Refrigeration Transition

Self-contained retail food refrigeration	Supermarket Refrigeration (remote condensing units)	Retail Food (remote condensing unit)	Industrial Process Refrigeration
			
Product	System	System	System or Product
Manufacture prohibition after January 1, 2025 Sell-through for three years until January 1, 2028	Full system install prohibition after January 1, 2027	Full system install prohibition after January 1, 2026	Systems: Install prohibition after 1/1/26 (except -30°C to -50°C, 1/1/28) Products: Manufacture prohibition after 1/1/26 (except -30°C to -50°C, 1/1/28)

Current Timeline

AC/HP Transition

Commercial & Residential Package AC/HP	Chillers used for comfort cooling	Residential and Light Commercial AC/HP	VRF/VRV AC/HP
	 *		
Product	System/Product	System	System
Manufacture prohibition after January 1, 2025 Sell-through for three years until January 1, 2028	Full system install prohibition after January 1, 2025 *Chillers with no refrigerant leaving the unit are treated as a product and have a compliance deadline of January 1, 2025	Full system install prohibition after January 1, 2026 using components manufactured before January 1, 2025	Full system install prohibition after January 1, 2027 using components manufactured before January 1, 2026

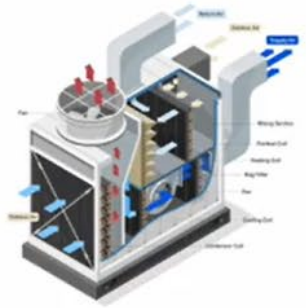
NYS DEC Part 494

New York Refrigeration Transition

Stand-alone units medium/low temperature	Supermarket Refrigeration	Remote Condensing Unit	Refrigerated food processing and dispensing equipment
			
Product	System	System	System or Product
Manufacture prohibition after January 1, 2025 Sell-through for one year until January 1, 2026	Full system install prohibition after January 1, 2026	Full system install prohibition after January 1, 2026	Systems: Install prohibition after 1/1/26 Products: Manufacture prohibition after 1/1/26
GWP20 <10: January 1, 2034	GWP20 <10: January 1, 2034	GWP20 <10: January 1, 2034	GWP20 <10: January 1, 2034

NYS DEC Part 494

New York AC/HP Transition

Commercial & Residential Package AC/HP	Chillers used for comfort cooling	Residential and Light Commercial AC/HP	VRF/VRV AC/HP
			
Product	System/Product	System	System
Manufacture prohibition after January 1, 2026 Sell-through for one year until January 1, 2027	Full system install prohibition after January 1, 2025 *Chillers with no refrigerant leaving the unit are treated as a product and have a compliance deadline of January 1, 2025	Full system install prohibition after January 1, 2026	Full system install prohibition after January 1, 2026
GWP20 <10: January 1, 2034	GWP20 <10: January 1, 2030	GWP20 <10: January 1, 2034	GWP20 <10: January 1, 2030

Refrigerant Market

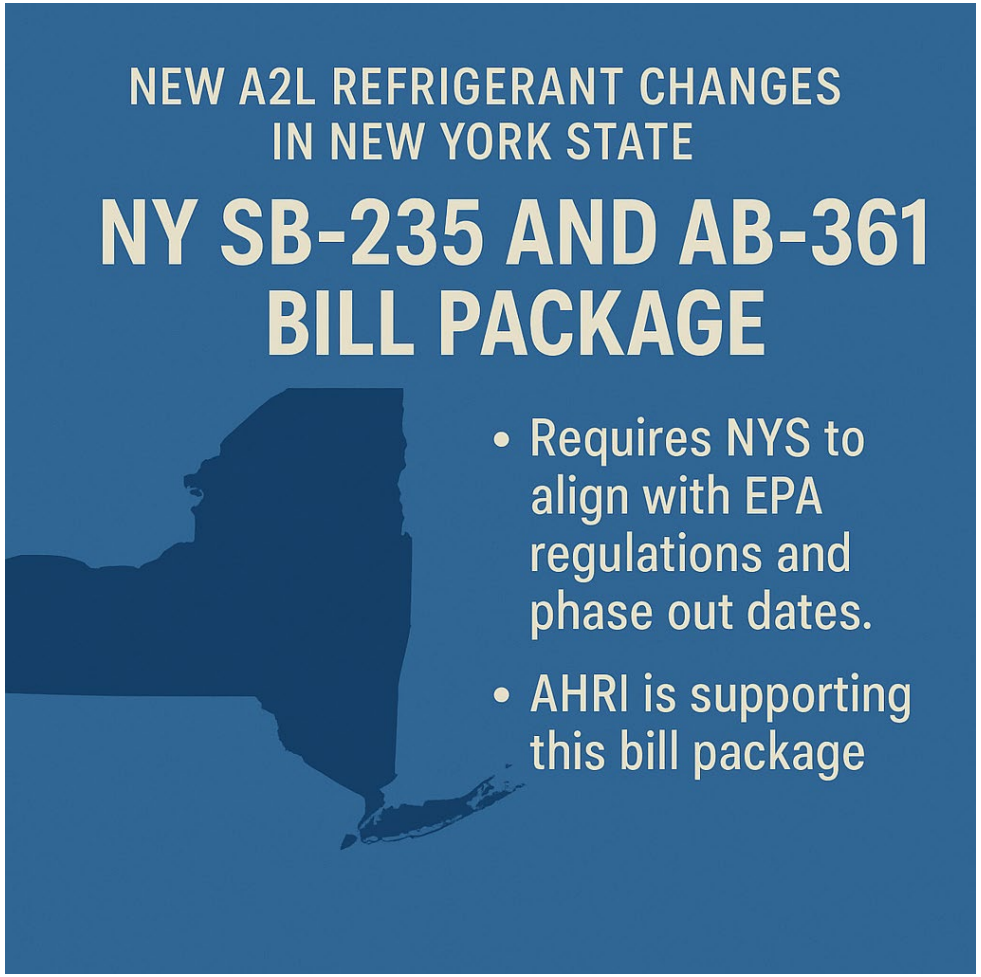
		R-410 A	R-466 A	R-452 B	R-454 B	R-32
GWP	AR4	2088	734	698	466	675
Safety	ASHRAE Class	A1	A1*	A2L	A2L	A2L
Composition	Refrigerants (% by weight)	R-32 / R-125 (50 / 50)	R-32 / R-125 / R-13I1 (49 / 11.5 / 39.5)	R-32 / R-125 / R-1234yf (67 / 7 / 26)	R-32 / R-1234yf (68.9 / 31.1)	R-32 (100)
Efficiency (COP)	R-410A = 1.0	1	↑ 1%	↑ 1%	↑ 1%	↑ 1%
Capacity Change	R-410A = 1.0	1	↓ 3%	↓ 3%	↓ 4%	↑ 7%
Glide Condenser	(△ F /△ K)	0.2 / 0.1	2.7 / 1.5	2.2 / 1.2	2.6 / 1.4	0 / 0

	R-22	R-454 A	R-444 B	ARM-20b	R-290
GWP(AR4)	1810	239	295	251	3
ASHRAE 34 Classification	A1	A2L	A2L	A2L†	A3
Composition	Chlorodiflouro methane	R-32 / R-1234yf (35 / 65)	R-32/ R-1234ze(E)/ R-152a (41.5 / 48.5 / 10)	R-32 / R-1234yf / R-152a (35 / 55 / 10)	propane
Efficiency* (COP)	1	↑ 4%	↑ 1%	↑ 2%	=
Capacity*	1	↑ 2%	↑ 2%	↑ 5%	↑ 10%
Condenser Glide* (R/K)	0	9.4 / 5.2	13.3 / 7.4	8.7 / 4.8	0

Hank Hill

SB-25 & AB-361

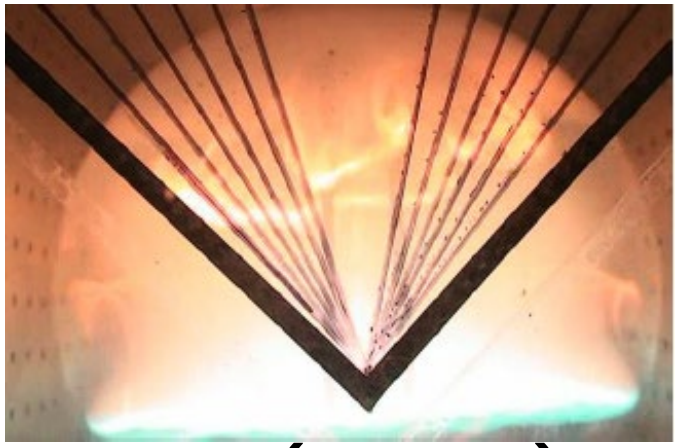
- Would Require NYS to Comply/Mirror EPA Phase Out Dates
- This is making its way through committees and hopefully will go to votes.
- Bipartisan Bill Package
- Sponsored by:
  - Sen. Patrick Gallivan, Sen. George Borrello, Gen. Pamela Helming, Sen. Peter Oberacker, Asmb. William Conrad, Asmb. Pamela Hunter.



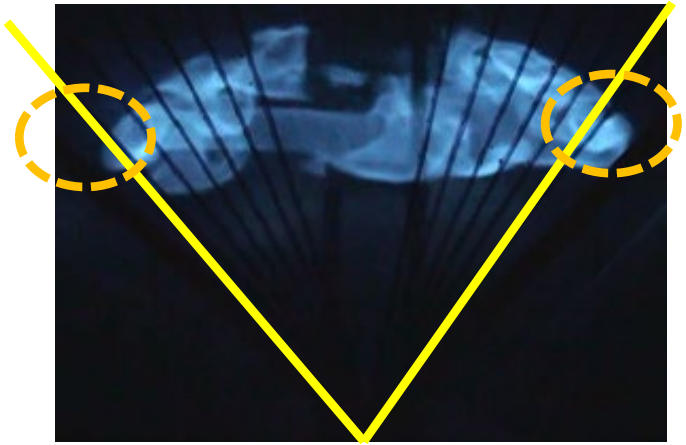
The Difference Between ASHRAE Refrigerant Flammability

There are "no" Hydrocarbons in A2L's…

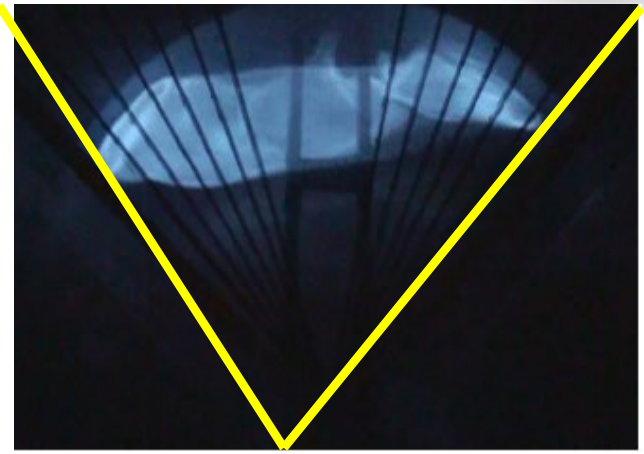
Rampant rumors of A2L's containing Propane



Class 3 (Propane)



Class 2L (R454B / R32)



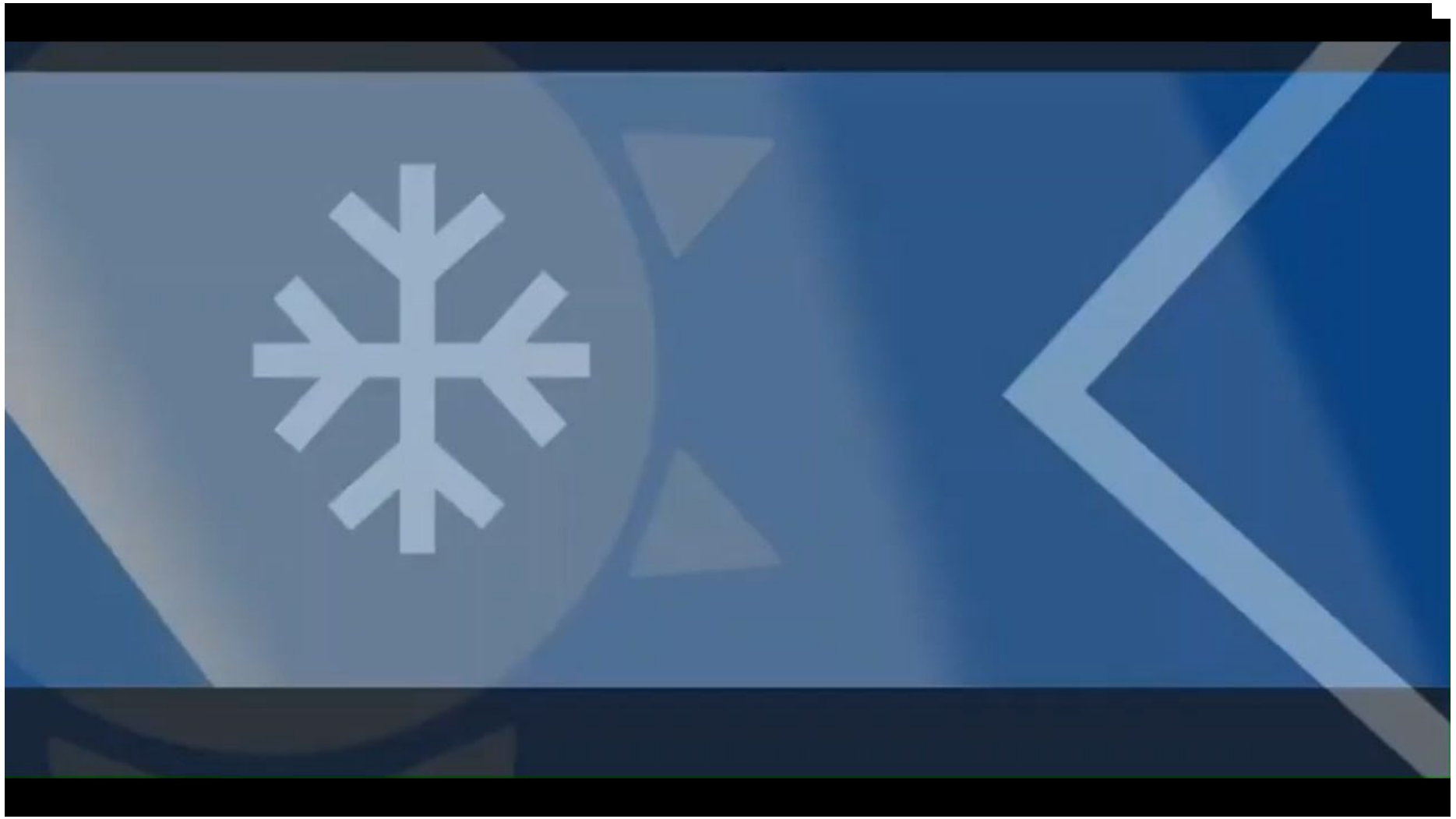
Class 1 (R410A)

