Johnson Controls

R-454B Refrigerant

Contents

North American HFC Regulations

International

Montreal Protocol (1987)

- Phaseout of Chlorofluorocarbons used in new equipment manufacturing (CFCs) by 2010
- Phaseout of ozone depleting substances (ODS), leading a shift to hydrofluorocarbons (HFCs)
- New production and import of virgin HCFC-22 will be phased out in North America by 2020

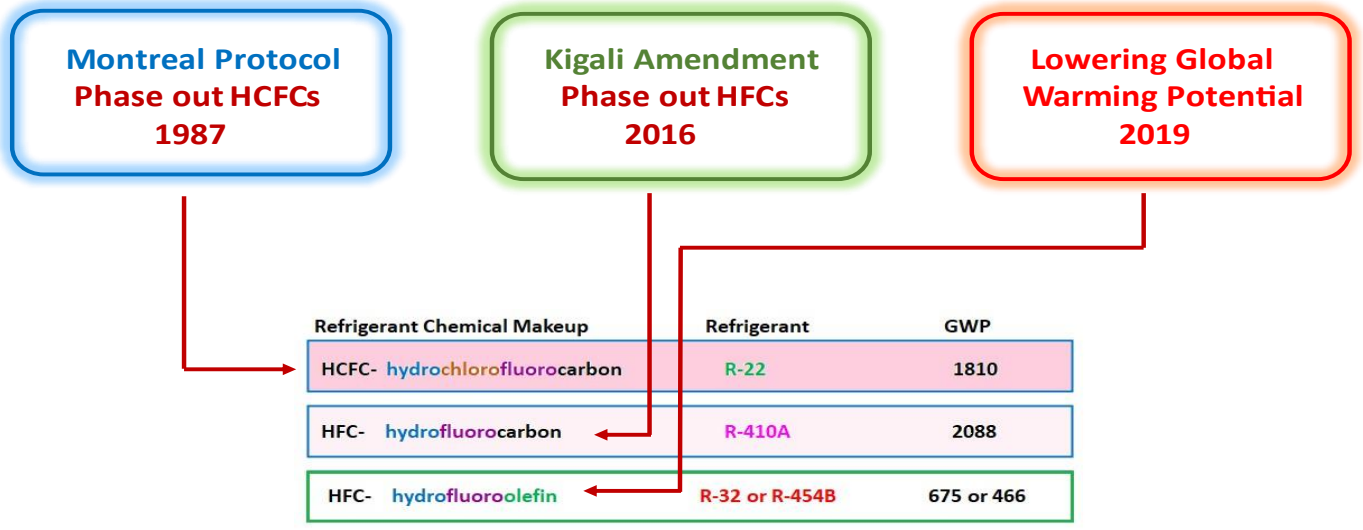
Kigali Amendment (2016) to the Montreal Protocol

- Phasedown of production and consumption of HFCs to reduce greenhouse gas emissions.
- Effective in January 2019 where ratified
- More than 90 countries have ratified (including Canada and the U.S., as of September 2022)
- Driving global transition to lower global warming potential (GWP) solutions.

U.S. Federal

Significant New Alternative Policy (SNAP)

- The Environmental Protection Agency (EPA) made certain HFCs unacceptable for use in SNAP Rules 20 (2016) and 21 (2017).
- However, SNAP Rules 20 and 21 were partially vacated by the D.C. Circuit Court; the EPA is reviewing the court decision. The industry awaits the EPA rewrite, expected in 2023.
- Despite being vacated at the federal level, states may choose to adopt and set their own timeline for the implementation of rules. For further details, visit EPA.gov/SNAP.



Refrigerant Management (Clean Air Act, Section 608)

- In 2016, the EPA extended the refrigerant management program to include HFCs (40 CFR Part 82, Subpart F, under Section 608 of the Clean Air Act).
- The EPA signed a rule in February 2020 that rescinded some parts of the program, including the extension of leak repair provisions to appliances using HFCs.
- This rule did not rescind other parts affecting HFCs, such as sales restriction or requirements for technician certification, for safe disposal, recovery, and reclamation.
- Likewise, this rule does not affect the requirements for equipment containing ozone depleting substances. For more information, visit EPA.gov/Section608.

U.S. Federal

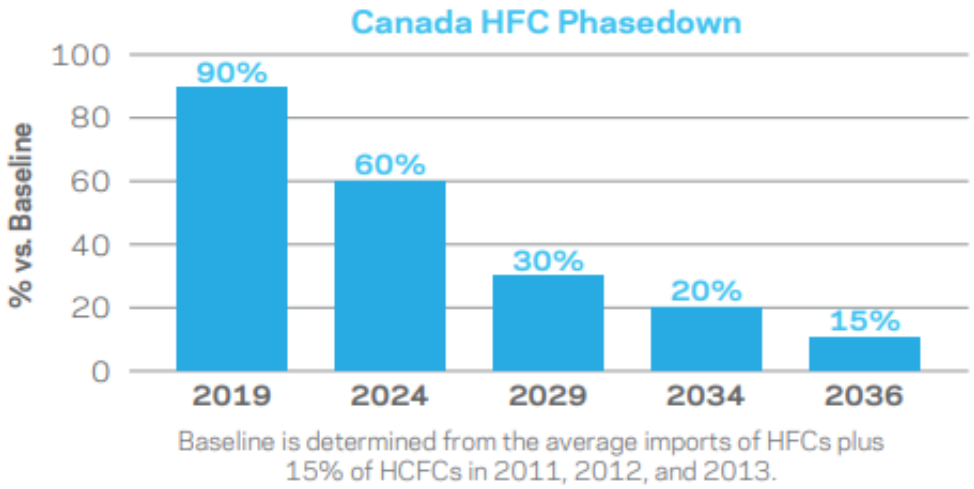
American Innovation and Manufacturing (AIM) Act

- On December 27th, 2020, the AIM Act was signed into law, allowing for a federal phasedown of the production and consumption of HFCs, with implementation dates yet to be developed by the EPA.
- The phasedown will be managed through an allocation program, and the schedule will mirror the schedule proposed in the Kigali amendment.
- This legislation grants the EPA the authority to establish standards for recovery and reclamation of HFCs.
- The Aim Act authorizes the EPA to facilitate transitions to next-generation technologies by establishing sector-based use case restrictions.
- Implementation could create significant economic and new employment benefits.

Canada

Amendments to the Ozone-Depleting Substances and Halocarbon Alternatives Regulations (ODSHAR)

- Phasedown of HFCs in alignment with Kigali Amendment
- Product-specific refrigerant GWP limits for new equipment.
- Existing equipment, service, and retrofit are not impacted by product-specific controls.
- Effective as of April 2018
- Visit laws-lois.justice.gc.ca/eng/regulations for more information.



U.S. State-Level Activity

Climate Alliance

The United States Climate Alliance, founded in 2017, is a bipartisan coalition of U.S. states and territories committed to reducing greenhouse gas emissions by at least 26-28% below 2005 levels by 2025—this is consistent with the goals of the 2015 Paris Agreement. The Alliance represents greater than 55% of the U.S. population and over 60% of the economy. As of February 2020, there are 25 members, with 8 states joining in 2019. Visit USClimateAlliance.org for more information.

