HFC Refrigerants in Heat Pumps
The EPA & ASHRAE have spoken!

Tuesday, March 28th, 2023
10:30am - 11:30am

Presenter: JS Rancourt
Js.rancourt@dxseng.com
AHUs (catalogued – modular – full custom), ERVs, Chillers, ASHP & WSHP Chillers, Fans, Lab exhaust, Lab energy recovery, pre-fab plants, terminal equipment, humidification, air purification etc.

www.hts.com

Specialized in VRV/VRF, ASHPs, VRV driven ERVs and AHUs, VRV controls

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Largest Daikin VRV rep in North America!

Building automation, energy monitoring and reporting, fault detection systems, lab energy recovery controls

www.controltechinc.com
Disclaimers

1. Our description of ASHRAE 15 2019 and 2022 is our interpretation, and engineers should always refer to the actual standard for design purposes.

2. The 2022 edition of ASHRAE 15 and the latest EPA rulings were only released last Fall, and we are still discussing and evaluating some clauses, and our opinions on all sections may not be final and is subject to change.

3. Any and all snapshots from ASHRAE standards are property of ASHRAE and should not be copied or re-used without reference to ASHRAE.
Reducing Emissions from our Built Environment

Energy efficiency & electrification (fossil fuel to heat pump conversion)

- Distributing heat directly from outdoors to indoors with refrigerant is advantageous (efficiency, emissions, cost)

- Heat pumps require high pressure HFC refrigerants, and reducing their GWP increases their flammability rating

- ASHRAE/UL Standards needed to evolve, and now need to be adopted to allow these low GWP refrigerants in buildings
  - ASHRAE 15 – 2019
  - ASHRAE 15 – 2022

Reducing emissions from refrigerant leaks

- Legislations on phasing down / out high GWP HFCs

- Other ways of reducing refrigerant emissions

Impacts on HVAC equipment designs and decisions today
Reducing Emissions from our Built Environment

Lifetime (30 year) Emissions of a building

- Conventional
- All Electric HVAC
- All Electric HVAC 2030
- All Electric HVAC 2050
- All Electric HVAC 2050 Zero Embodied

Emissions categories:
- Embodied
- Refrigerant
- Fossil Fuel
- Electrical Consumption
Looking at refrigerant emissions in isolation

Still very important to address!

https://www.ccacoalition.org/en/blog/global-agreement-addressing-ozone-depletion-will-also-bring-large-climate-benefits#&gid=1&p=1
What is more important in reducing Emissions

Electrification & Energy Efficiency VS Reducing emissions from refrigerant leaks

The answer is: Both are important, but make sure decisions consider overall lifetime emissions impact, and not just impacts from one potential source (such as refrigerants).

Hint: Refrigerant choice can have major impacts on overall HVAC system efficiency, their ability to heat, complexity and resulting emissions.
Reducing Emissions from our Built Environment

Energy efficiency & electrification (fossil fuel to heat pump conversion)

Reducing emissions from refrigerant leaks

Legislations on phasing down / out high GWP HFCs
EPA History, and HFC Phase Down attempts

- Under Clean Air Act (CAA); EPA was directed to identify and evaluate substitutes for ozone-depleting substances, resulted in the phase-out of CFCs & HCFCs.

- Rule 20 (2016) and 21 (2017) attempted to introduced HFC phase downs based on GWP.

- These were shut down in court and were never adopted (EPA did not have the authority under the CAA).

21: Deemed a long list of HFCs unacceptable for chillers (only) starting January 1st 2024 (including R-410a)

(No reference to ASHPs or VRV)

https://www.sciencedirect.com/science/article/pii/S1631071318301147#fig0015
The Kigali Amendment

- Amendment to the Montreal Protocol to globally phase down HFC’s (85% reduction in CO₂ tons equivalent) due to their Global Warming Potential (GWP)
- U.S. has been in and out (Obama – Trump – Biden)
- No direct legislative impact in the U.S. (until the AIM Act...)