ASHRAE 34

Refrigerant	GWP	Toxicity	Flammability
R-410A	2,088	A	1
R-134A	1,430	A	1
A2L (R-32)	675	A	2L
A2L (R-454B)	466	A	2L
R-290	N/A (< 5)	A	3

- **The difference between Class 1 & Class 2L is a few degrees**
- **A2L's like R454B / R32 have far less ignition energy than A3's**
- **Toasters, electric heaters, cigarettes and other common household products will not ignite an A2L.**

Refrigerant Video

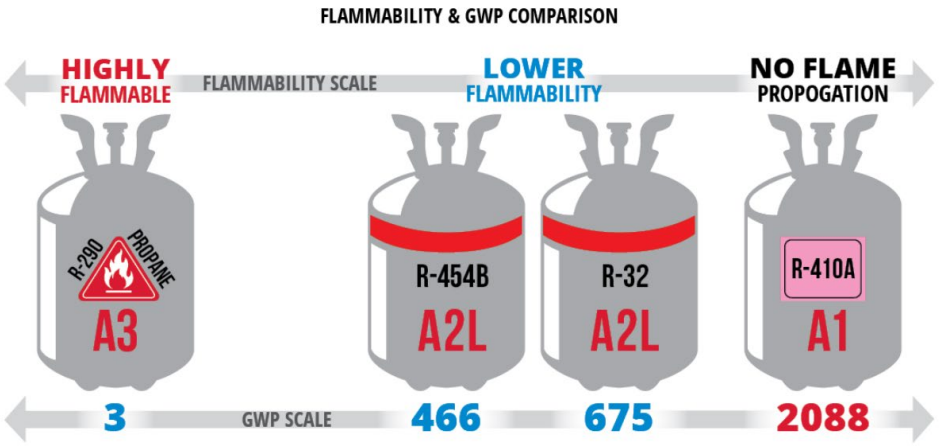


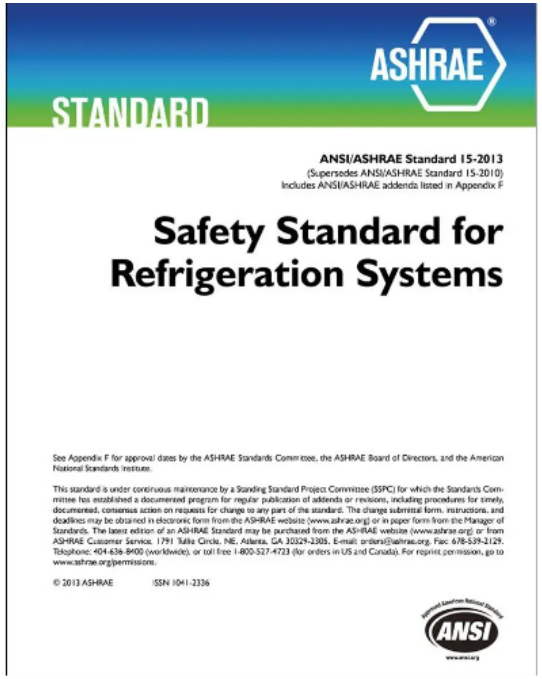
Key Takeaways

- LFL (Lower Flammability Limit) The concentration of the refrigerant required in air to ignite. A3 is 2% of Air. A2L is 4x propane
- MIE (Minimum Ignition Energy) A2L is 2000x higher than propane. 300mJ vs mJ.
- Reactivity, Burning Velocity, Flame Spread: A2 is 5x slower than A3.

ASHRAE 15 and 34

- ASHRAE 15 relies on ASHRAE 34:
  - Refrigerant safety classifications
  - Refrigerant concentration limits
    - Toxicity
    - Flammability
    - Oxygen Deprivation
  - Key refrigerant property information that must be submitted with an application for designation




ASHRAE
STANDARD

ANSI/ASHRAE Standard 15-2013
(Supersedes ANSI/ASHRAE Standard 15-2010)
Includes ANSI/ASHRAE addenda listed in Appendix F

Safety Standard for Refrigeration Systems

See Appendix F for approval dates by the ASHRAE Standards Committee, the ASHRAE Board of Directors, and the American National Standards Institute.

This standard is under continuous maintenance by a Standing Standard Project Committee (SSPC) for which the Standards Committee has established a documented program for regular publication of addenda or revisions, including procedures for timely, documented, consensus action on requests for change to any part of the standard. The change submittal form, instructions, and deadlines may be obtained in electronic form from the ASHRAE website (www.ashrae.org) or in paper form from the Manager of Standards. The latest edition of an ASHRAE Standard may be purchased from the ASHRAE website (www.ashrae.org) or from ASHRAE Customer Service, 1791 Tullie Circle, NE, Atlanta, GA 30329-2305. E-mail: orders@ashrae.org. Fax: 678-539-2129. Telephone: 404-636-8400 (worldwide), or toll free 1-800-527-4723 (for orders in US and Canada). For reprint permission, go to www.ashrae.org/permissions.

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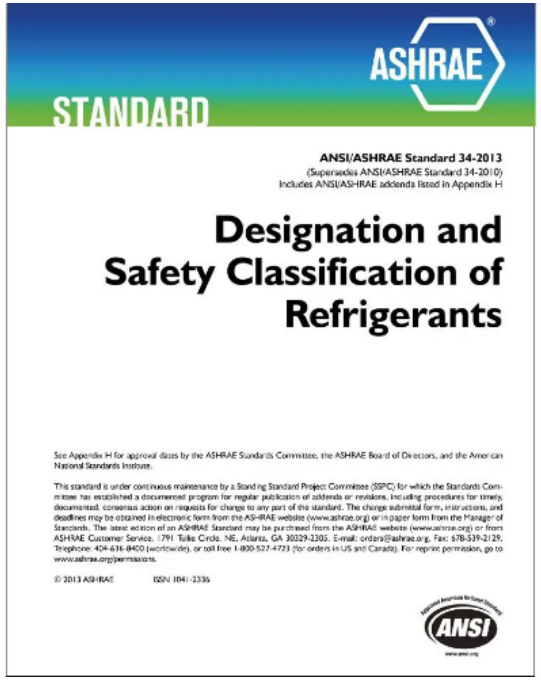
ANSI


ASHRAE
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Designation and Safety Classification of Refrigerants

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ANSI

ASHRAE 34 RCL

Limits are established to ensure that a potential leak remains safe for the occupants.

26 Lbs of R410A per 1,000 Ft3

13 Lbs of R410A per 1,000 Ft3 (institutional)

A2L Limits

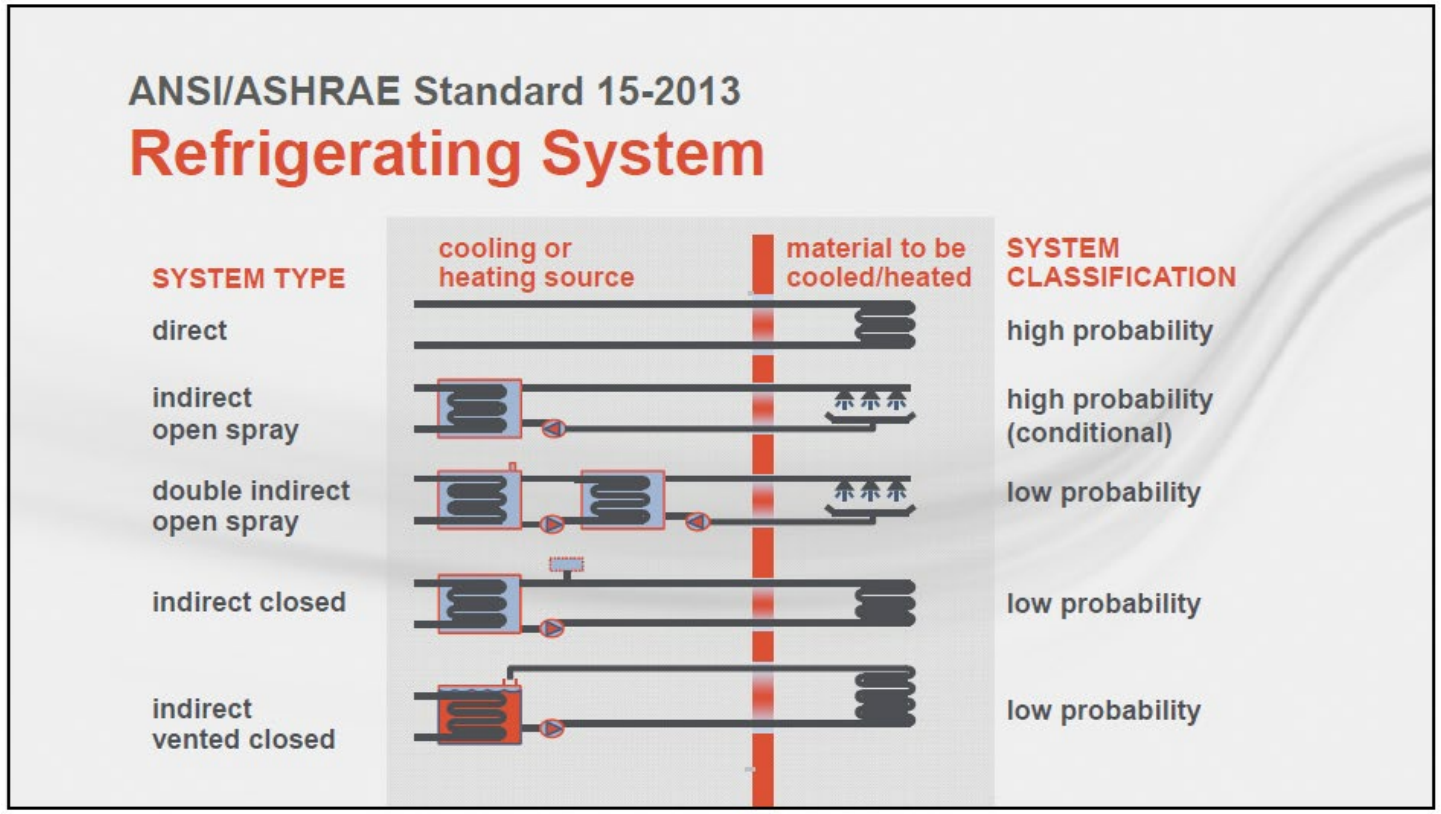
Limits for A2L will be a 1/5 of current limits.