Climate Alliance members in motion with SNAP rules

Certain members of the U.S. Climate Alliance have taken steps to adopt SNAP rules, with some modifications, at the state level (as of January 2021: CA, CO, MA, MD, NJ, NY, VT, and WA). Other states that have expressed an intent to regulate HFCs include CT, DE, HI, ME, OR, RI, and VA. Note that states adopting SNAP rules may implement special reporting and labeling requirements. Visit EPA.gov/SNAP to learn more.

Why R-454B Refrigerant?

In May, of 2021, Johnson Controls, the global leader in smart, healthy, and sustainable buildings, chose to provide R-454B as the future refrigerant solution for their ducted residential and commercial HVAC products, as well as its air-cooled scroll chiller applications. This decision supports Johnson Controls sustainability goals in transitioning away from the use of high Global Warming Potential (GWP) refrigerants, such as R-410A, reinforcing their commitment to addressing climate change and lowering customers' emissions.

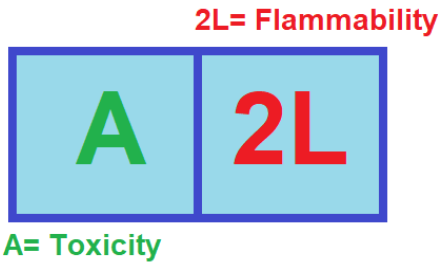
R-454B is a low GWP (AR4: 466). The AR4: 466 is a report that was defined as the ratio of the time integrated, radiative forcing from the instantaneous release of 1 kg of a trace substance relative to that of 1 kg of a reference gas (IPCC, 1990). R-454B is a non-ozone depleting refrigerant that offers a 78% reduction in GWP while improving energy efficiency and lowering charge size when compared to R-410A. This refrigerant offers Johnson Controls the ability to achieve their long-term carbon dioxide (CO_2) emission reduction goals and requires minimal design modifications due to its similar operating temperature and pressure to R-410A. R-454B provides the optimal balance of performance, safety, and longevity for future air conditioning applications.

Future regulatory requirements on CO_2 emission reduction will stimulate the transition to lower GWP refrigerants. R-454B has the lowest EPA SNAP approved GWP for unitary applications of all ASHRAE classified A2L (low-toxicity, mild flammability) refrigerants in the HVAC industry today much lower than the pending 750 GWP limits being proposed. It is compatible with plastic and elastomer materials and POE oil that will minimize working capital design changes and enable an easier transition from a R-410A platform.

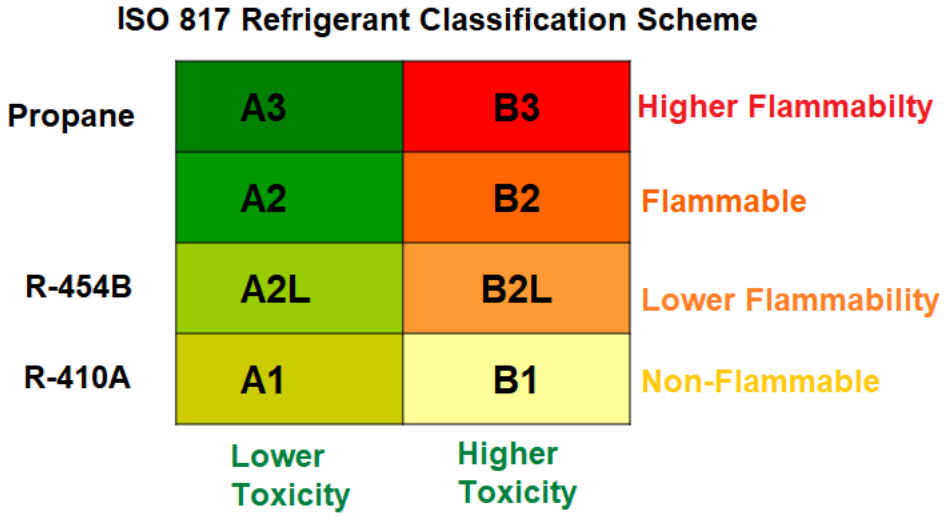
This decision was made as the HVAC industry is preparing to phase out high-GWP refrigerants, which are now being formally addressed by the Environmental Protection Agency (EPA) through the recently passed American Innovation and Manufacturing (AIM) Act (http://www.epa.gov/climate-hfcs-reduction/aim-act).

A2L Refrigerant Characteristics

R-454B has been a mildly flammable low global warming potential (GWP) hydrofluoroolefin (HFO) based refrigerant to replace R-410A in new equipment designs. R-454B offers the optimal balance of properties to replace R-410A in positive displacement, direct expansion air conditioning, heat pump and chiller applications, or other end-uses where R-410A has historically been used. R-454B is the lowest GWP solution for R-410A-like replacement (78% reduction) and provides improved performance. R-454B offers similar properties to R-410A which makes it easy and cost-effective to apply in new equipment without major modifications. R-454B is classified as a lower flammability (ISO/ ASHRAE class 2L) refrigerant. R-454B is a blend of two refrigerants, 69.1% R-32 and 31.1% R-1234yf. Always check your newest local regulations and Standards such as UL, IEC, or ASHRAE to verify the allowable system charge, new equipment design and safe handling requirements for the intended application.



Note
R-454B has an ISO 817 refrigerant classification of A2L. The A2L rating consists of the toxicity of the refrigerant and the flammability of the refrigerant.



Benefits of Using R-454B

- Lowest GWP replacement for R-410A (reduction of 78%)
- Comparable capacity and improved efficiency compared to R-410A.
- Excellent performance in normal and high ambient conditions.
- Very close match to R-410A – easily convertible from R-410A design with minimal changes.
- Very low temperature glide – can be topped off after leaks.
- Lower toxicity and lower flammability (ISO/ASHRAE 34 A2L).
- Miscible with POE lubricant.

A2L Refrigerants and Global Warming Potential (GWP)

Refrigerant	GWP	Applications
R-454B	676	R-410A Replacement
R-32	675	R-410A Replacement
R-447A	>500	R-410A Replacement
R-454B	466	R-410A Replacement

Properties of R-454B

ASHRAE Number	R-454B
Composition Weight %	R-32/R-1234yf 68.9/31.1
Molecular Weight	62.6 g/mol
Boiling Point at 1 atm (101.3 kPa / 14.7 psia)	-50.5 C (-59.6 F)
Critical Pressure kPa (psia)	5266.9 kPa (763.9 psia)
Critical Temperature °C (°F)	78.1 C (172.6 F)
Liquid Density at 21.1 °C (70 °F)	1001.1 kg/m^3 (62.5 lb/ft^3)
Ozone Depletion Potential (CFC-11 = 1.0)	0
AR4 (AR5) GWP (CO_2 = 1.0)	466 (467)
ASHRAE Safety Classification	A2L
Temperature Glide (°C/°F)	-1.5 C/ -2.7 F
LFL (based on WCF flammability)	0.303 kg/m^3 (18.9 * 10-3 lb/ft^3)

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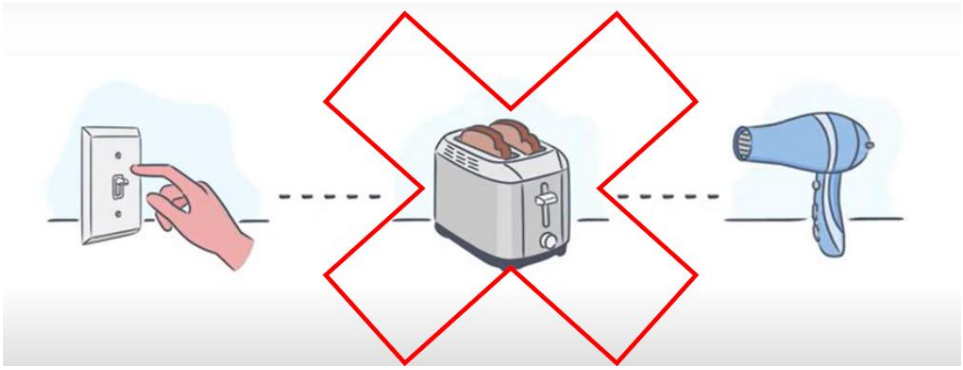
Flammability of R-454B

R-454B refrigerant is a mildly flammable. R-454B refrigerant can propagate a flame. R-454B will burn, but their burning velocity is **below 10cm per second or 3.93 inches per second** and has a low energy burst when ignited. In practical terms, it is very difficult to ignite 2L gases. Auto ignition for R-454B is 928°F (498 °C).