2016
- Signed October 15th 2016 (28th meeting of the Montreal Protocol)

2019
- Start of the phase down for developed countries (including USA)

2036
- Phase down of developed countries (including USA) by 85%
U.S. Climate Alliance states started taking matters into their own hands

Many followed the SNAP 20/21 guidelines

Some States are still continuing with their phase down / phase out plans in parallel to the EPA

Both EPA rules and State rules can apply in certain States!
Prohibitions on the Use of Certain Hydrofluorocarbons (310 CMR 7.76)

Massachusetts is phasing in bans on certain hydrofluorocarbons (HFCs) in aerosol propellants, chillers, foam, and stationary refrigeration end-uses through January 2024.

End-Use Category: Air Conditioning


- These MA regulations are still coming into affect, and are 1 year earlier than EPA’s latest rules (which cover a wider range)
- Heating only heat pumps are not included in this language
- VRV/VRF and mini/multi splits are not included in this language
- Jury is still out on whether reversible heat pumps (that also make chilled water) are included
Finally, federal direction under the AIM Act

The AIM Act

S.2754 – The American Innovation and Manufacturing Act of 2019

The AIM Act provides a highly limited and discrete grant of authority to EPA to phase down HFCs. The Act cannot be used for any purpose other than phasing down HFCs.

The AIM Act supports a transition to next generation refrigerant technologies in 3 primary ways:

<table>
<thead>
<tr>
<th>1. HFC production</th>
<th>2. EPA authorization</th>
<th>3. Sector-based use restrictions</th>
</tr>
</thead>
<tbody>
<tr>
<td>HFC production and consumption is phased down over a 15-year period via a closed allowance allocation and trading program. This provides for an orderly and market- and consumer-friendly transition from HFCs.</td>
<td>EPA is authorized to establish standards for the management of HFCs used as refrigerants, such as in equipment servicing and repair, and for the recovery of “used” HFCs for purification and resale, known as reclaim. This helps ensure an adequate supply of HFCs for servicing existing equipment.</td>
<td>EPA can establish sector-based use restrictions, as a way to facilitate transitions to next generation refrigerant technologies. These restrictions would complement the broader production and consumption phase down, aiding sectors able to transition more quickly away from HFCs and providing more flexibility for those sectors in need of more time to complete a transition.</td>
</tr>
</tbody>
</table>
Focuses on part 1 of 3 of AIM: Phase down of HFC production and consumption to 15% of the 2011-2013 average by 2036
  - Follows Kigali, gets the US back on track by 2024

How: Implementing HFC allowance allocation and trading program
  - 10% reduction started 1/1/2022
  - 40% reduction starting 1/1/2024
EPA Rules (Old news – from 2021)

No limitations on domestically reclaimed HFCs, which promotes reclaiming and recycling refrigerants. Follows CARB.

Unfortunately, HVAC equipment not manufactured in the U.S., and imported, do not have any restrictions refrigerants.
EPA Rules (Hot news – Fall 2022)

Protecting our Climate by Reducing Use of Hydrofluorocarbons

December 2022

https://www.epa.gov/climate-hfc-reduction

FACT SHEET

Proposed Rule - Phasedown of Hydrofluorocarbons: Restrictions on the Use of Certain Hydrofluorocarbons under Subsection (i) of the American Innovation and Manufacturing Act

What Does This Rule Propose?

Consistent with the AIM Act, EPA is proposing to restrict the use of certain higher-GWP HFCs in aerosols, foams, and refrigeration, air conditioning, and heat pump products and equipment. The proposed restrictions are listed by sector and subsector in Table 1 and Table 2 at the end of this document. The proposed rule would prohibit manufacture and import of products containing restricted HFCs by January 1, 2025, in most cases, and would prohibit the sale, distribution, and export of products containing restricted HFCs a year later, which in most cases would be January 1, 2026.
## EPA Rules (Hot news – Fall 2022)