19Lbs of R32 per 1,000 Ft3

5Lbs of R32 per 1,000 Ft3 (institutional)

Applying ASHRAE 15

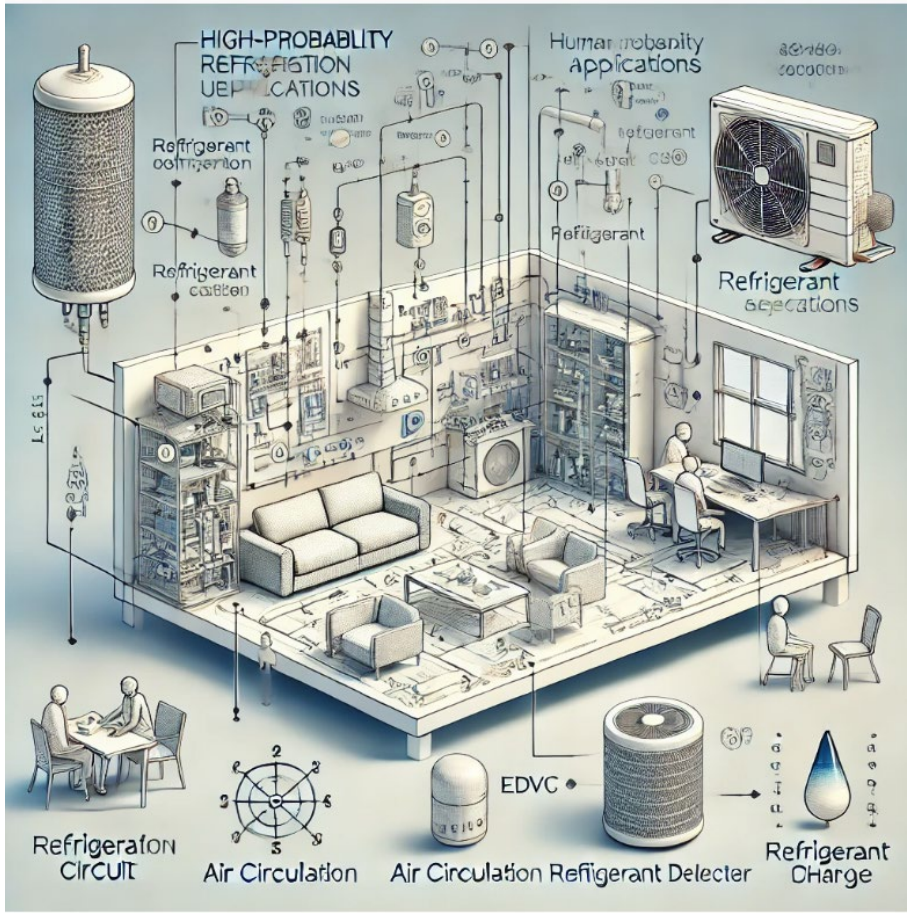
- Identify Safety Group Classification of the Refrigerant
- Determine Occupancy Classification
  - Institutional
  - Industrial
  - Public Assembly
  - Commercial
- Determine System Probability Classification
  - High probability-RTU, Split, HP, VRF, Ptac
  - Low Probability-Chiller



A2L Requirements

- **LISTED EQUIPMENT MUST BE USED**

- UL 60335-2-40/CSA C22.2 No. 60335-2-40, *Standard for Household and Similar Electrical Appliances–Safety–Part 2-40: Particular Requirements for Electrical Heat Pumps, Air-Conditioners and Dehumidifiers*
- UL 484, *Standard for Room Air Conditioners*



Standard 15 VS UL Listing

- Both standards set a maximum refrigerant charge limit. UL 60335-2-40/CSA C22.2 No. 60335-2-40 requires manufacturers to calculate the minimum floor area for the room served by the equipment, based on a specified minimum installation height, and display these values on the product nameplate. Standard 15 calculates refrigerant limits using an effective dispersal volume (Veff)
- Does not include an occupant adjustment factor (Focc) when determining the maximum refrigerant charge. Therefore, for an occupancy classified as "institutional," the Standard 15 calculation of EDVC will likely be more stringent
- There are some applications where Standard 15 might require a refrigerant detection system.

RDS system required

❑ Manufacturer's RDS is mandatory for certain systems (7.6.2.3)

Ducted systems with m_{rel} > 4.0lb and low openings*

Ducted systems considering connected spaces

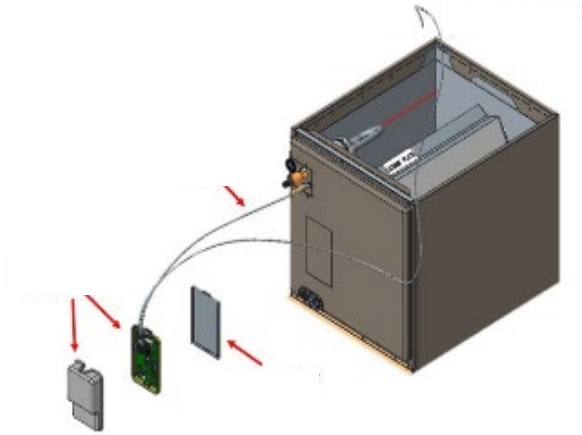
Institutional occupancies

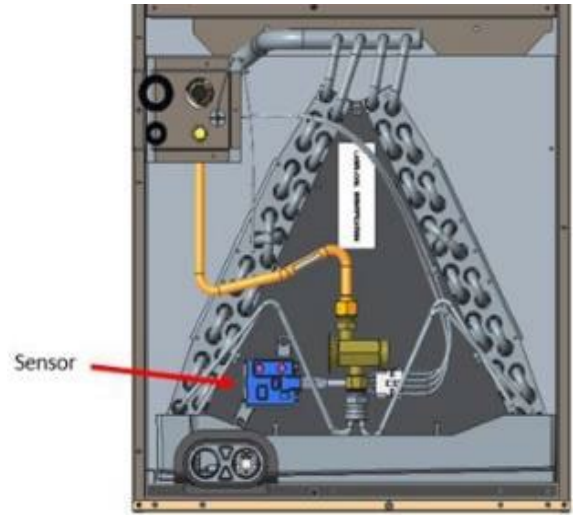
- Ducted system that has releasable charge Greater than 4lbs or has any duct opening lower than 5.9 ft above the finished floor
- Ducted systems in which connected spaces served by the same supply air duct are used to calculate the EVDC
- Refrigeration system installed in institutional occupancy
- Must be integral and listed with the equipment

A2L Equipment

- A2L Products will begin entering the market “in mass” this year
- RDS MUST be factory mounted “Generic” RDS “kits” not allowed. MUST BE INTERGRAL AND LISTED
- Multiple sensors for larger units…
- All RDS will be listed by a safety agency for the specific units to which they are applied
  - Per UL 60335-2-40, ASHRAE 15 & 15.2
- RDS not required in all applications
  - Below minimum’s charge size (< 4 lbs)

Split System Product





RDS Requirements

Shall alarm within **30 seconds** of exposure to 25% LFL

Pre-calibrated, nonadjustable set point

Shall resist poisoning over time

Shall not be damaged by release of refrigerant or oil

Long term stability

temp | RH% | pressure
vibration | electrical

Hourly self-test with alarm on failure**, close on power failure

Self-determination and alarm on EOL*

Accessible and serviceable for replacement

RDS

Control Requirements

- Part of a UL-60335-2-40 listed system
- Indoor units shall be 5-tons or less
- Refrigerant detection in all units or all spaces
- Isolate all possible paths in the event of system failure

Mitigation Actions

- Energize equipment's *air circulation* fans
- Open all (any) zone dampers to full airflow & activate ventilation*
- De-energize any electric heat and ignition sources
- Activate safety shutoff valves

Room Volume Calculations

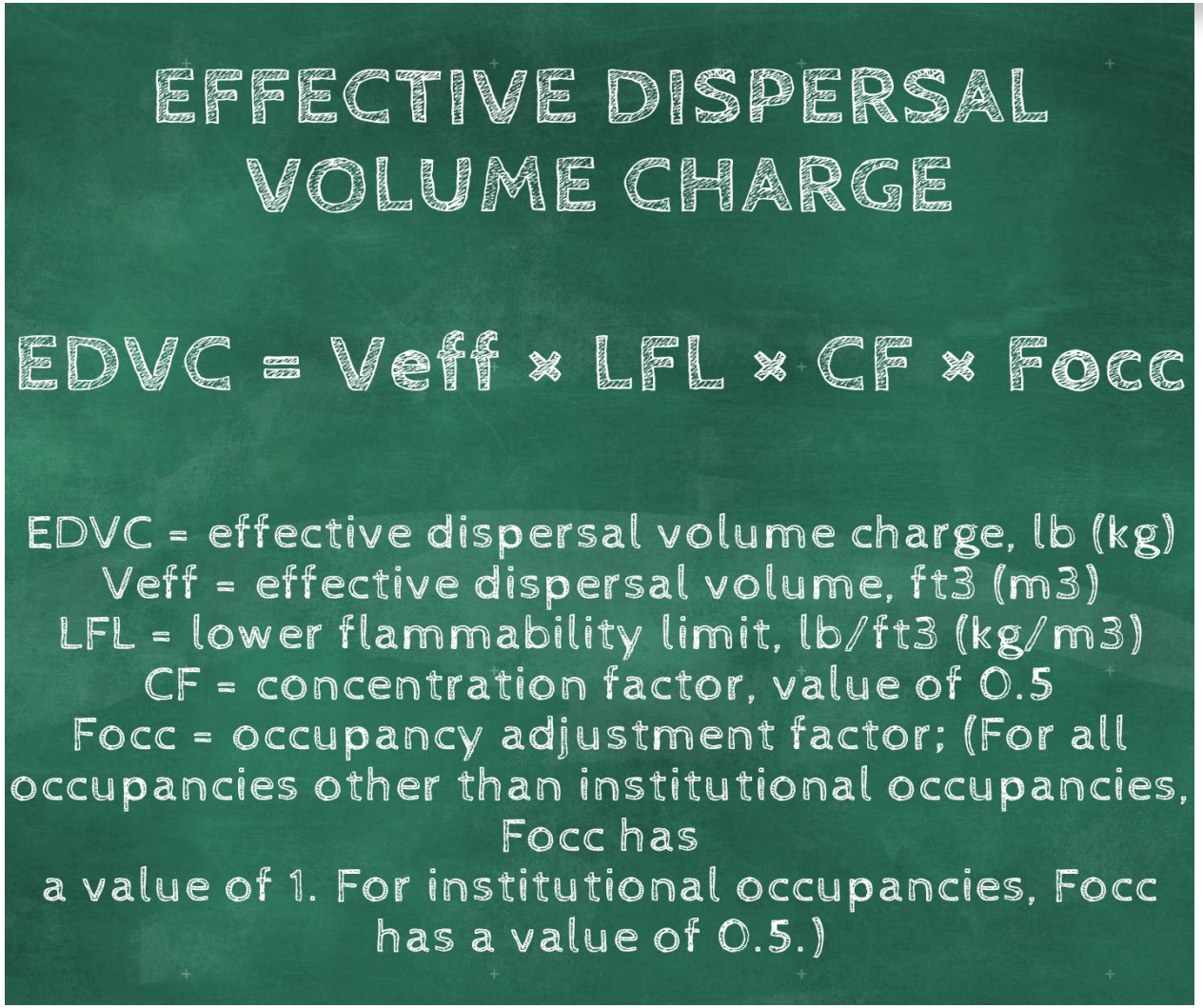
SYSTEMS WITH AIR CIRCULATIONS

Effective dispersal volume charge (EDVC)=

is the maximum refrigerant charge permitted for an effective dispersal volume

The refrigerant charge of a direct system (or releasable charge) cannot exceed the EDVC

- A2L INCLUDE OCCUPIED AND NON OCCUPIED.



Exempt Spaces

Determining V_{eff} - Exempted Spaces

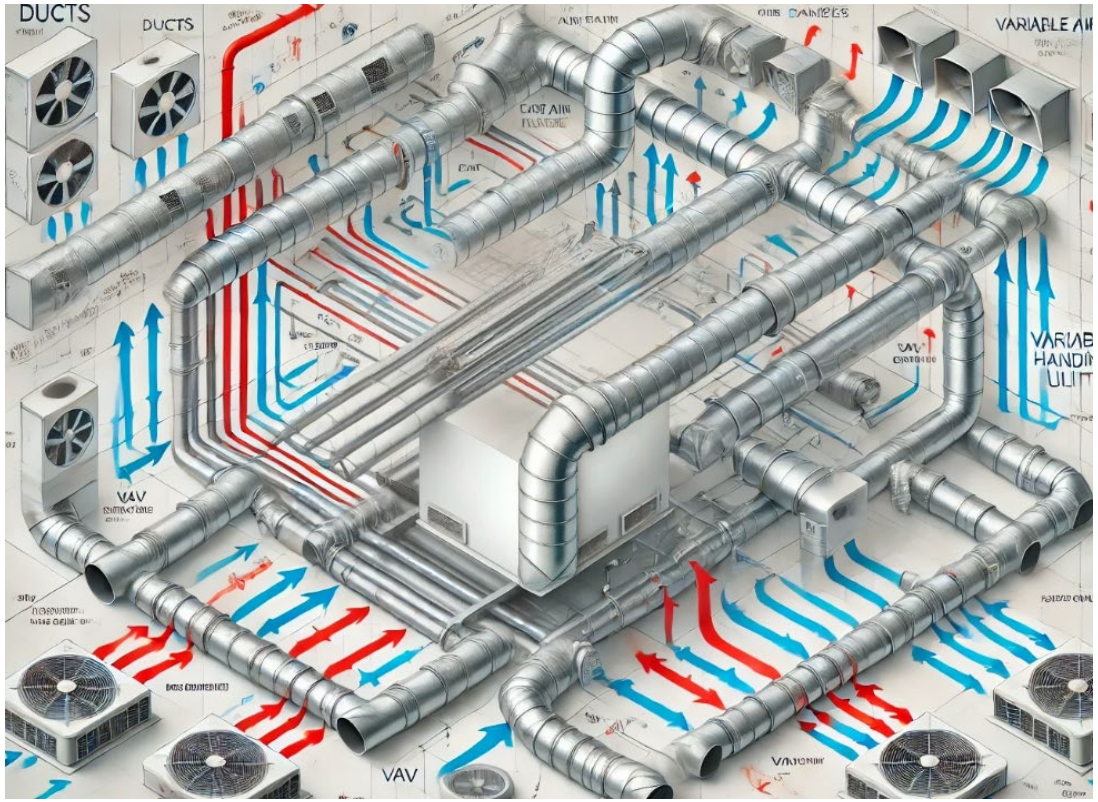
Spaces containing only **continuous refrigerant piping**, or **joints & connections that have been tested** in accordance with 9.13 are exempt from the effective dispersal calc.