R-454B will not ignite if the concentration level in a room stays below their lower flammability limit (LFL). R-454B refrigerant has a LFL rating of .780 (lb./ft3) R-454B will not ignite with static charge generated by human contact. House hod items such as light switches, lamps, toasters, and hair dryers cannot ignite R-454B. Ignition of R-454B comes only by a constant heat source (such as a constant, open, hot flame).



Examples of common items that will not ignite R-454B refrigerant

R-454B vs R-410A Refrigerant Properties

R-454B is the lowest GWP solution for R-410A-like replacement and provides improved performance. R-454B offers similar properties to R-410A which makes it easy and cost-effective to apply in new equipment without major modifications.

R-454B is comparable in capacity and improved efficiency compared to R-410A. R-454B has a very low temperature glide and the charge can be topped off after refrigerant leaks. Direct replacement (new designed equipment only) for all equipment that typically used R-410A.

Conditions: 7.2° C (45° F) Evap, & 46.1° C(115°F)Cond, 11.1°C(20°F)Superheat, 5.5°C(10°F)Subcooling

	R-410A	R-454B
Relative Capacity	100	0.98
Relative COP	100	1.03
Relative Mass Flow	100	0.81
Suction Pressure PSIG (kPa)	144.9(999.1)	134.7(928.7)
Discharge Pressure PSIG (kPa)	406(2802.0)	379.3(2615.1)
Discharge Temperature °C (°F)	81.3 (178.5)	87.3(189.2)

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UL60335-2-40 (IEC 60335-2-40)

IEC 60335 deals with the safety of electric heat pumps, sanitary hot water heat pumps, air conditioners, incorporating motor compressors, as well as hydronic fan coils units, dehumidifiers (with or without motor compressors), thermoelectric heat pumps and partial units. The IEC 60335 is presently on its 7th Edition and expects more and constant changes as introduction to more refrigerants goes forward. This standard does not consider refrigerants other than group A1, A2L, A2 and A3 as defined by ISO 817 classification, A2L REFRIGERANTS are limited to those of a molar mass of more than or equal to 42 kg/kmol based on WCF as specified in ISO 817. Safety training will be the key issue for new installation instruction.

UL 60335-2-40 requires that refrigerant charge limits be based on the minimum occupied volume of the room where the equipment is expected to be used. This charge limit requirement also includes a safety factor of four to ensure any leaked refrigerant is diluted to well below the lower flammability limit (LFL), based on room size. UL 60335-2-40 also requires appliances to be free of potential internal ignition sources to mitigate the risk of fire due to a leak.

UL 60335-2-40 Requirements for Refrigerant Leak Detection Systems

1. Indicating type detectors, are required to be factory installed by the manufacturer with sensors optimally located to detect any leaks.
2. Refrigerant leak detector sensor set point is factory set and sealed with no field adjustment permitted. Routine factory inspections are conducted by UL as part of the listing requirements. Detector markings identify the manufacturer and refrigerants used.
3. The leak detection system is required to activate at a maximum concentration of < 25% of the LFL of the refrigerant being used in the equipment. This 4-times safety factor helps ensure flammable concentrations are not reached.
4. Detectors turn on available mitigation devices such as circulation fans.
5. Self-test protocols run every hour to ensure proper operation and function. In the event of detector failure, the circulation fans activate and maintain a required airflow to prevent flammable concentrations from forming. This fail-safe mode is maintained until the detector is replaced.
6. Detector software is considered part of a Protective Electronic Circuit. Robustness, functionality, and reliability of this circuit is determined in accordance with clause 19 of UL 60335-2-40 which includes the requirements in UL 60335-1 or UL 60730.
7. The sensor shall not be subject to poisoning due to common household and workplace contaminants that shall not damage the sensor or produce false alarms or nuisance trips per Annex LL of UL 60335-2-40.
8. These systems are required to pass testing designed to address long term stability, vibration, range and setpoint verification, and response time per Annex LL of UL 60335-2-40.
9. If the detector has a defined life and requires replacement after a given period, the detection system shall initiate the mitigation requirements in Annex GG and LL of UL 60335-2-40.

How UL is Making an Impact

Refrigerant leak detection systems have been in use by the HVAC/R industry for decades — in areas such as machine rooms and supermarkets — for most of all refrigerants currently in use. While technology exists today to meet the new specifications outlined in UL 60335-2-40, HVAC equipment manufacturers are actively working with sensor manufacturers to determine the optimal balance of properties for their system designs while also integrating all the safety requirements defined for a full detector package. Further research is being conducted to enhance this process. To learn more visit HVACInfo@ul.com or visit ul.com/lowGWP.

Charging or Repairing A2L System

A. A2L refrigerants will safely be removed following local and national codes (EPA Rule 603 which requires recovery.)
B. Purge circuit(s) with inert gas (i.e., oxygen free nitrogen) and repeat if necessary.
C. Evacuation is required (Ensure outlet of pump is not near an ignition source)
D. Purge with inert gas for 5 minutes (This will be a second purge.)
E. Evacuate a second time.
F. Open the circuit by cutting or brazing, this is a final repair preparation. Do not leave system open, close system as soon as possible.
G. Repair the system and for brazing, purge with nitrogen during brazing process.
H. Leak Test and pressure test the unit.
I. Evacuate the system down to 500 micro.
J. Charge the system as per manufactures charging procedures.

R-454B vs R-410a Service Tools

Many of the same service items can be used for servicing A2L refrigerants versus R-22 and R-410A. However, some service equipment, due to the electrical components and motors, should be specifically designed for use with mildly flammable A2L refrigerants (e.g., R-1234yf, R-32, etc.), which also needs to compliant with local regulation. All service should be conducted in a safe manner and with respect to the guidelines given by the relevant codes and standards in your country/region. This new A2L service items should be available as there is an increasing number of service equipment companies providing these tools.

Service Tools	R-410A	R-454B
Guage Manifold Set	Routine	Routine
Charging Hoses	Routine	Routine
Scales(Weight)	Routine	Routine
Flare Tool	Routine	Routine
Pipe Cutter	Routine	Routine
Vacuum Pump	Routine	Routine*
Dry Powder/CO2 Fire Extingusher	Not Necessary	Chemical Compatible
Gas Detector	Routine	2L Certified
Leak Detector	Routine	2L Certified
Refrigerant Recovery Cylinder	Routine	Flammable (GHSLabel) Left Hand Theread
Recovery Machines	Routine	2L Certified

* Proposed switch be located away from work zone

Tools needed to handle and service R-454B are listed above. As you will notice most tools have not changed from those used with R-410A and with R-R454B, except those highlighted red. Some other guidelines in tools when using R-454B are listed, on the next chart.