### Protecting our Climate by Reducing Use of Hydrofluorocarbons

<table>
<thead>
<tr>
<th>Sectors and Subsectors</th>
<th>Proposed GWP Limit</th>
<th>Compliance Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Automatic commercial ice machines – self-contained with refrigerant charge capacities</td>
<td>150</td>
<td>January 1, 2025</td>
</tr>
<tr>
<td>of 500 grams or lower</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transport refrigeration – intermodal containers</td>
<td>700</td>
<td>January 1, 2025</td>
</tr>
<tr>
<td>Residential refrigeration systems</td>
<td>150</td>
<td>January 1, 2025</td>
</tr>
<tr>
<td>Chillers – industrial process refrigeration</td>
<td>700</td>
<td>January 1, 2025</td>
</tr>
<tr>
<td>Chillers – comfort cooling</td>
<td>700</td>
<td>January 1, 2025</td>
</tr>
<tr>
<td>Residential and light commercial air conditioning and heat pump systems</td>
<td>700</td>
<td>January 1, 2025</td>
</tr>
<tr>
<td>Residential and light commercial air conditioning – variable refrigerant flow systems</td>
<td>700</td>
<td>January 1, 2026</td>
</tr>
<tr>
<td>Residential dehumidifiers</td>
<td>700</td>
<td>January 1, 2025</td>
</tr>
</tbody>
</table>

The result:
• VRV/VRF industry needs to shift to a refrigerant below a GWP of 700 by 1/1/26
• R410a VRF can be manufactured / imported until 1/1/26, and the sale and distribution can continue until 1/1/27
• Building codes across the country need to adopt the latest standards by then (hopefully sooner)
EPA Rules (Hot news – Fall 2022)

**CARB Regulation Final**

<table>
<thead>
<tr>
<th>Product</th>
<th>Production Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>PTAC</td>
<td>1/1/2023</td>
</tr>
<tr>
<td>All AC/HP except VRV</td>
<td>1/1/2025</td>
</tr>
<tr>
<td>VRV</td>
<td>1/1/2026</td>
</tr>
</tbody>
</table>

**EPA Regulation EXPECTED**

<table>
<thead>
<tr>
<th>Product</th>
<th>Production Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>All except VRV</td>
<td>1/1/2025</td>
</tr>
<tr>
<td>VRV</td>
<td>1/1/2026</td>
</tr>
</tbody>
</table>

GWP limit: 750 VS GWP limit: 700

Rules regarding existing systems and replacements expected in 2023:
• AIM act specifically protects existing systems, ensuring they can be operated, maintained, repaired and even replaced (with some restrictions) without forcing a refrigerant change
• CARB rules expected to come out soon, and EPA expected to align
• We expect a big R-410A VRV market to continue feeding this replacement industry
Reducing Emissions from our Built Environment

Energy efficiency & electrification (fossil fuel to heat pump conversion)

- Distributing heat directly from outdoors to indoors with refrigerant is advantageous (efficiency, emissions, cost)

Reducing emissions from refrigerant leaks

- Legislations on phasing down / out high GWP HFCs
Transferring heat to water VS Direct refrigerant distribution
(Hydronic ASHP systems) (VRV/VRF and mini/multi splits)

Ie. ASHP chillers to HXs to 2/4 pipe fan coils
Ie. VRV/VRF to Branch boxes to fan coils
Transferring heat to water  **VS**  Direct refrigerant distribution

(Hydronic ASHP systems)  **VS**  (VRV/VRF and mini/multi splits)

**Potential Refrigerant Emissions**

- More refrigerant
- Field install

**Lifetime Operational Emissions**

- Cold climate
- Heating efficiency
- No / little backup heat

- Design & Install complexity
- Maintenance
- Comfort
- Sound
- Retrofit flexibility

**Capital costs**

- Apples-to-apples
- With VRF contractor

With VRF contractor
Other all-electric options with less refrigerant

- Central Air Handling driven by VRV or Hydronic ASHPs (schools, labs, some commercial)
All-Electric K-12 (New)