Connected Space

Option 1	Option 2	Option 3
Permanent Natural Ventilation Openings	Spaces Connected via Ductwork*	via Mechanical Ventilation

Permanent Natural Ventilation Openings

- Spaces connected by natural ventilation openings must be on the same floor of a building
- Equations are provided to determine the required minimum size of the opening
- Bottom of the opening of the connected spaced must be no higher than 12” above the finished floor.
- Any Area of the opening above 12”cannot be considered for meeting the minimum size requirement.
- Ductwork
  - Include volume of all spaces served by common supply and return ductwork unless the space can be total close off other than by a smoke or fire damper.
  - You can include the space it serves Unless a vav box reduces the airflow to below 10% of it design air flow
  - Include volume of supply and return ductwork
  - Include volume of ceiling or floor plenum, if its part of the supply or return air system
  - VRF system tied to 3rd party AHU



MECHANICAL VENTILATION

- Different 62.1
- Removal of air and leaked refrigerant from a space, in the event of a refrigerant leak. Not intended to control indoor air quality. Rather, ventilation in Standard 15 serves as a safety mitigation method for reducing the refrigerant concentration within a space.
- Required use of separate exhaust fans.
- Most likely use when equipment does not have circulation fan.
- Can either operate continuously be activate by refrigerant detector.
- Makeup air must be provided, with opening positioned to allow makeup air to mix with leaked refrigerant
- Intakes for exhaust air located with bottom edge of intake less than 12" above where leaked refrigerant accumulates.
- Discharge to prevent recirculation of exhaust air.
- No ignition sources in space where equipment is located.
- No open flame devices
- Monthly testing
- New for 2024 Where two or more spaces are connected by a mechanical ventilation system complying with the requirements of Section 7.6.4, the volume of all such *connected spaces shall* be included in the *effective dispersal volume* used to calculate the *EDVC*

Refrigerant Change Over Box

- When a *ventilated enclosure* is applied, compliance with the other requirements for Mechanical Ventilation are not required

Ventilated MCU Concept

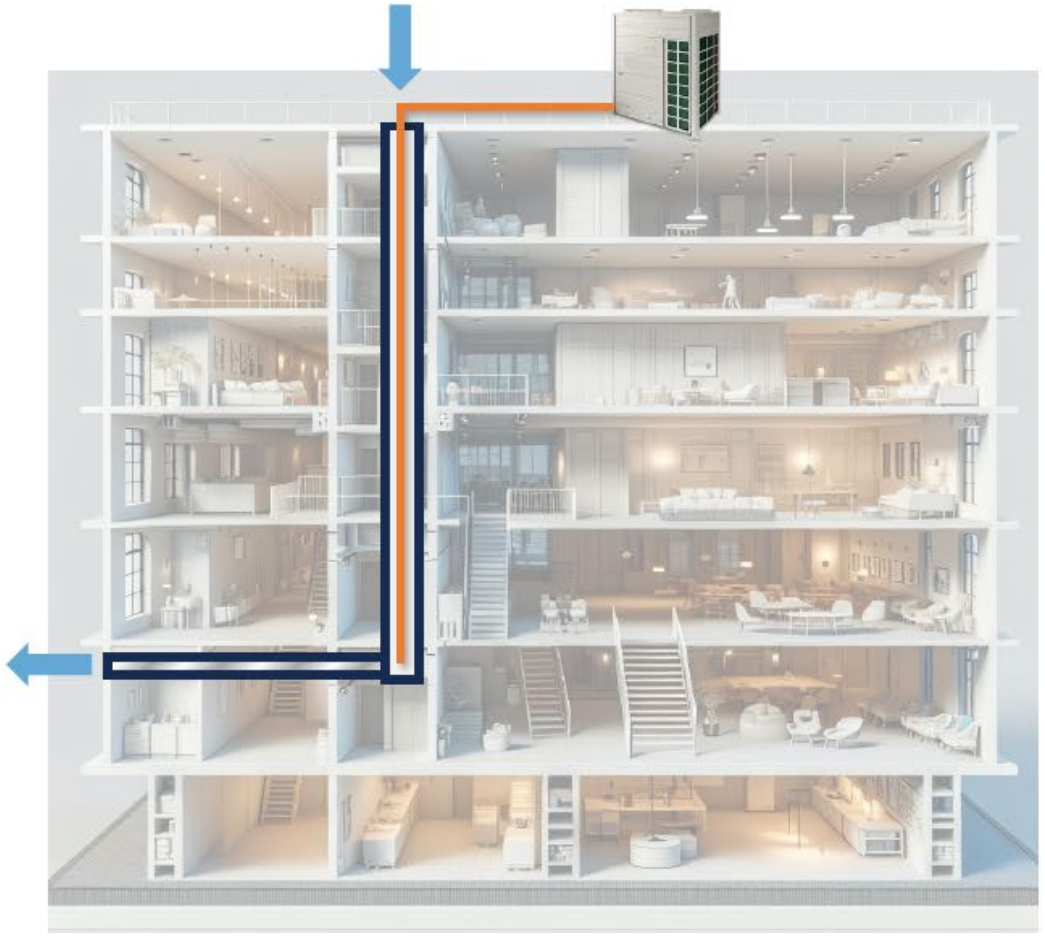
Ventilated Enclosure

- Exhaust system prevents leak of refrigerant to surrounding space
- Exhaust to outdoors or sufficiently large space volume
- Keeps appliance under negative pressure (20 Pa)
- Minimum exhaust airflow
  - Min **11 CFM** for ETRS systems

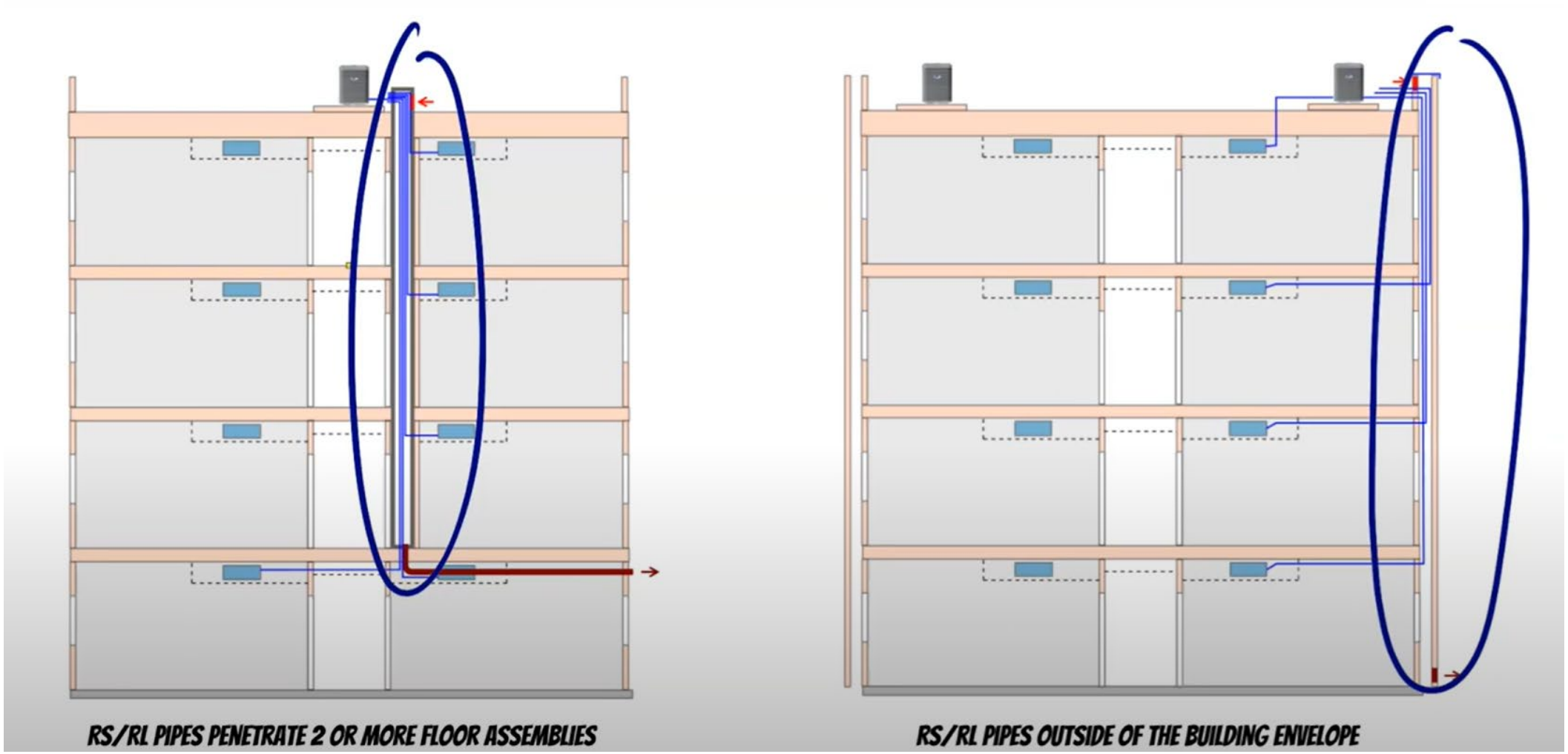
Shaft Ventilation

Option 1: Natural Ventilation

- Shall have a pipe, duct, or conduit:
  - Min. 4" Ø
  - Connects to the lowest point of the shaft
  - Level or pitched downwards to outdoors
  - Extends to the outdoors
- Makeup air opening should be provided at the top of the shaft (when designing in accordance with ASHRAE 15)



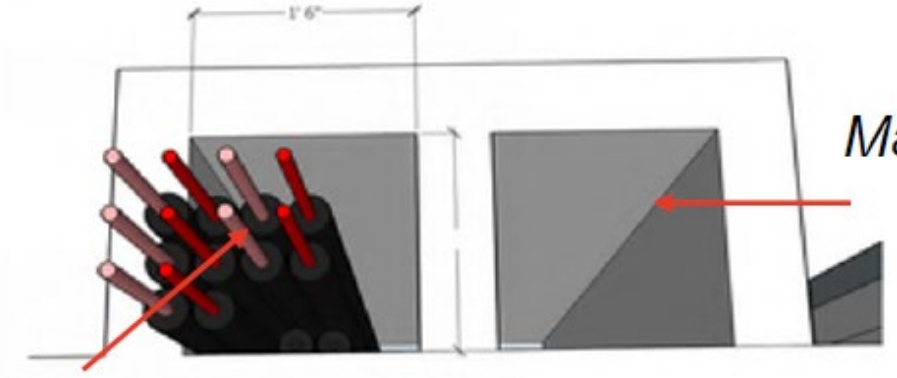
Shaft Ventilation

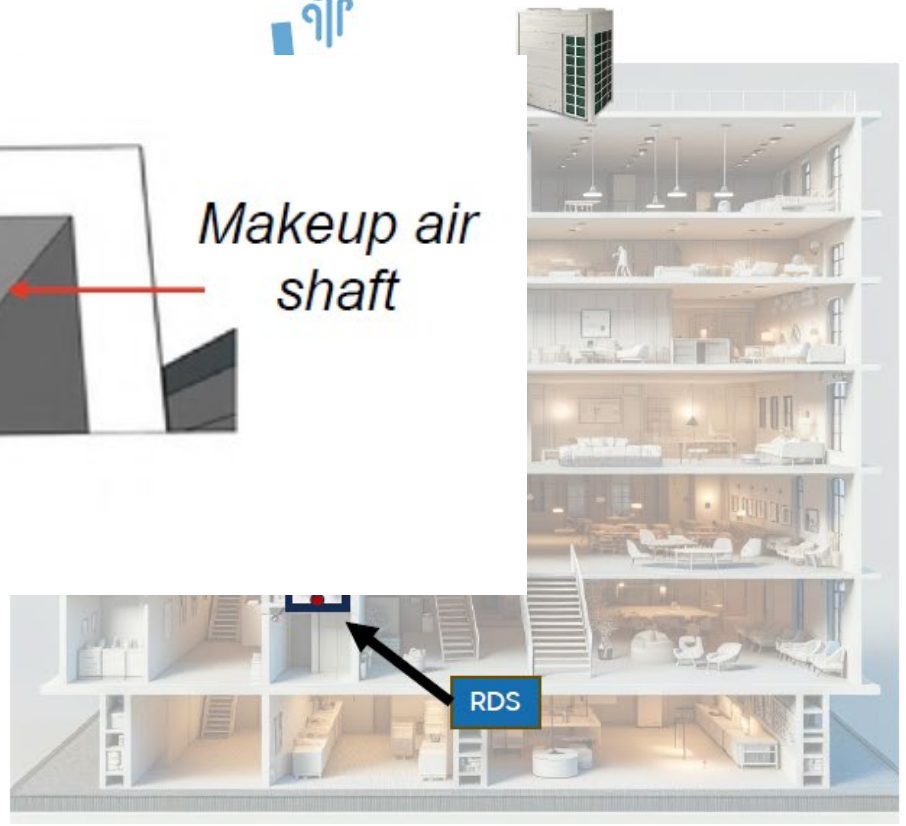


Mechanical Shaft Ventilation

Option 2: Mechanical Ventilation

- Must me
- Must ope
- ...Include
  activate
  - *Note! This is not an SHA-supplied RD.*
  - located in an area will a leak will concentrate
  - Activate ventilation at 25% LFL