Service cylinders use for A2L

Service Item	R-404A	R-410A	R-454B
Cylinder Type	Returnable	Returnable	Returnable
Cylinder Pressure Rating			Min 42 bar
Valve Threading	Right hand	Right hand	Left hand
Valve type			Typical DIN 477-1
GHS Markings			

Although A2L cylinders have the same rated pressure as current R-410 cylinders, tanks are designed with several distinguishing characteristics, including:

Pressure relief valve	In the event of excessively high cylinder pressure, A2L cylinders include a pressure relief valve that's designed to only release enough refrigerant to reduce the pressure in that cylinder. Upon release, the valve will reset
Red band/stripe	A2L cylinders will have a red band (stripe) or the entire top painted red to indicate the presence of the mildly flammable refrigerant.
Left-hand (LH) thread	To further distinguish from other types of refrigerants, A2L cylinders will most likely have a LH thread.

The AIM Act

In December 2020 the American Innovation and Manufacturing act (AIM) was signed into US law with significant bipartisan support. The Aim Act creates the framework to grant the EPA the authority to begin the orderly nation-wide phase down of high global warming potential (GWP) hydrofluorocarbons (HFC)

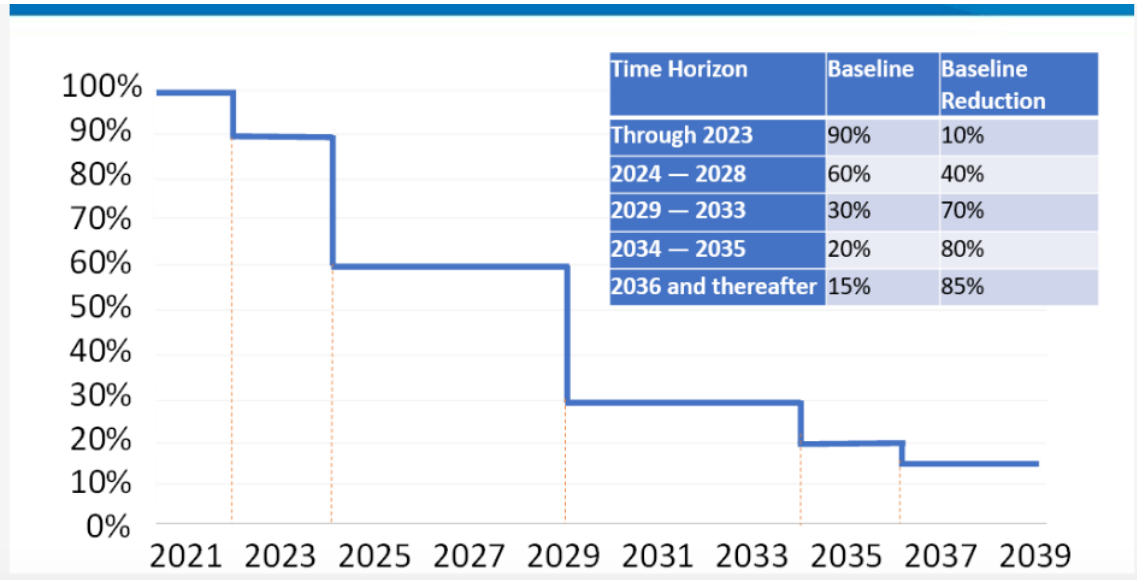
The Aim Act is expected to bring significant environmental and economic benefits including 33,000 new jobs and the preservation of 138,4000 existing jobs, $38.8 billion in direct and indirect manufacturing output, and an improvement to the U.S trade balance in equipment and chemicals by $12.5 billion.

How the AIM Act grants authority to the EPA to regulate HFCs

- Grants authority to the EPA to phase down the production and consumption of HFCs over a 16- year period using an allowance allocation program; much like the way ozone-depleting substances were regulated under Title VI (the “Clean Air Act”).
- Authorizes the EPA to establish sector-based, use case restrictions by application to facilitate the transition to next-generation technologies. These use case restrictions would complement the broader production and consumption phase down.
- Allows the EPA to establish standards for a Refrigerant Reclaim Program.

The AIM Act outlines a phase down schedule based on production and consumption levels from 2011-2013 as the baseline period. From the Baseline, the law outlines the following production and consumption phase down.

AIM Act HFC Phase Down



Time Horizon	Baseline	Baseline Reduction
Through 2023	90%	10%
2024 — 2028	60%	40%
2029 — 2033	30%	70%
2034 — 2035	20%	80%
2036 and thereafter	15%	85%

What the AIM Act Means for You?

- High-GWP products will be under new regulatory scrutiny.
- Price and availability of products will change through the phase down.
- New refrigerants and system architectures will be entering the market to meet the new requirements.

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ASHRAE (Standard 34 and 15)

Standard 34. assigns an identifying reference letter and number to each refrigerant to classify it according to the hazard involved in its use. The capital letter designates a toxicity class based on allowable exposure. The numeral denotes flammability. For example, Standard 34 defines two safety classifications for toxicity. Class A denotes refrigerants of lower toxicity, and class B denotes refrigerants of higher toxicity. For flammability, there are three classifications and one subclass. The three main flammability classifications are class 1, for refrigerants that do not propagate a flame when tested as per the standard; class 2, for refrigerants of lower flammability; and class 3, for highly flammable refrigerants such as the hydrocarbons. Although there are classifications, there are extreme ambient conditions which, coupled with the refrigerant nature, can lead to higher toxicity. ASHRAE recently updated the safety classification matrix to include a new flammability subclass 2L, for flammability class 2 refrigerants that burn very slowly. Some HFOs, which have very low global warming potential, are mildly flammable and are classified as A2L. This indicates that they are of lower toxicity and have low burning velocity.

Standard 15, Safety Standard for Refrigeration Systems, sets forth requirements to help protect people and property where refrigeration facilities are located. Further information is available in the current edition, ANSI/ ASHRAE Standard 15-2019. Personal injury and property damage can result from several origins, such as rupture of a part with flying debris, release of refrigerant from a fracture or fire resulting from or intensified by burning, or deflagration of escaping refrigerant or lubricant. In addition, personal injury can result from the accidental release of refrigerants in inadequately ventilated spaces; narcotic and cardiac sensitization effects; toxic effects of vapor or the decomposition products due to vapor contact with flames or hot surfaces; corrosive attack on the eyes, skin, or other tissue; or freezing of tissue by contact with liquid.

Standard 15.2 (2022) ASHRAE Standard 15.2 is a safety standard designed to accommodate the use of A2L-classified refrigerants in low-rise residential applications and is intended for use by manufacturers, installers, contractors, service technicians, building code officials, and others. requires that all products be listed to a national product safety standard and installed per the manufacturer's installation instructions. Specific requirements are included for which refrigerants can be used, the maximum allowable refrigerant charge, accessories, and interconnecting piping, so that in the event of a full release of the refrigerant charge, the concentration in the space remains safely below the lower flammability limit of the refrigerant.