VRV driven custom central VAV AHUs [Haakon]
VRV Heat Pump condensing units [Daikin]
Low-carbon life science / lab! (Retro)

VRV driven semi-custom AHUs [Daikin]
Glycol heat recovery runaround loop [LabX]
VRV Heat Pump condensing units [Daikin]
Other all-electric options with less refrigerant

- Central Air Handling driven by VRV or Hydronic ASHPs (schools, labs, some commercial)
- Packaged terminal heat pump units, and all-in-one units (mainly multi-residential)
Packaged Terminal Heat Pump (PTHP)
PTHP with integral ERV (All-In-One)
Packaged Terminal Heat Pump (PTHP)

Vertical AHU

With integral ERV
Other all-electric options with less refrigerant

- Central Air Handling driven by VRV or Hydronic ASHPs (schools, labs, some commercial)
- Packaged terminal heat pump units, and all-in-one units (mainly multi-residential)
- Geothermal system feeding central or distributed WSHPs, or water-source VRV
Water-Souce Geothermal VRV condensing units
Reducing Emissions from our Built Environment

Energy efficiency & electrification (fossil fuel to heat pump conversion)
- Distributing heat directly from outdoors to indoors with refrigerant is advantageous (efficiency, emissions, cost)
- Heat pumps require high pressure HFC refrigerants, and reducing their GWP increases their flammability rating

Reducing emissions from refrigerant leaks
- Legislations on phasing down / out high GWP HFCs
# ASHRAE Standard 34 – Designation and Safety Classification of Refrigerants

<table>
<thead>
<tr>
<th>Flammability Level</th>
<th>A1</th>
<th>A2*</th>
<th>B1</th>
<th>B2*</th>
<th>A3</th>
<th>B3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Higher Flammability</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lower Flammability</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No Flame Propagation</td>
<td>R-410A</td>
<td>R-32</td>
<td>R-454B</td>
<td>A2L*</td>
<td>B2L*</td>
<td></td>
</tr>
</tbody>
</table>

### Notes:
- All refrigerants can be combusted when put into a high-energy situation such as a fire.
  - *There is no class called “non-flammable”*
- **Class 1:** no flame propagation (at testing standard of 140F)
  - *Class 2 & 3 have flame propagation at 140F*
- **Class 2:** lower flammability
- **Class 3:** higher flammability (LFL < 0.10 kg/m³ or Heat of Combustion HOC > 19 kJ/g)

*New flammability subclass for class 2 refrigerants that burn very slow
- 2L have slow velocities; <10 cm/sec ~ 20ft/minute
Why is transitioning (high pressure HFCs) to low GWP so hard?

- Flammability and GWP are essentially inversely proportional

**GWP vs Flammability**

- More Fluorine results in more stables chemicals. Great to reduce flammability, bad for GWP as it doesn’t breakdown

High Pressure Refrigerants
A1 vs A2L Flammability comparison

R-410A, the most common air conditioning refrigerant in use globally today, is not actually "non-flammable." It is ASHRAE-listed as an A1 refrigerant, meaning that it has no flame propagation at 63°C.

R-410A behaves very similarly to R-32 especially when exposed to higher temperatures (e.g., a fire impacting AC equipment).

As confirmed by AHRI research, it takes three failures in a system to ignite an A2L refrigerant used in air conditioning equipment. Failures required include the following:

a. There would have to be a significant refrigerant leak.

b. The leak would have to be sufficient to reach the lower flammability limit (LFL) concentration. LFL concentrations for A2Ls are above 10%.

c. There would have to be an open flame or a high energy ignition source where the concentration is sufficient to ignite A2L refrigerants.
R-410a Alternatives

R-410A
2088 GWP

R-32
675 GWP

R-454B
466 GWP

Class: A1

Class: A2L

Class: A2L

- Capacity (quantity)
- Efficiency
- Not a blend
- Availability
- Ownership / Patent
- 190M global installs
- 60 OEMs in 120 countries

Awesome refrigerant
Something less awesome, but results in an A1 classification

vs R-410a

vs R-32

- Capacity (quantity)
- Efficiency
- Availability
- Ownership / Patent
- Equipment in dev
- Blend
R-32: Non-proprietary, open to the world

Daikin VRV brings building

The drive for effective energy efficiency in buildings is a global priority. Daikin’s VRV R32 heat recovery system is a key component in the decarbonization of buildings for direct and indirect CO2eq impact. Daikin’s VRV R32 system has been proven to increase energy efficiency in real-life conditions, minimising its impact on the environment.