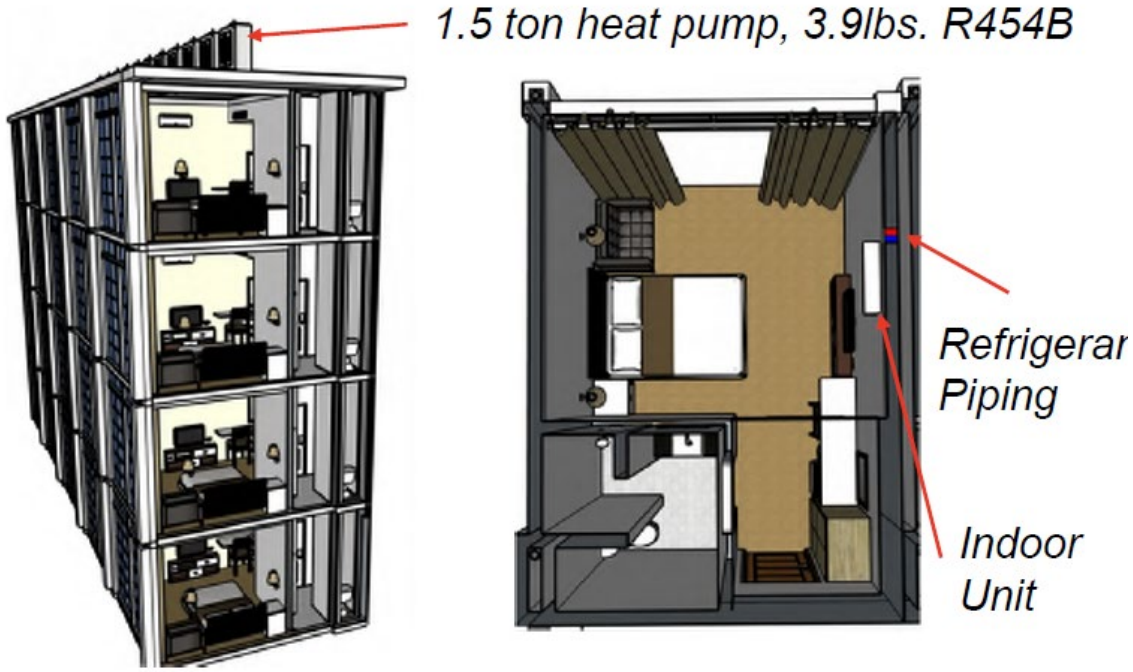


Exceptions

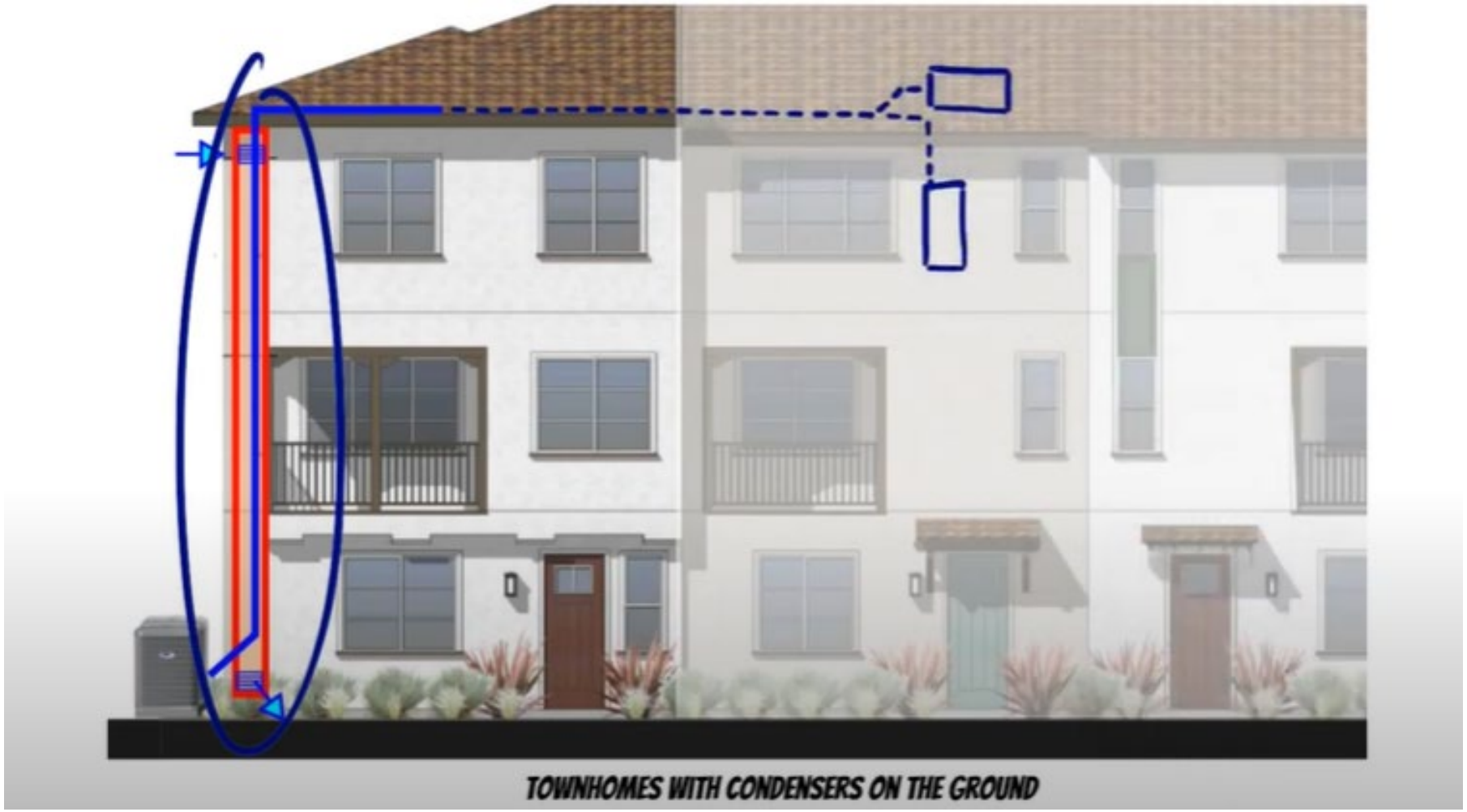
- **9.12.1.5.1 Shaft Alternative (b)**

Key Requirement:
•Refrigerant piping penetrating 2 or more floor/ceiling assemblies must be enclosed in a fire-resistance-rated shaft.
•Shaft construction must comply with applicable building codes for life safety and containment.

What Else Can Be Routed in the Shaft:
•Domestic water piping
•Electrical conduits
•Communication wiring
•Sprinkler lines
(*As long as shaft meets code and refrigerant piping is properly enclosed*)



Townhomes



Prohibited Locations

Prohibited Locations for Refrigerant Piping (Section 9.12.1.3)

- Refrigerant piping shall not be installed in any of the following locations if exposed:
  - Within a fire-resistance-rated exit access corridor.
  - Within an interior exit stairway
  - Interior exit ramp
  - Exit passageway
  - Elevator, dumbwaiter, or any other shaft containing a moving object.

Exit Passageway Definition: An exit component separated from other interior spaces of a building or structure by fire-resistant-rated construction. Provides a protected egress path in a horizontal direction to an exit or outside exit door.

Machinery Room-Detection & Ventilation

Ventilation Requirements (8.11.6.1)

- Continuous OR Activated (by RDS)
  - If continuous, failure of system activates an alarm
- Vented to outdoors
- Via one or more powered fans
  - Single or multi speed
  - Electric motors NOT in ductwork
  - Fan rotating elements shall be nonferrous or nonsparking OR…
  - …Casing shall consist of or be lined with such material
- Makeup air shall serve no other areas*
- Inlet location specifics*
- **Level I Ventilation** rate at minimum
- **Level II Ventilation** rate

Detection Requirements (8.11.6.2)

- Detection of concentration > 25% LFL** shall:
  - De-energize compressors
  - De-energize pumps
  - De-energize normally closed automatic refrigerant valves
  - De-energize other unclassified electrical sources with apparent power > 1 kVA

Machinery Room-Refrigerant Detectors

Detect each refrigerant designation

Setpoint not greater than lowest OEL

Setpoint not greater than lowest RCL

Means for automatic self-testing w/ trouble alarm

Tested during install

Tested annually or per mfg.'s instructions*

Machinery Room–Alarm Requirement

Visual and audible inside

Visual and audible outside each door

Manual reset located inside*

Alarm on self-test failure

Dedicated, remote control shutdown outside door(s) for equipment

Ventilation control switch outside door(s)

Machine Room Example

8.11.11 Ventilation-Exhaust Calculations

- Ventilation Calculation Example (I-P):
  - Water Source HP system greater than 27.5 lbs, use equation 8-4
  - Machinery Room 6’ x 10’
  - Refrigerant Pressure: 425psig