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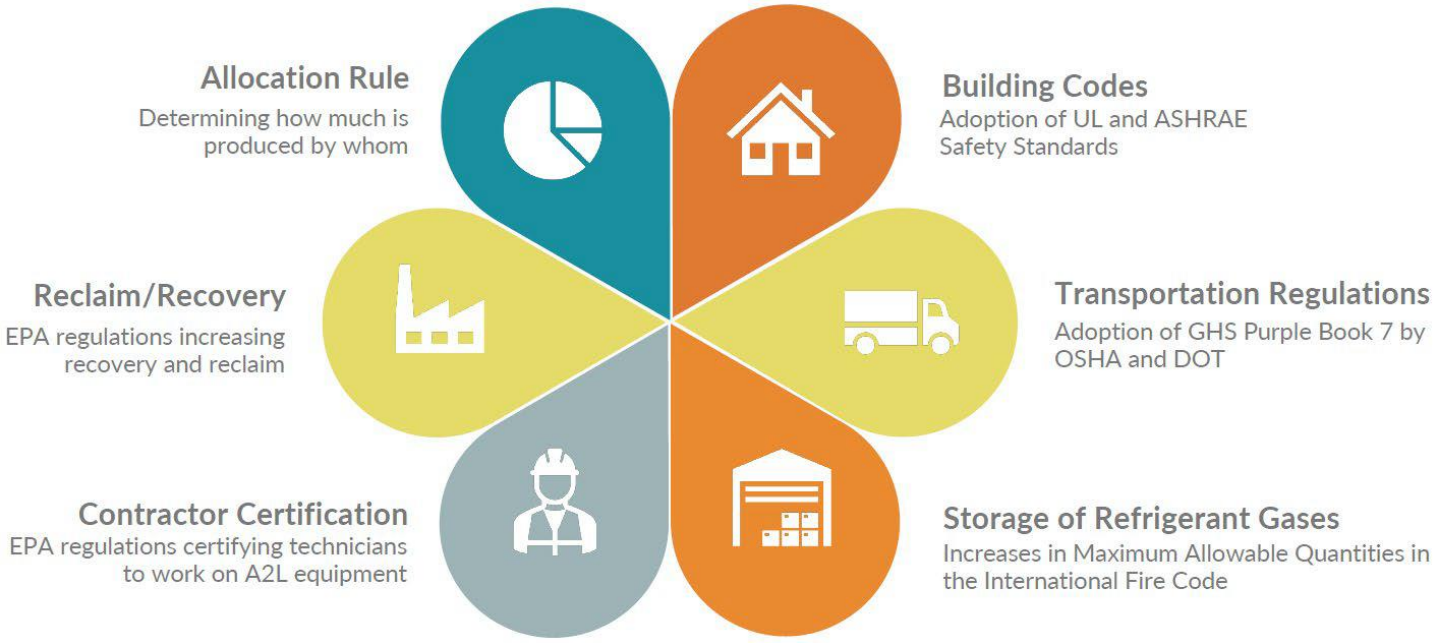
Environmental Protection Agency

The EPA has been tasked to oversee and make necessary changes in building codes, transportation regulations, storage of refrigerants, contractor certifications, reclaim/recovery, and new allocation rules. Final deliberations on what refrigerants will be acceptable are expected soon.



Requirements and Storage of R-454B

Mechanical Equipment Room Requirements

- Install an A2Lflammable rated air monitor capable of detecting the refrigerant(s) used in concentrations up to the OEL (Occupational Exposure Limit).
- Install suitable alarms that activate at or below the refrigerant's OEL, and that will alert persons outside of the equipment room that a leak condition exists.
- Route relief valve discharge headers and purge units outdoors, away from all air intakes to building or per local codes and regulations.
- Install local exhaust to ventilate the work area in the event that the air monitor alarm point is exceeded per local codes and regulations.
- Follow standards for refrigerants as required and current version of ISO 5149 or EN 378.

Working with R-454B in Enclosed Areas

1. Make sure all relief and purge vent piping are routed outdoors, and away from all air intakes to the building, per local codes and regulations.
2. Make certain the area is well ventilated. Use auxiliary ventilation, rated for A2L refrigerants, such as blowers or fans, if necessary, to disperse refrigerant vapors.
3. Test the work area for available oxygen before entering enclosed areas. Do not use a leak monitor to test for oxygen. A refrigerant leak detector will not tell you if adequate oxygen is present to sustain life.
4. Install an A2L flammable rated refrigerant leakage detection and oxygen monitoring equipment in the work areas.

Large R-454B Leaks

Do not attempt to enter the area to repair equipment until the vapors are dispersed, OR until you are equipped with proper breathing apparatus. Evacuate everyone until the area has been ventilated. Use blowers or fans to circulate air at the floor level and in any basement or low areas.

1. Appropriate respiratory protection equipment should be readily available in case of a large release.
2. Personnel should be trained how to use this equipment.
3. Consult the most recent version of ISO 5149 or EN 378 for additional information.

General Refrigerant Handling of Flammable Refrigerants

In general, all refrigerants, including the R-454B refrigerants should not be mixed with any flammable gases or liquids for any reason because these mixtures can have unpredictable flammability properties and could be unsafe. Mixtures of R-454B refrigerants with high concentrations of air at elevated pressure and/or temperature will change the flammability in the presence of an ignition source. The flammability is also elevated in an oxygen-enriched environment (oxygen concentrations greater than air). The exact flammability characteristics of a mixture containing these refrigerant products and air, or these refrigerant products in an oxygen enriched atmosphere, depends on the inter-relationship of 1) the temperature, 2) the pressure, and 3) the proportion of oxygen in the mixture. In general, these products should not be allowed to exist with air above atmospheric pressure or at high temperatures; or in an oxygen- enriched environment.

These products should NOT be mixed with air under pressure for leak testing or other purposes. Care should be taken to ensure that the R-454B refrigerants are compatible with any other chemicals that the refrigerant may come into contact within a leakage scenario when being used in process cooling application. In general refrigerants should not be exposed to open flames or electrical heating elements. High temperatures and flames can cause the refrigerants to decompose, releasing toxic and irritating fumes.

In addition, a flame (such as a cutting torch) can become dramatically larger or change color if used in high concentrations of many refrigerants. This flame enhancement can cause surprise or even injury. Always recover refrigerants, evacuate equipment, and ventilate work areas properly before using any open flames.

Pressure and Cylinder Safety

- In an overfilled container, vessel, or pipeline where temperature increases may become “liquid full” and immediately cause a dangerous increase in hydrostatic pressure, which can cause high -pressure leaks or even rupture of the vessel.
- A correctly filled returnable cylinder that is heated above the recommended maximum temperature of 52°C (125°F) could result in dangerously high pressures, possibly more than the cylinder design pressures.
- A returnable refrigerant cylinder connected to the discharge side of refrigeration or air-conditioning equipment may be exposed to pressures that can exceed the capacity of the cylinder relief devices, causing the cylinder to rupture or shatter.

Proper Procedures for handling R-454B Returnable Cylinders

- Verify that the refrigerant label matches any color code or labeling used on the equipment.
- Remove liquid from the cylinder when charging any R-454B refrigerant blend. Once removed from the cylinder, it can be flashed to vapor for charging.
- Verify proper hookup of charging hoses. Do not charge to the discharge side of the compressor.
- Open valves slowly and transfer refrigerant.
- Protect cylinders from moisture and rusting during storage.
- Do not store cylinders near incompatible materials or near incendiaries, such as cartons or boxes.
- Do not pressurize systems or vessels containing these refrigerants with air for leak testing or any other purpose.
- Do not place cylinders near flames or heat sources or discard into fires.
- Do not tamper with any relief devices on cylinders or refrigerant equipment.
- Do not drop, dent, or mechanically abuse containers.
- Do not recharge refillable cylinders with used refrigerants. Use only proper recovery cylinders for this purpose. It is illegal to ship original cylinders with used refrigerants.
- Do not force connections.
- Do not use flame on cylinders to heat them. Never expose cylinders to temperatures above 52°C (125°F).