Additionally, Daikin VRV system allows simultaneous cooling and heating, which is useful in multi-zone buildings such as hotels and office buildings. By providing a comfortable environment in each zone, the system is also a cost-effective solution for energy management.

Daikin gives free access to its R32 patents

In a move to encourage the adoption of the R32 refrigerant, Daikin is offering free access to its R32 patents worldwide. This initiative is a step towards making refrigeration technology more sustainable and accessible to all.

The R32 refrigerant is a low-GWP alternative to traditional refrigerants, making it an environmentally friendly solution for air conditioning systems. Daikin’s decision to share its patents is a significant contribution to the industry’s efforts towards reducing greenhouse gas emissions.

Daikin releases more R32 patents

Daikin has released a further 123 patents related to the manufacture and use of R32 refrigerant in air conditioning systems. These patents will enable more companies to develop and implement R32-based technologies, further accelerating the transition towards more sustainable refrigeration solutions.

Daikin’s latest announcement ensures a total of 299 of its R32 patents are open to use without prior permission or contract, providing a strong foundation for the future of sustainable refrigeration technology.
New R32 VRF air conditioning provides complete solution

Mitsubishi Electric has launched new first complete range of lower Global W
The R32 City Multi YNW range is available conditioning systems. For the first time complete building or an entire network

VRV/VRF in Europe (R-32 Alignment)

Heat Recovery Outdoor Unit

Many buildings require a mix of simultaneous heating and cooling. The outstanding City Multi R2 system meets this requirement by distributing surplus heat from cooling operations (and vice versa) to rooms where it is needed. This efficiency can result in energy savings of up to 30% over conventional systems.

R2 Series High Efficiency Heat Recovery (YNW)
R23 VRF heat recovery outdoor units available from 22.5kW, complement the widest range of innovative VRF solutions available on the market. They deliver lower GWP solutions and offer customers the ability to use one single refrigerant access a complete building or an entire network.

Available in 22.4kW, 25.0kW, 34.6kW

R2 Series Standard Heat Recovery (YNW)
R32 VRF heat recovery outdoor units available from 22.5kW, complement the widest range of innovative VRF solutions available on the market. They deliver lower GWP solutions and offer customers the ability to use one single refrigerant access a complete building or an entire network.

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  - ASHRAE 15 – 2019

Reducing emissions from refrigerant leaks
- Legislations on phasing down / out high GWP HFCs
ASHRAE Standard 15

- Application standard for refrigerant systems with a focus on health & safety
- Version currently followed by most U.S. building codes (2013 or 2016) does NOT allow class A2L refrigerants in occupied spaces (or A2, A3, B1, B2, B3)

Outdoor chillers: A2L's OK
- Not high-probability

Very small systems: A2L's OK
- Very low refrigerant charge

VRV / ASHP: A2L's not ok (yet)
- High-probability
The 2019 version of the standard partially allows the use of A2L refrigerants in buildings (basically limited to systems below 4.1 lbs of A2L refrigerant)
• Some States have already adopted ASHRAE 15 – 2019, others are on their way
• Some were done by legislation while others advanced through the normal code change process
Daikin Announces Daikin ATMOSPHERA with R-32 Refrigerant

The first single zone system with R-32 in North America features impressive efficiency gains while reducing emissions vs. R-410A

HOUSTON, December 21, 2021 — For the first time in North America, Daikin is launching a home comfort product featuring R-32, a refrigerant with one-third the Global Warming Potential (GWP) of the most common refrigerants currently being used in the United States and Canada.