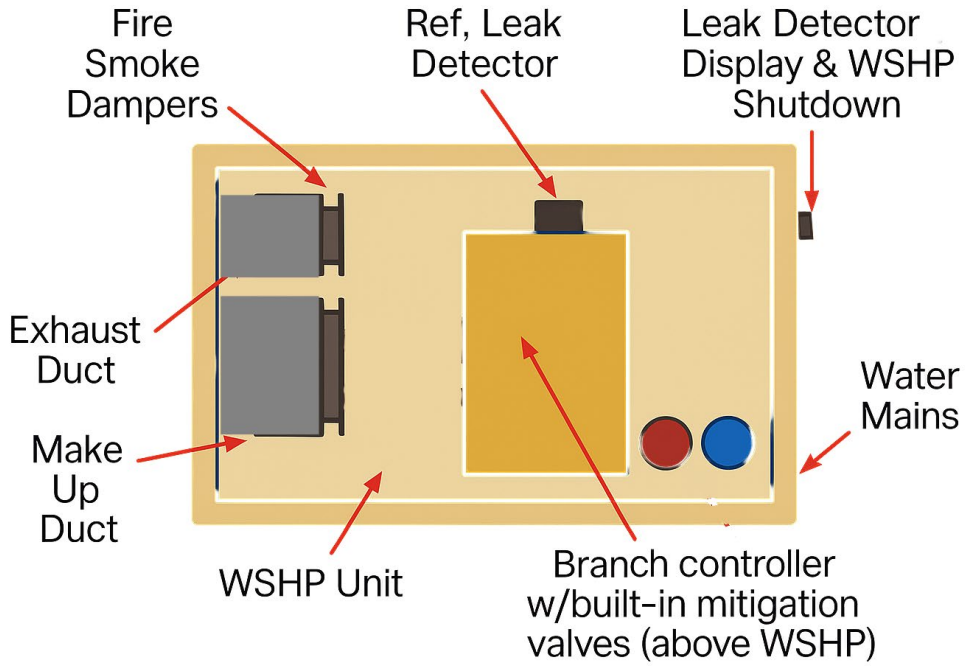
Table 8-3

G =	30
P =	425
G' =	271.5788
Q' =	27531.74
Q1 =	40
Airflow Q (cfm) =	3876.706

Table 8-2

Machinery Room Area [sf] =	80
Min Airflow [cfm]	40

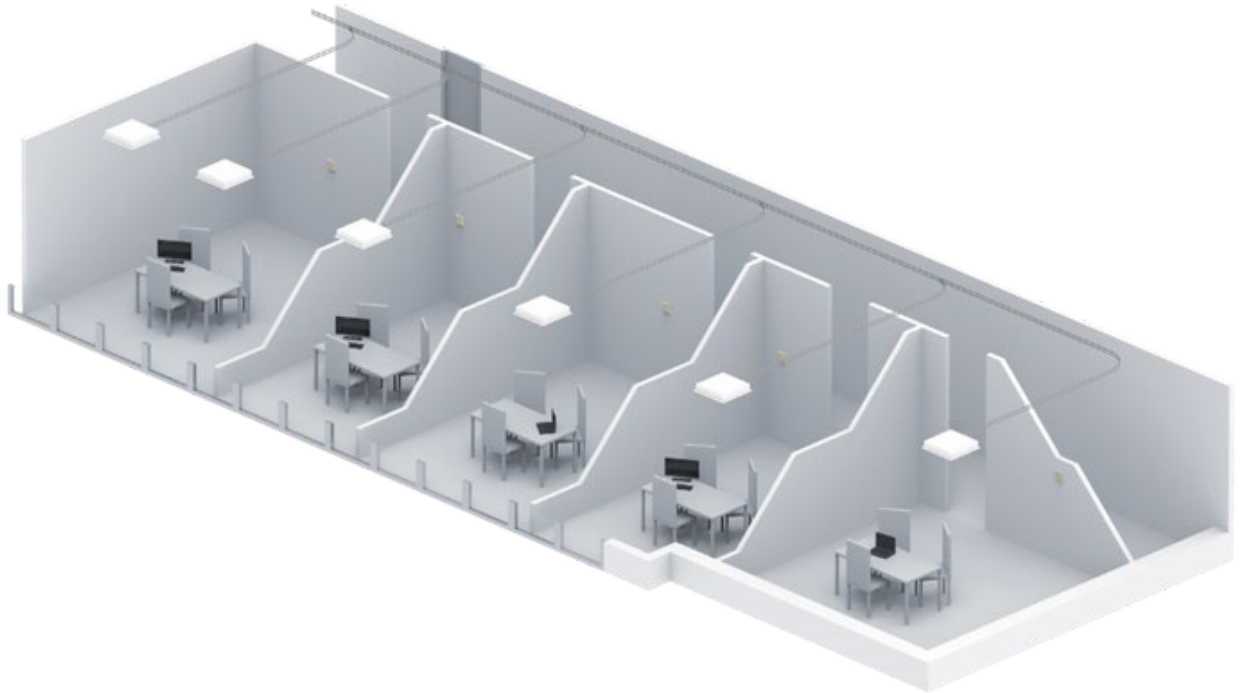
Exhaust Fan Requirement: 3876 CFM



A2L Equipment

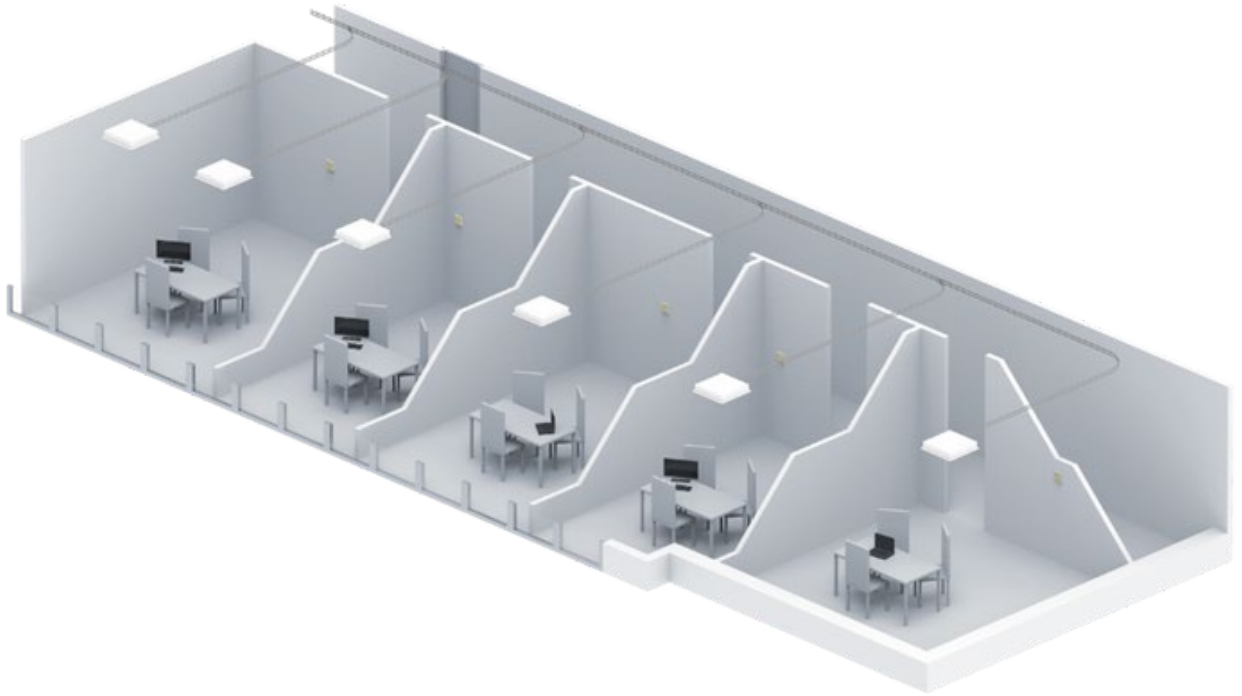
Analysis of smallest zone, with higher refrigerant concentration

- Zone is 10x10ft
- 10 ft ceiling height
- Releasable refrigerant charge is greater than effective dispersal volume charge



Connected Spaces

- If the system uses R-32 Refrigerant
  - Total Refrigerant Charge=27lbs
  - Single Circuit: Mrel=27 Lbs
  - LFL for R-32=19.1 LBS/1000 ft^3 =0.0191/lbs ft^3
  - Effective Dispersal Volume Veff= 1000 ft^3
  - Equipped with a refrigerant detector to initiate air circulation.
  - EVDC=0.0191 lbs/ ft^3 x 1000 ft^3 x 0.5 x 1.0= 9.55 lbs

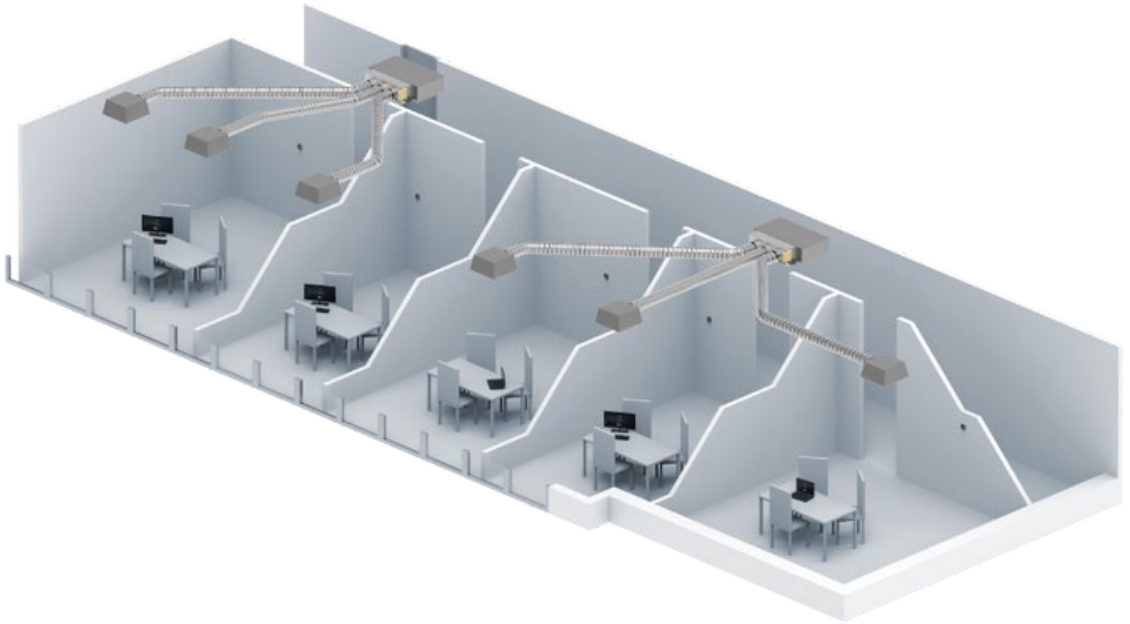


Does this installation comply with ASHRAE 15?

Connected Spaces

Solution for commercial projects

- Less indoor units
- Reduction of refrigerant piping
- Lower refrigerant charge

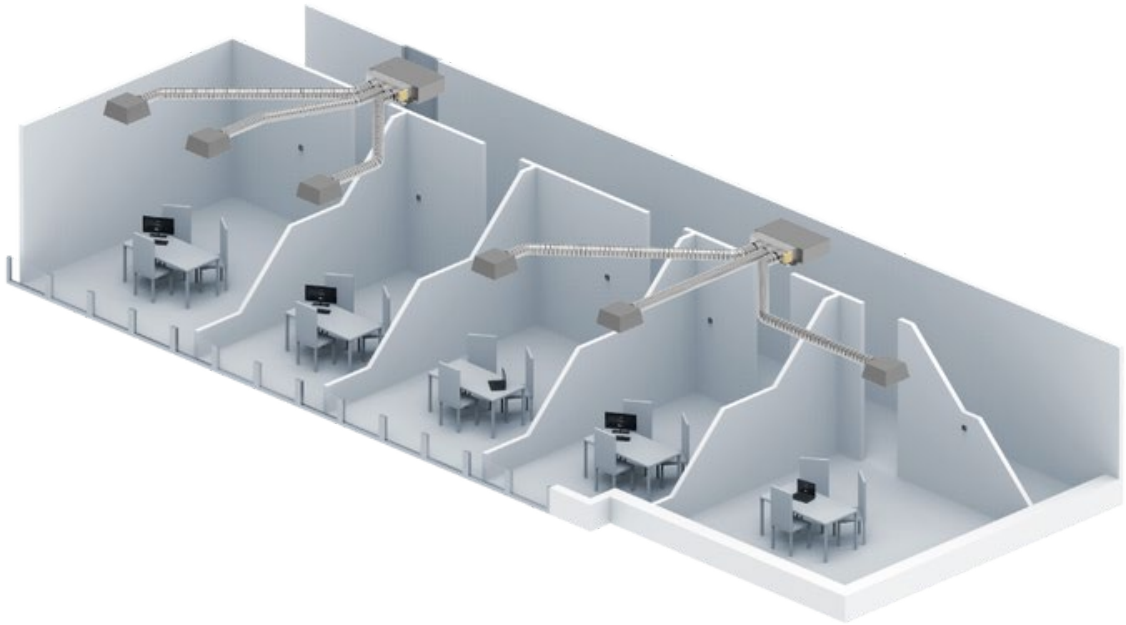


Connected Spaces

If the system uses R-32 Refrigerant

- Total Refrigerant Charge=27lbs
- Single Circuit: Mrel=27 Lbs
- LFL for R-32=19.1 LBS/1000 ft^3 =0.0191/lbs ft^3
- Effective Dispersal Volume Veff= 3000 ft^3
  Equipped with a refrigerant detector to initiate air circulation.

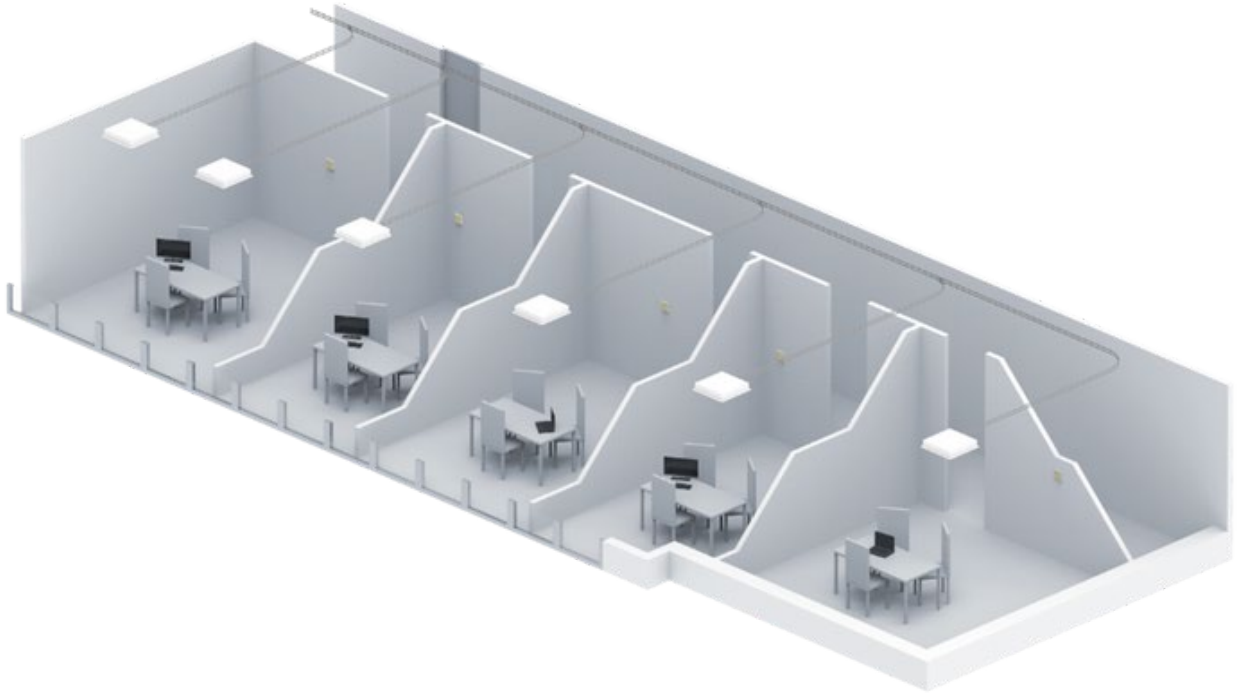
EVDC=0.0191 lbs/ ft^3 x 3000 ft^3 x 0.5 x 1.0= 28.65 lbs