EPA United States Environmental Protection Agency

Transport Storage

While R-454B refrigerants exhibit low or mild flammability properties per ISO 817 and ANSI/ASHRAE 34, this classification system is not recognized by the Globally Harmonized System or GHS. Under GHS, there is no distinction between flammable gases. According to GHS, all flammable gases are noted currently as “extremely flammable” under section 2 of the SDS.

Storage

- National Fire Safety Storage Requirements
  - Permit from fire code official
    - Hazardous Materials Management Plan
    - Hazardous Material Inventory Statement
  - Requires visible hazard identification signs (NFPA 704 sign)
  - No smoking signs
  - No open flames or high temperature devices (could include warehouse heaters)
- Empty tanks/cylinders (Heels)
  - Must be free of residual material and vapor before storage for reuse
- Safety Data Sheets
  - SDS must be available on site
- Upright storage
  - Exception for nonflammable gases secured to a pallet

Example of Signs

AHRI SAFE REFRIGERANT TRANSITION TASK FORCE

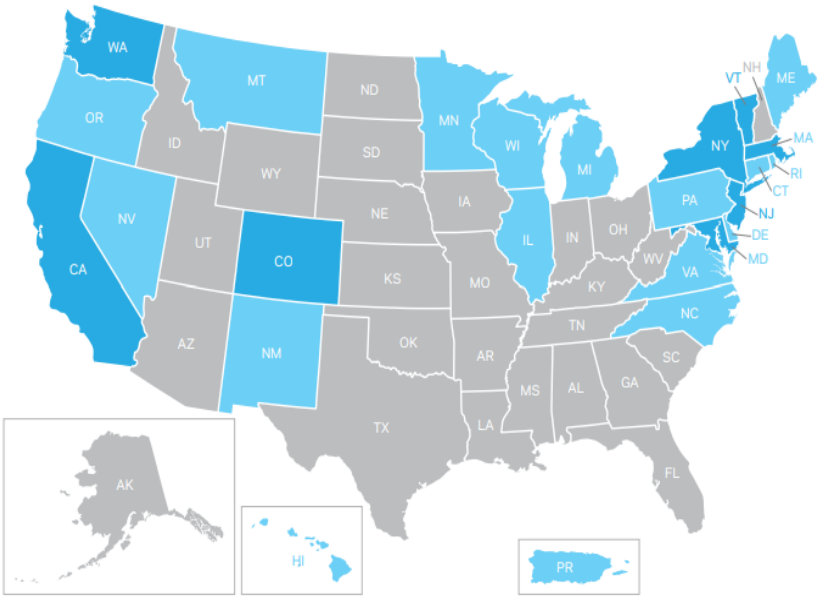
What's in the Future?

The future for Federal and State rules and regulations is wide open. Some states are wanting to have more stringent regulations while others do not. As of now, no one Federal mandate exists to cover the entire united states.

U.S. State-Level Activity

Climate Alliance
The United States Climate Alliance, founded in 2017, is a bipartisan coalition of U.S. states and territories committed to reducing greenhouse gas emissions by at least 26-28% below 2005 levels by 2025—this is consistent with the goals of the 2015 Paris Agreement. The Alliance represents greater than 55% of the U.S. population and over 60% of the economy. As of February 2020, there are 25 members, with 8 states joining in 2019. Visit USClimateAlliance.org for more information.

Climate Alliance members in motion with SNAP rules
Certain members of the U.S. Climate Alliance have taken steps to adopt SNAP rules, with some modifications, at the state level (as of January 2021: CA, CO, MA, MD, NJ, NY, VT, and WA). Other states that have expressed an intent to regulate HFCs include CT, DE, HI, ME, OR, RI, and VA. Note that states adopting SNAP rules may implement special reporting and labeling requirements. Visit EPA.gov/SNAP to learn more.



Seveso III: Directive 2012/18/EU of the European Parliament and of the Council on the control of major-accident hazards involving dangerous substances.

		Quantity 1	Quantity 2
P2	FLAMMABLE GASES	10 t	50 t

Other regulations:

Take note of Directive 94/33/EC on the protection of young people at work or stricter national regulations, where applicable.

15.2 Chemical safety assessment

Chemical Safety Assessments have been carried out for these substances.

SECTION 16: Other information

Other information	:	Opteon™ and any associated logos are trademarks or copyrights of The Chemours Company FC, LLC. Chemours™ and the Chemours Logo are trademarks of The Chemours Company. Before use read Chemours safety information. For further information contact the local Chemours office or nominated distributors.

Full text of H-Statements

H220	:	Extremely flammable gas.
H280	:	Contains gas under pressure; may explode if heated.

Full text of other abbreviations

Flam. Gas	:	Flammable gases
Press. Gas	:	Gases under pressure

ADN - European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways; ADR - European Agreement concerning the International Carriage of Dangerous Goods by Road; AICS - Australian Inventory of Chemical Substances; ASTM - American Society for the Testing of Materials; bw - Body weight; CLP - Classification Labelling Packaging Regulation; Regulation (EC) No 1272/2008; CMR - Carcinogen, Mutagen or Reproductive Toxicant; DIN - Standard of the German Institute for Standardisation; DSL - Domestic Substances List (Canada); ECHA - European Chemicals Agency; EC-Number - European Community number; ECx - Concentration associated with x% response; ELx - Loading rate associated with x% response; EmS - Emergency Schedule; ENCS - Existing and New Chemical Substances (Japan); ErCx - Concentration associated with x% growth rate response; GHS - Globally Harmonized System; GLP - Good Laboratory Practice; IARC - International Agency for Research on Cancer; IATA - International Air Transport Association; IBC - International Code for the Construction and Equipment of Ships carrying Dangerous Chemicals in Bulk; IC50 - Half maximal inhibitory concentration; ICAO - International Civil Aviation Organization; IECSC - Inventory of Existing Chemical Substances in China; IMDG - International Maritime Dangerous Goods; IMO - International Maritime Organization; ISHL - Industrial Safety and Health Law (Japan); ISO - International Organisation for Standardization; KECI - Korea Existing Chemicals Inventory; LC50 - Lethal Concentration to 50 % of a test population; LD50 - Lethal Dose to 50% of a test population (Median Lethal Dose); MARPOL - International Convention for the Prevention of Pollution from Ships; n.o.s. - Not Otherwise Specified; NO(A)EC - No Observed (Adverse) Effect Concentration; NO(A)EL - No Observed (Adverse) Effect Level; NOELR - No Observable Effect Loading Rate; NZIoC - New Zealand Inventory of Chemicals; OECD - Organization for Economic Co-operation and Develop-

IATA (Cargo)
Packing instruction (cargo aircraft) : 200
Packing group : Not assigned by regulation
Labels : Flammable Gas

IATA (Passenger) : Not permitted for transport

14.5 Environmental hazards

ADN
Environmentally hazardous : no

ADR
Environmentally hazardous : no

RID
Environmentally hazardous : no

IMDG
Marine pollutant : no

14.6 Special precautions for user

The transport classification(s) provided herein are for informational purposes only, and solely based upon the properties of the unpackaged material as it is described within this Safety Data Sheet. Transportation classifications may vary by mode of transportation, package sizes, and variations in regional or country regulations.