The new Daikin ATMOSPHERA system featuring R-32 refrigerant from Daikin North America LLC is a single zone, ductless system that gains impressive efficiencies over its R-410A predecessor line, the LV Series, with up to 27.4 SEER, 13.8 EER RP and 16.3 EER ratings for ultra-efficient cooling and heating. Four sizes of indoor and outdoor heat pumps are available, from 9,000 to 24,000 BTU.

"Daikin has sold over 33 million R-32 systems in more than 100 countries and regions," said Takayuki (Taka) Inoue, Executive Vice President and Chief Sales and Marketing Officer. "We are excited to be the first to bring this proven technology to North America. With an estimated 160 million R-32 systems sold by Daikin combined with other manufacturers worldwide, we are confident R-32 has the all-around performance benefits to make it the ideal replacement for R-410A."
7.3 Volume Calculations. The volume used to convert from refrigerant concentration limits to refrigerating system quantity limits for refrigerants in Section 7.2 shall be based on the volume of space to which refrigerant disperses in the event of a refrigerant leak.

7.3.1 Nonconnecting Spaces. Where a refrigerating system, or a part thereof, is located in one or more enclosed occupied spaces that do not connect through permanent openings or HVAC ducts, the volume of the smallest occupied space shall be used to determine the refrigerant quantity limit in the system. Where different stories and floor levels connect through an open atrium or mezzanine arrangement, the volume to be used in calculating the refrigerant quantity limit shall be determined by multiplying the floor area of the lowest space by 8.2 ft (2.5 m).

7.3.2 Ventilated Spaces. Where a refrigerating system, or a part thereof, is located within an air handler, in an air distribution duct system, or in an occupied space served by a mechanical ventilation system, the entire air distribution system shall be analyzed to determine the worst-case distribution of leaked refrigerant. The worst case or the smallest volume in which the leaked refrigerant disperses shall be used to determine the refrigerant quantity limit in the system, subject to the following criteria.

7.3.2.1 Closures. Closures in the air distribution system shall be considered. If one or more spaces of several arranged in parallel can be closed off from the source of the refrigerant leak, their volumes shall not be used in the calculation.
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  - ASHRAE 15 – 2022

Reducing emissions from refrigerant leaks
- Legislations on phasing down / out high GWP HFCs
• The ASHRAE Standard 15 committee did a fantastic job! Released Fall 2022

• The standard has multiple long-awaited clarifications and definitions for the VRF industry

• The standard provides different options for the application of A2L refrigerants

• Results in increased safety for VRF systems

• Results in a reduction in refrigerant leakage and associated emissions

• Alignment with IEC 60335-2-40
EDVC: Effective Dispersal Volume Charge
Maximum refrigerant charge permitted for an effective dispersal volume

M_{rel}: Releasable Refrigerant Charge
A portion of the refrigerant charge that can be released into a space as a result of a single point of failure
1. Smallest room: 15’ x 15’ x 8’ = 1,800 cubic feet
2. Allowable charge = volume x RCL = 1,800 x 26 / 1000 = 46.8 lbs or R-410A
3. Releasable charge = full system charge = 40 lbs
4. 40 < 46.8 system in compliance
1. Smallest room: 15’ x 15’ x 8’ = 1,800 cubic feet
2. Allowable charge (with air circulation) = volume x RCL = 1,800 x 9.6 / 1000 = 17.28 lbs or R32
3. Releasable charge (no SSOVs) = full system charge = 30 lbs
4. 30 > 17.28 system not in compliance
1. Smallest room: $18' \times 24' \times 8' = 3,456$ cubic feet

2. Allowable charge (with air circulation) = volume $\times$ RCL $= 3,456 \times 9.6 / 1000 = 33.2$ lbs or R32

3. Releasable charge (no SSOVs) = full system charge $= 30$ lbs

4. $30 < 33.2$ system not in compliance

Spaces connected via Natural Ventilation using Formula (transfer grill below 12”)

ASHRAE Std 15 – 2022 (Our interpretation!)
ASHRAE Std 15 – 2022 (Our interpretation!)