Compliance with ASHRAE 15

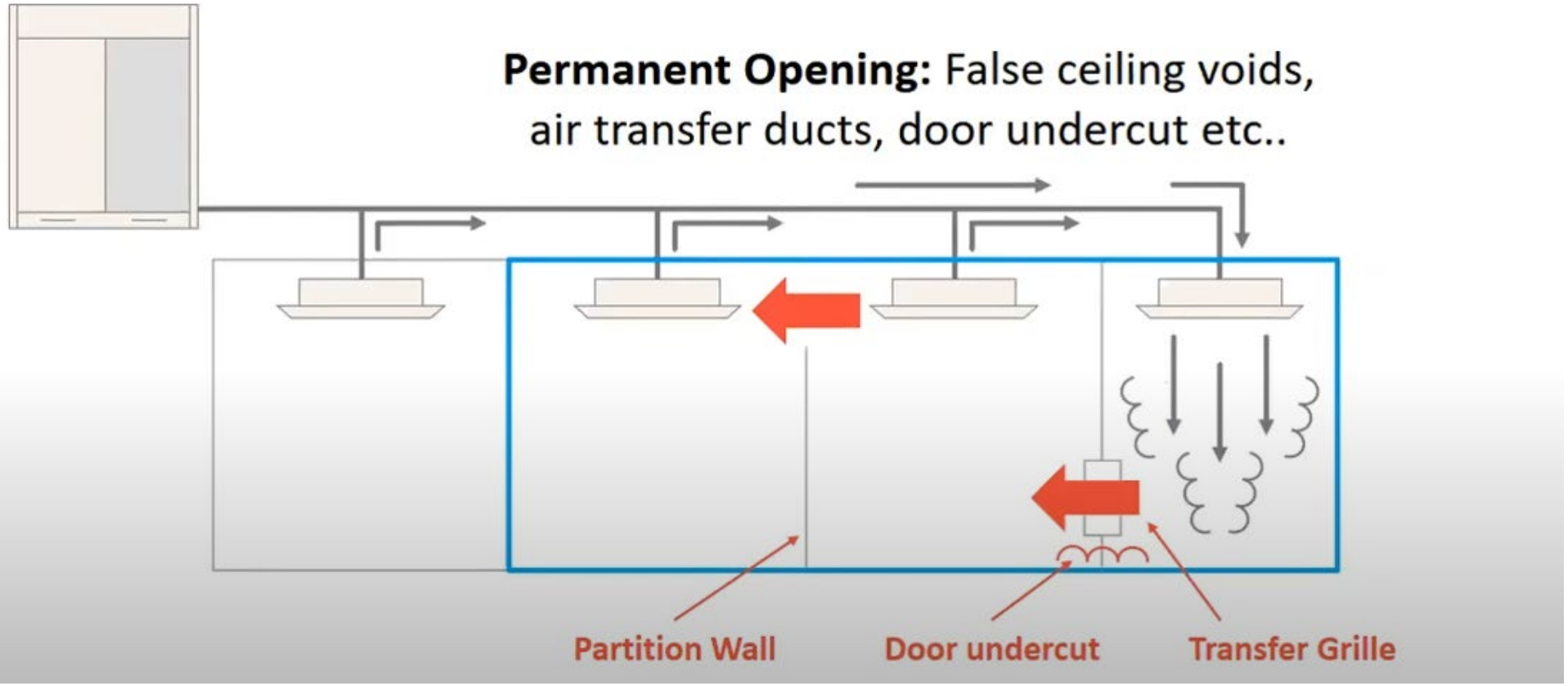
Mechanical Ventilation

- If the system uses R-32 Refrigerant
  - Total Refrigerant Charge=27lbs
  - Single Circuit: Mrel=27 Lbs
  - LFL for R-32=19.1 LBS
  - Effective Dispersal Volume Veff= 1000 ft3.
  - EVDC=0.0191 lbs/ft3 x 1000 ft3 x 0.5 x 1.0= 9.55 lbs
  - ms – EDVC = 27.0 lb – 9.55 lb = 17.45 lb
  - Qreq = 2 × 17.45 lb / (4 minutes × 0.0191 lb/ft3)=456 CFM