14.7 Transport in bulk according to Annex II of Marpol and the IBC Code

Remarks : Not applicable for product as supplied.

SECTION 15: Regulatory information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

REACH - Candidate List of Substances of Very High Concern for Authorisation (Article 59). : Not applicable

REACH - List of substances subject to authorisation (Annex XIV) : Not applicable

Regulation (EC) No 1005/2009 on substances that deplete the ozone layer : Not applicable

Regulation (EC) No 850/2004 on persistent organic pollutants : Not applicable

Regulation (EC) No 649/2012 of the European Parliament and the Council concerning the export and import of dangerous chemicals : Not applicable

REACH - Restrictions on the manufacture, placing on the market and use of certain dangerous substances, preparations and articles (Annex XVII) : Not applicable

IATA (Passenger)	:	UN 3161 Not permitted for transport

14.2 UN proper shipping name

ADN	:	LIQUEFIED GAS, FLAMMABLE, N.O.S. (Difluoromethane, 2,3,3,3-Tetrafluoropropene)
ADR	:	LIQUEFIED GAS, FLAMMABLE, N.O.S. (Difluoromethane, 2,3,3,3-Tetrafluoropropene)
RID	:	LIQUEFIED GAS, FLAMMABLE, N.O.S. (Difluoromethane, 2,3,3,3-Tetrafluoropropene)
IMDG	:	LIQUEFIED GAS, FLAMMABLE, N.O.S. (Difluoromethane, 2,3,3,3-Tetrafluoropropene)
IATA (Cargo)	:	Liquefied gas, flammable, n.o.s. (Difluoromethane, 2,3,3,3-Tetrafluoropropene)
IATA (Passenger)	:	LIQUEFIED GAS, FLAMMABLE, N.O.S. Not permitted for transport

14.3 Transport hazard class(es)

ADN	:	2
ADR	:	2
RID	:	2
IMDG	:	2.1
IATA (Cargo)	:	2.1
IATA (Passenger)	:	Not permitted for transport

14.4 Packing group

ADN

Packing group	:	Not assigned by regulation
Classification Code	:	2F
Hazard Identification Number	:	23
Labels	:	2.1

ADR

Packing group	:	Not assigned by regulation
Classification Code	:	2F
Hazard Identification Number	:	23
Labels	:	2.1
Tunnel restriction code	:	(B/D)

RID

Packing group	:	Not assigned by regulation
Classification Code	:	2F
Hazard Identification Number	:	23
Labels	:	2.1 ((13))

IMDG

Packing group	:	Not assigned by regulation
Labels	:	2.1
EmS Code	:	F-D, S-U

2,3,3,3-Tetrafluoropropene:

Bioaccumulation : Remarks: No bioaccumulation is to be expected (log Pow <= 4).

12.4 Mobility in soil

No data available

12.5 Results of PBT and vPvB assessment

Product:

Assessment : This mixture contains no substance considered to be persistent, bioaccumulating and toxic (PBT).. This mixture contains no substance considered to be very persistent and very bioaccumulating (vPvB)..

12.6 Other adverse effects

Global warming potential

Regulation (EU) No 517/2014 on fluorinated greenhouse gases

Product:

100-year global warming potential: 466.319

SECTION 13: Disposal considerations

13.1 Waste treatment methods

Product : Dispose of in accordance with local regulations.
According to the European Waste Catalogue, Waste Codes are not product specific, but application specific.
Waste codes should be assigned by the user, preferably in discussion with the waste disposal authorities.

Contaminated packaging : Empty containers should be taken to an approved waste handling site for recycling or disposal.
Empty pressure vessels should be returned to the supplier.
If not otherwise specified: Dispose of as unused product.

SECTION 14: Transport information

14.1 UN number

ADN	:	UN 3161
ADR	:	UN 3161
RID	:	UN 3161
IMDG	:	UN 3161
IATA (Cargo)	:	UN 3161

SECTION 12: Ecological information

12.1 Toxicity

Components:

Difluoromethane:

Toxicity to fish	:	LC50 (Fish): 1,507 mg/l Exposure time: 96 h
Toxicity to daphnia and other aquatic invertebrates	:	EC50 (Daphnia (water flea)): 652 mg/l Exposure time: 48 h
Toxicity to algae	:	EC50 (algae): 142 mg/l Exposure time: 96 h
Toxicity to fish (Chronic toxicity)	:	NOEC: 65.8 mg/l Exposure time: 30 d Species: Fish

2,3,3,3-Tetrafluoropropene:

Toxicity to fish	:	LC50 (Cyprinus carpio (Carp)): > 197 mg/l Exposure time: 96 h
Toxicity to daphnia and other aquatic invertebrates	:	EC50 (Daphnia magna (Water flea)): > 100 mg/l Exposure time: 48 h
Toxicity to algae	:	NOEC (algae): > 100 mg/l Exposure time: 72 h

12.2 Persistence and degradability

Components:

Difluoromethane:

Biodegradability	:	Result: Not readily biodegradable. Biodegradation: 5 % Exposure time: 28 d Method: OECD Test Guideline 301D

2,3,3,3-Tetrafluoropropene:

Biodegradability	:	Result: Not readily biodegradable. Method: OECD Test Guideline 301F

12.3 Bioaccumulative potential

Components:

Difluoromethane:

Partition coefficient: n-octanol/water	:	log Pow: 0.714

Components:

Difluoromethane:

Reproductive toxicity - Assessment	:	Weight of evidence does not support classification for reproductive toxicity, Based on data from similar materials

2,3,3,3-Tetrafluoropropene:

Reproductive toxicity - Assessment	:	Weight of evidence does not support classification for reproductive toxicity

STOT - single exposure

Not classified based on available information.

STOT - repeated exposure

Not classified based on available information.

Components:

Difluoromethane:

Assessment	:	No significant health effects observed in animals at concentrations of 250 ppmV/6h/d or less.

2,3,3,3-Tetrafluoropropene:

Assessment	:	No significant health effects observed in animals at concentrations of 250 ppmV/6h/d or less.

Repeated dose toxicity

Components:

Difluoromethane:

Species	:	Rat
NOAEL	:	49100 ppm
Application Route	:	inhalation (gas)
Exposure time	:	90 d
Remarks	:	No significant adverse effects were reported

2,3,3,3-Tetrafluoropropene:

Species	:	Rat
NOAEL	:	50000 ppm
LOAEL	:	>50000 ppm
Application Route	:	inhalation (gas)
Exposure time	:	90 d
Method	:	OECD Test Guideline 413
Remarks	:	No significant adverse effects were reported

Aspiration toxicity

Not classified based on available information.

2,3,3,3-Tetrafluoropropene:

Species	:	Not tested on animals
Result	:	No eye irritation

Respiratory or skin sensitisation

Skin sensitisation

Not classified based on available information.

Respiratory sensitisation

Not classified based on available information.

Components:

Difluoromethane:

Exposure routes	:	Skin contact
Species	:	Not tested on animals
Result	:	negative
Species	:	Not tested on animals
Result	:	negative

2,3,3,3-Tetrafluoropropene:

Exposure routes	:	Skin contact
Species	:	Not tested on animals
Result	:	negative

Germ cell mutagenicity

Not classified based on available information.