SSOVs
1. Smallest room: 15’ x 15’ x 8’ = 1,800 cubic feet
2. Allowable charge (with air circulation) = volume x RCL = 1,800 x 9.6 / 1000 = 17.28 lbs or R32
3. Releasable charge (beyond SSOV) = 12 lbs
4. 12 < 17.28 system not in compliance
ASHRAE Std 15 – 2022 (Our interpretation!)

Warning: Check each run!
Smallest space may be okay (close to an SSOV)
A larger space further away may not be
ASHRAE Std 15 – 2022 (Our interpretation!)

Warning: Check each run!

Smallest space may be okay (close to an SSOV)

A larger space further away may not be
Other items

- **7.5.1.2 Public corridors and lobbies limited to “Unit systems”**
  - Regarding what can and can’t be placed in those areas

- **7.6.2.4 Requirements of detection systems**
  - Access, self-diagnosis, energize air circulation automatically, output signal within 30 seconds of exposure

- **7.6.2.5 Mitigation Action Requirements**
  - Energize fans, open any zone dampers, de-energize electric resistance heat in air-duct, activate SSOV

- **7.6.3 Ignition sources in ductwork**
  - No open flames, No “unclassified” electrical devices in ductwork, Nothing above 1290F unless flow proved

- **9.12.1.3 Prohibited locations [of refrigerant piping]**
  - Similar to previous version of standard

- **9.12.1.5 Pipe Shafts: fire-resistance-rated shaft**
  - Similar to previous version of standard

- **9.12.1.8 Pipe identification**
  - Need to label piping, in spaces that are not where the IDU is, with “WARNING – Risk of Fire. Flammable”

- **10.1.1 Install Identification**
  - Each system shall have a very legible sign. We expect our refrigerant stickers to change.
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  - ASHRAE 15 – 2022

Reducing emissions from refrigerant leaks

- Legislations on phasing down / out high GWP HFCs
- Other ways of reducing refrigerant emissions
Other ways of reducing refrigerant emissions

• Pay attention to refrigerant charge (reduce where possible)

• **Keep. Refrigerant. In. Systems.** (reduce the risk of leaks)
  
  • Who is installing the systems? *(Certifications, not just of the contractor, but of who on site is physically doing the work)*

  • Who is (truly) witnessing the pressure test? Who is inspecting the install?

  • Where is the equipment being procured from? *(Engineering rep firms with training, experience, and service / QC / Commissioning capabilities)*

  • Advanced on-going monitoring systems

Also a major contributor to reduced failures and down time, and overall project success
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- Distributing heat directly from outdoors to indoors with refrigerant is advantageous (efficiency, emissions, cost)
- Heat pumps require high pressure HFC refrigerants, and reducing their GWP increases their flammability rating
- ASHRAE/UL Standards needed to evolve, and now need to be adopted to allow these low GWP refrigerants in buildings
  - ASHRAE 15 – 2019
  - ASHRAE 15 – 2022

Reducing emissions from refrigerant leaks
- Legislations on phasing down / out high GWP HFCs
- Other ways of reducing refrigerant emissions

Impacts on HVAC equipment designs and decisions today
Desire to reduce refrigerant emissions? Consider lifetime emissions of the entire HVAC system.

In the next decade, converting fossil fuel heating into heat pumps is the leading way to decarbonize, followed by focusing on energy efficiency to reduce electrical consumption and resulting emissions.

Do pay attention to refrigerant charge, and design systems keeping in mind the future refrigerant transition of that system.

Impact on HVAC design & decisions
THANK YOU!

HFC Refrigerants in Heat Pumps
The EPA & ASHRAE have spoken!

JS Rancourt
Js.rancourt@dxseng.com
www.myVRVdrive.com