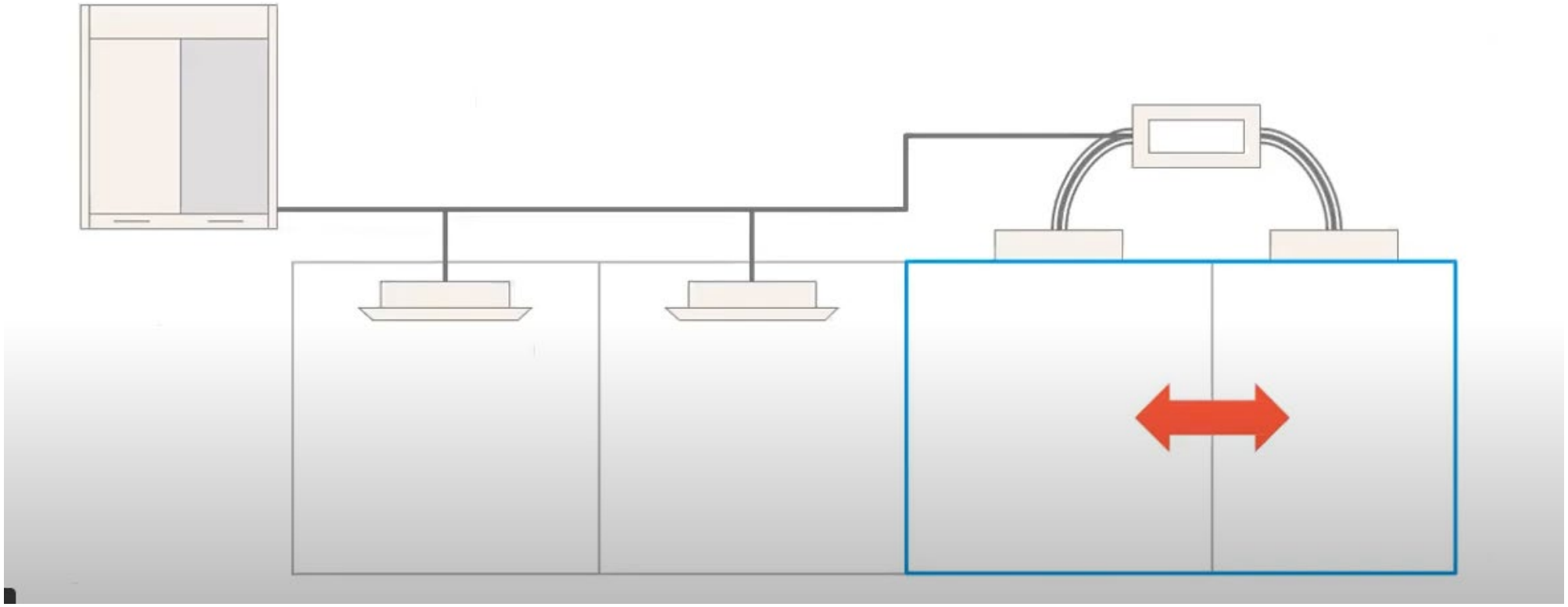
DESIGN CONSIDERATIONS

Increase the dilution volume



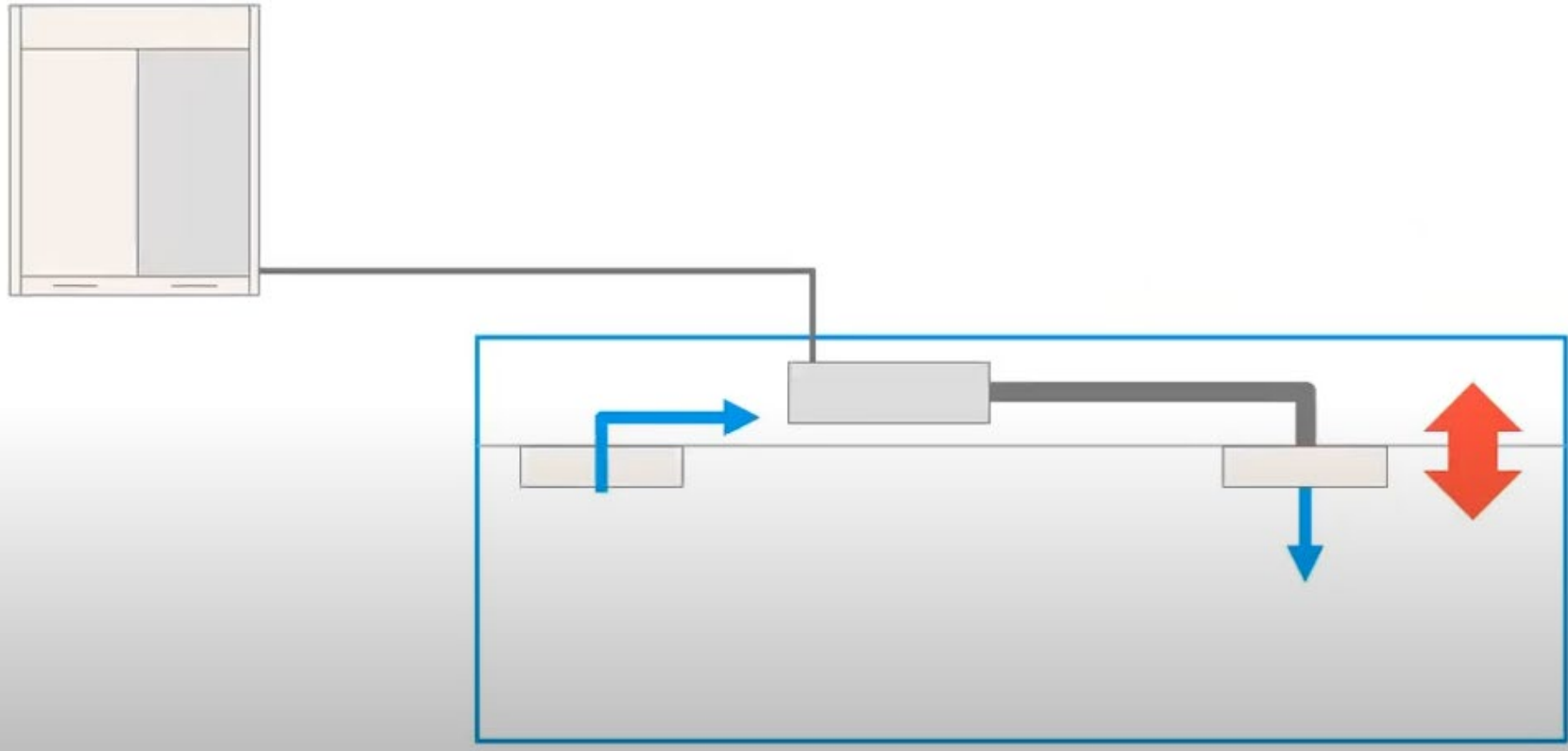
DESIGN CONSIDERATIONS

Use a ducted fan coil unit to serve multiple spaces

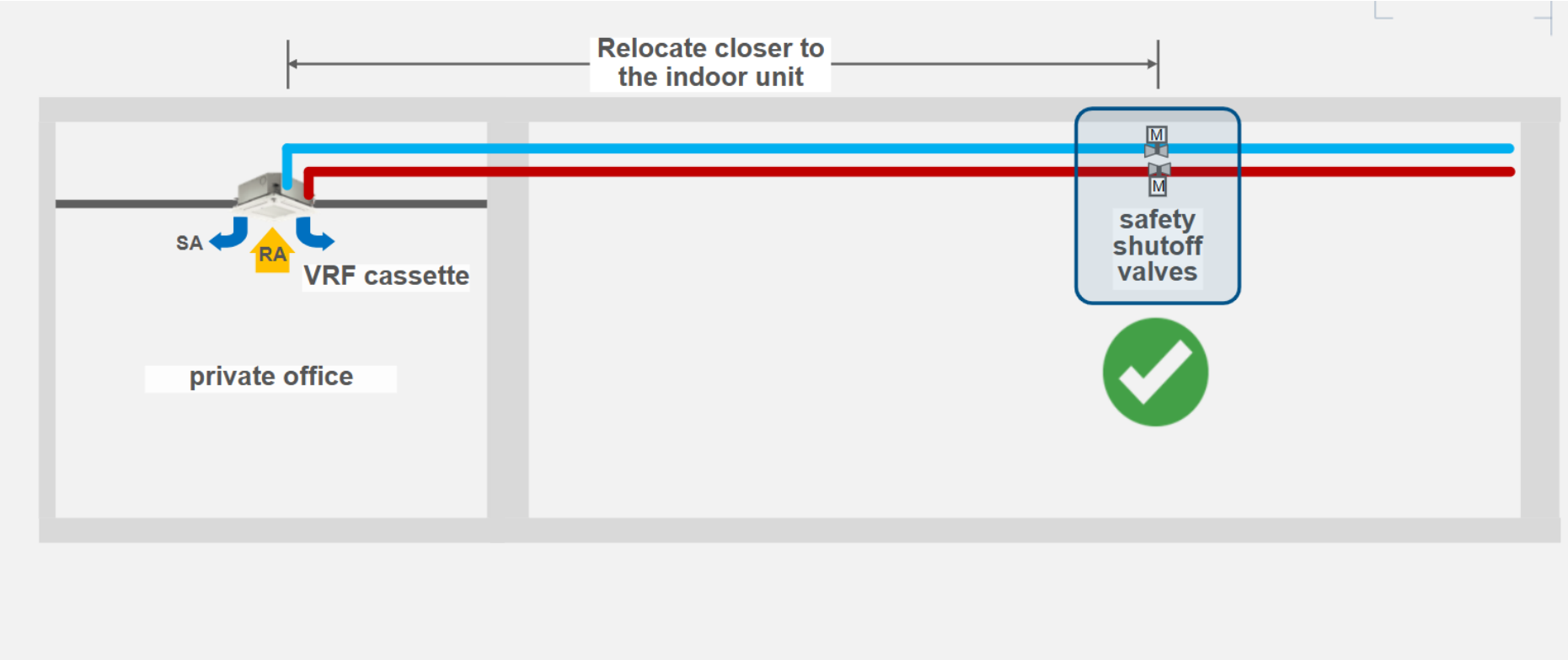


DESIGN CONSIDERATIONS

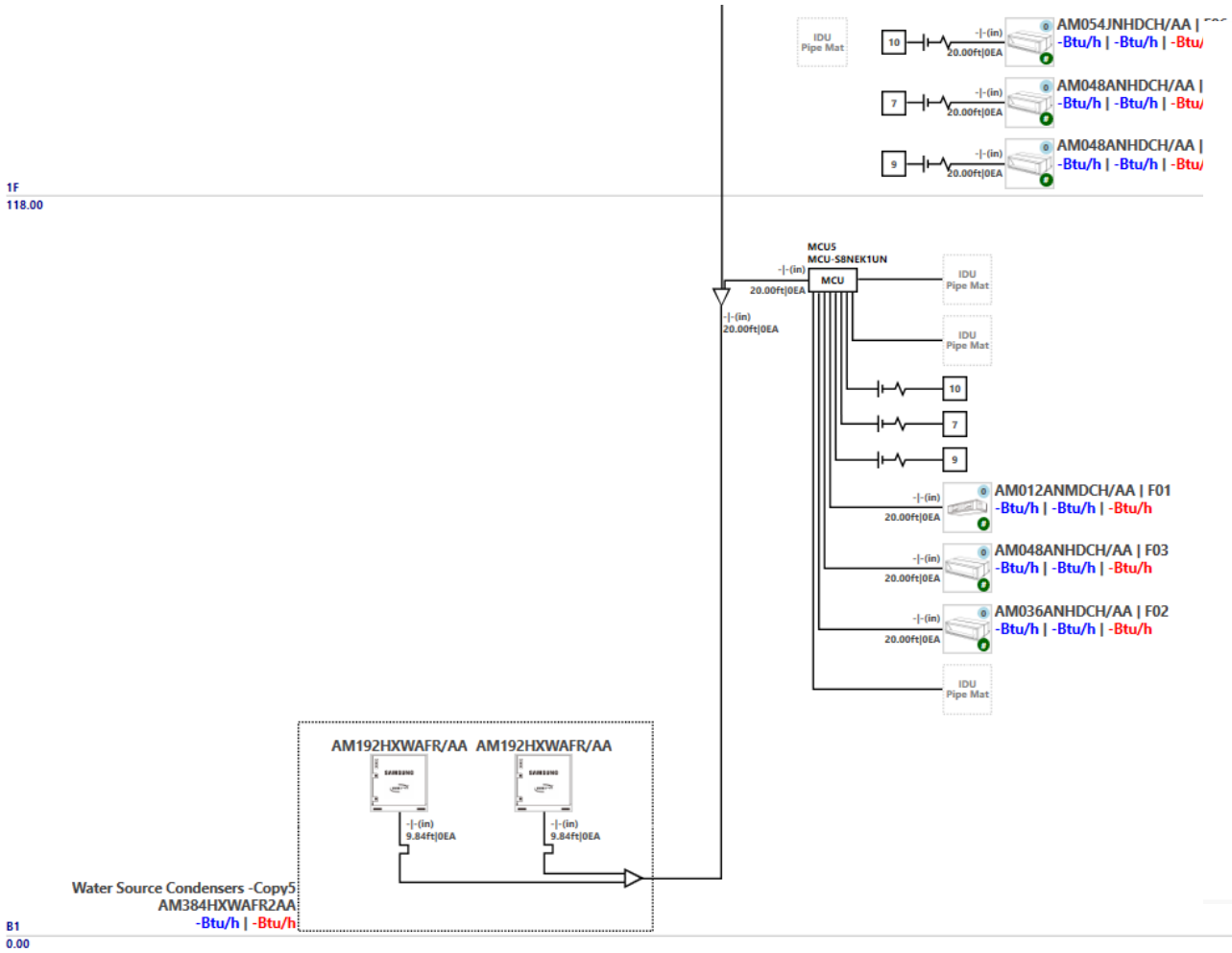
Using the void space as a plenum chamber

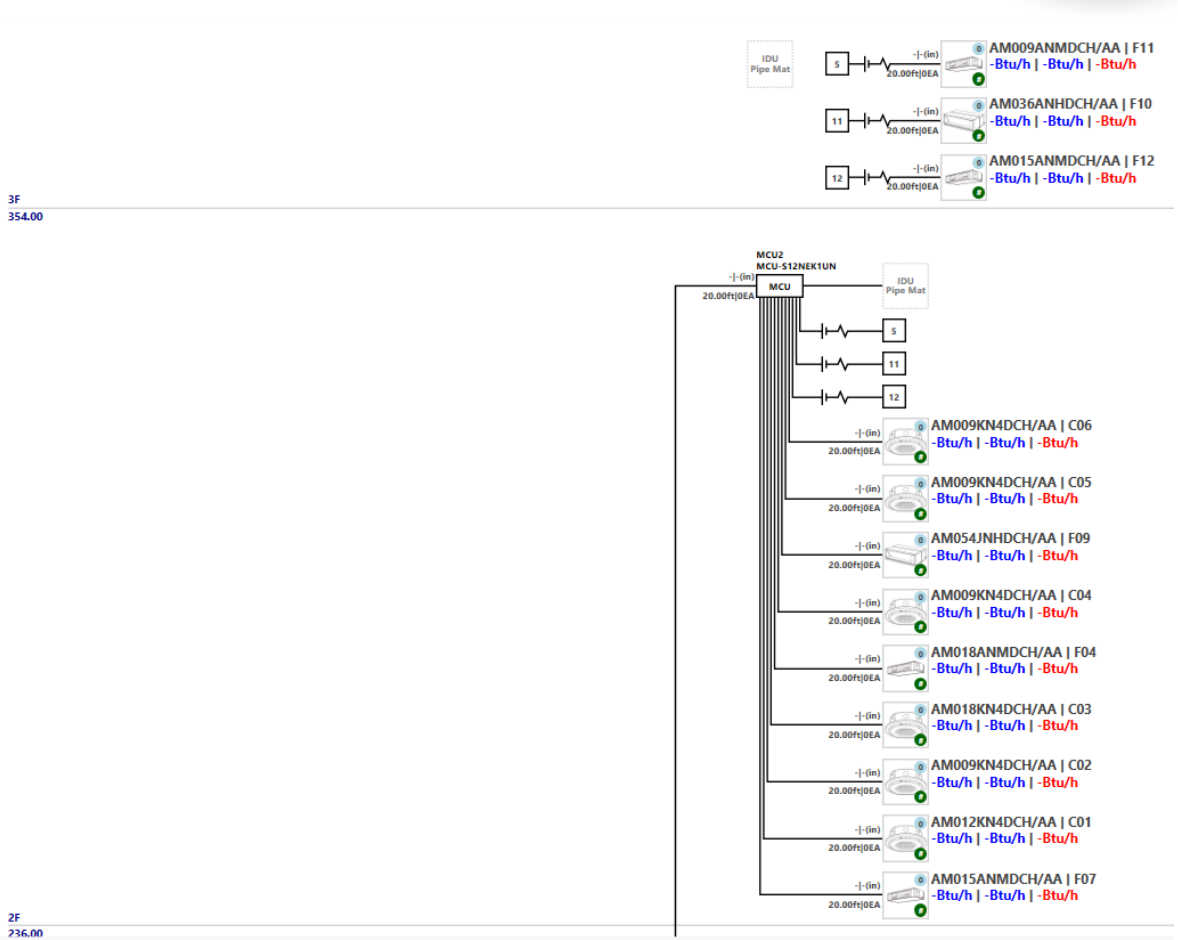


Design Considerations

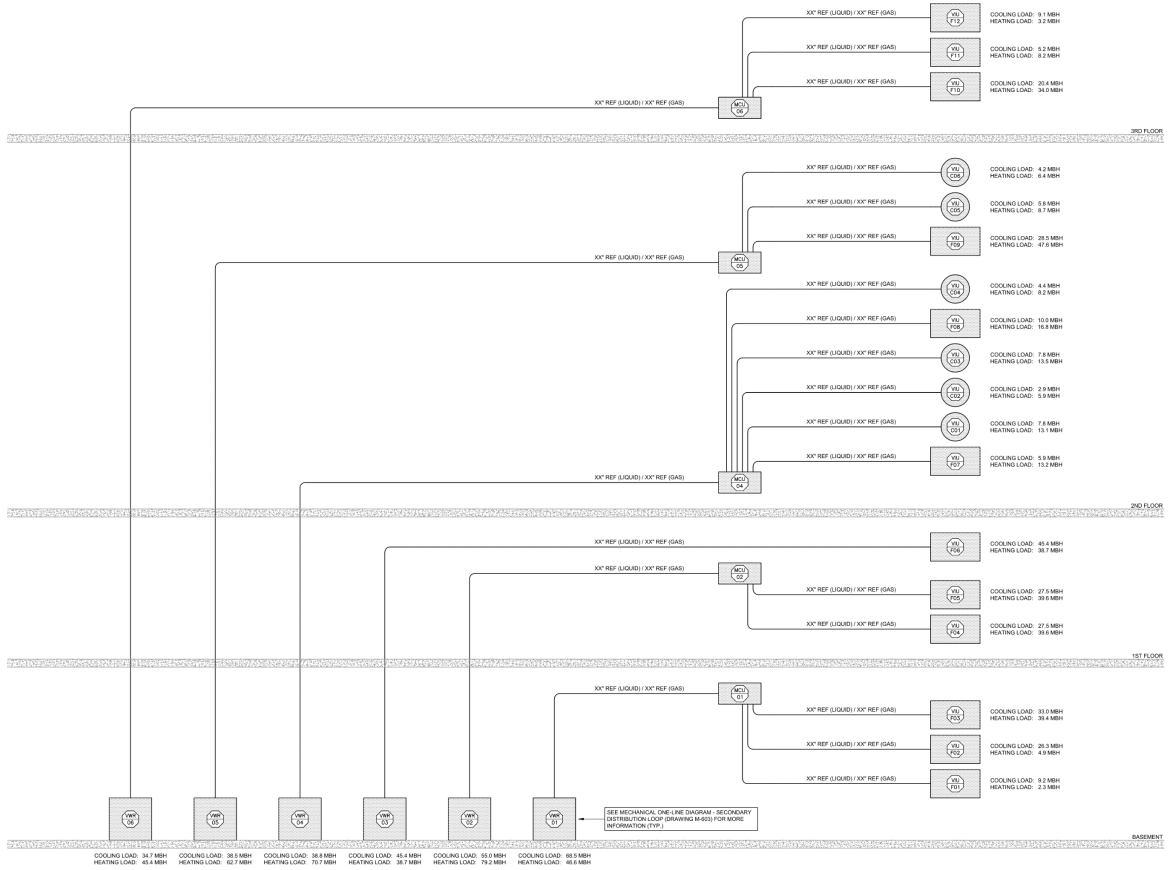


WATER SOUCE VRF





Water Source VRF



MECHANICAL ONE-LINE DIAGRAM - VRF RISER

SCALE: N.T.S.

Summary

Strategies for dealing with systems having a refrigerant charge in excess of the EDVC

- Increase the effective dispersal volume
  - Connect two or more spaces
    - Ducted units with zone damper
    - Natural ventilation
    - Mechanical Ventilation
- Decrease Releasable Refrigerant Charge
  - Specify smaller systems
  - Utilize Package Terminal Units in smaller spaces
  - Use smaller packaged equipment like water source heat pumps.

Questions

1. What is a key difference between A2L and A3 refrigerants?

A. A2L refrigerants are more flammable than A3

B. A2L refrigerants have a lower toxicity than A3

C. A2L refrigerants have a much higher minimum ignition energy than A3

D. A2L refrigerants contain propane

Questions

According to ASHRAE Standard 15, when is a refrigerant detection system (RDS) required?

A. Always required regardless of refrigerant type

B. Only for rooftop units

C. When the system has a releasable charge over 4 lbs in a ducted system

D. For systems using Class 1 refrigerants only

Questions

What standard must A2L HVAC equipment comply with to ensure safety?

A. ASHRAE 90.1

B. UL 1995

C. UL 60335-2-40

D. ISO 9001

Questions

Which method can increase the Effective Dispersal Volume (EDVC) in a space?

A. Increase Space Volume

B. Adding ignition sources

C. Increasing pipe length

D. Disconnecting ventilation systems


thank you
danke
謝謝
ngiyabonga
teşekkür ederim
gracias
merci
obrigado
bedankt
dziękuję
go raibh maith agat
mochchakkeram
sukriya
kop khun krap
grazie
arigatô
dakujem
terima kasih
спасибо
рахмат
Баярлалаа
faafetai lava
vinaka
blagodaram
dank je
misaotra
matondo
paldies
grazzi
mahalo
tapadh leat
хвала
asante
manana
obrigada
tenki
murakoze
djiere dieuf
tau
дякую
mamnun
chokrane
trugarez
мерси
shukriya
dhanyavadagalu
diolch
rahmet
tanemirt
ευχαριστώ
xièxie
감사합니다
ありがとう
najis tuke
kam sah hamnida
didi madloba
mèsi
sagolun
sobodi
dėkuji
enkosi
hvala
mauruuru
köszönöm
kiitos
dankie
dhanyavad
nanni
nandri
bayarlalaa
gràcie
chnorakaloutioun
gratias ago
gràcies
sulpáy
takk
taiku
akun
dankon
aciū
mersi
kia ora
barka
welalin
tack
spas
спасибі
rahmat
mercé

Refrigerant Regulations

Design Implications

Speaker:

Jason Filler / *FW Webb*