Components:

Difluoromethane:

Germ cell mutagenicity- Assessment	:	Weight of evidence does not support classification as a germ cell mutagen.

2,3,3,3-Tetrafluoropropene:

Germ cell mutagenicity- Assessment	:	Weight of evidence does not support classification as a germ cell mutagen.

Carcinogenicity

Not classified based on available information.

Components:

2,3,3,3-Tetrafluoropropene:

Carcinogenicity - Assessment	:	Weight of evidence does not support classification as a carcinogen

Reproductive toxicity

Not classified based on available information.

Lowest observed adverse effect concentration (Dog): > 350000 ppm
Symptoms: Cardiac sensitisation

No observed adverse effect concentration (Dog): 350000 ppm
Symptoms: Cardiac sensitisation

Cardiac sensitisation threshold limit (Dog): > 735,000 mg/m3
Symptoms: Cardiac sensitisation

2,3,3,3-Tetrafluoropropene:

Acute inhalation toxicity : LC50 (Rat): > 405000 ppm
Exposure time: 4 h
Test atmosphere: gas

Lowest observed adverse effect concentration (Dog): > 120000 ppm
Test atmosphere: gas
Symptoms: Cardiac sensitisation

No observed adverse effect concentration (Dog): 120000 ppm
Test atmosphere: gas
Symptoms: Cardiac sensitisation

Cardiac sensitisation threshold limit (Dog): > 559,509 mg/m3
Test atmosphere: gas
Symptoms: Cardiac sensitisation

Skin corrosion/irritation

Not classified based on available information.

Components:

Difluoromethane:

Species : Not tested on animals
Result : No skin irritation

2,3,3,3-Tetrafluoropropene:

Species : Not tested on animals
Result : No skin irritation

Serious eye damage/eye irritation

Not classified based on available information.

Components:

Difluoromethane:

Species : Not tested on animals
Result : No eye irritation

Viscosity
Viscosity, kinematic : Not applicable

Explosive properties : Not explosive

Oxidizing properties : The substance or mixture is not classified as oxidizing.

9.2 Other information

Particle size : Not applicable

SECTION 10: Stability and reactivity

10.1 Reactivity

Not classified as a reactivity hazard.

10.2 Chemical stability

Stable if used as directed. Follow precautionary advice and avoid incompatible materials and conditions.

10.3 Possibility of hazardous reactions

Hazardous reactions : Vapours may form flammable mixture with air
Can react with strong oxidizing agents.
Extremely flammable gas.

10.4 Conditions to avoid

Conditions to avoid : Heat, flames and sparks.

10.5 Incompatible materials

Materials to avoid : Oxidizing agents

10.6 Hazardous decomposition products

No hazardous decomposition products are known.

SECTION 11: Toxicological information

11.1 Information on toxicological effects

Information on likely routes of exposure : Inhalation
Skin contact
Eye contact

Acute toxicity

Not classified based on available information.

Components:

Difluoromethane:

Acute inhalation toxicity : LC50 (Rat): > 520000 ppm
Exposure time: 4 h
Test atmosphere: gas

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

Appearance	:	Liquefied gas
Colour	:	colourless
Odour	:	slight, ether-like
Odour Threshold	:	No data available
pH	:	No data available
Melting point/freezing point	:	No data available
Initial boiling point and boiling range	:	-50.9 °C
Flash point	:	Not applicable
Evaporation rate	:	> 1 (CCL4=1.0)
Flammability (solid, gas)	:	Flammable
Upper explosion limit / Upper flammability limit	:	Upper flammability limit 22 %(V) Method: ASTM E681
Lower explosion limit / Lower flammability limit	:	Lower flammability limit 11.25 %(V) Method: ASTM E681
Vapour pressure	:	15,856 hPa (25 °C)
Relative vapour density	:	2.2 (Air = 1.0)
Relative density	:	0.98 (25 °C)
Density	:	0.98 g/cm3 (25 °C) (as liquid)
Solubility(ies) Water solubility	:	No data available
Partition coefficient: n-octanol/water	:	Not applicable
Auto-ignition temperature	:	No data available
Decomposition temperature	:	No data available

Predicted No Effect Concentration (PNEC) according to Regulation (EC) No. 1907/2006:

Substance name	Environmental Compartment	Value
Difluoromethane	Fresh water	0.142 mg/l
	Intermittent use/release	1.42 mg/l
	Fresh water sediment	0.534 mg/kg
2,3,3,3-Tetrafluoropropene	Fresh water	0.1 mg/l
	Intermittent use/release	1 mg/l
	Fresh water sediment	1.77 mg/kg dry weight (d.w.)
	Soil	1.54 mg/kg dry weight (d.w.)
	Marine water	0.01 mg/l
	Marine sediment	0.178 mg/kg dry weight (d.w.)

8.2 Exposure controls

Engineering measures

Minimize workplace exposure concentrations.
Use only in an area equipped with explosion-proof exhaust ventilation if advised by assessment of the local exposure potential
Use with local exhaust ventilation.

Personal protective equipment

Eye protection : Wear the following personal protective equipment:
Chemical resistant goggles must be worn.
Face-shield

Hand protection
Material : Low temperature resistant gloves

Remarks : Choose gloves to protect hands against chemicals depending on the concentration and quantity of the hazardous substance and specific to place of work. For special applications, we recommend clarifying the resistance to chemicals of the aforementioned protective gloves with the glove manufacturer. Wash hands before breaks and at the end of workday. Breakthrough time is not determined for the product. Change gloves often!

Skin and body protection : Wear the following personal protective equipment:
Flame retardant antistatic protective clothing, unless assessment demonstrates that the risk of explosive atmospheres or flash fires is low

Respiratory protection : Use respiratory protection unless adequate local exhaust ventilation is provided or exposure assessment demonstrates that exposures are within recommended exposure guidelines.

Filter type : Organic gas and low boiling vapour type (AX)

Protective measures : Wear cold insulating gloves/ face shield/ eye protection.

7.2 Conditions for safe storage, including any incompatibilities

Requirements for storage areas and containers : Cylinders should be stored upright and firmly secured to prevent falling or being knocked over. Separate full containers from empty containers. Do not store near combustible materials. Avoid area where salt or other corrosive materials are present. Keep in properly labelled containers. Keep tightly closed. Keep in a cool, well-ventilated place. Keep away from direct sunlight. Store in accordance with the particular national regulations. Keep away from heat and sources of ignition.

Advice on common storage : Do not store with the following product types:
Self-reactive substances and mixtures
Organic peroxides
Oxidizing agents
Flammable liquids
Flammable solids
Pyrophoric liquids
Pyrophoric solids
Self-heating substances and mixtures
Substances and mixtures, which in contact with water, emit flammable gases
Explosives
Acutely toxic substances and mixtures
Substances and mixtures with chronic toxicity

Storage period : > 10 yr

Recommended storage temperature : < 52 °C

Further information on storage stability : The product has an indefinite shelf life when stored properly.

7.3 Specific end use(s)

Specific use(s) : No data available

SECTION 8: Exposure controls/personal protection

8.1 Control parameters

Derived No Effect Level (DNEL) according to Regulation (EC) No. 1907/2006:

Substance name	End Use	Exposure routes	Potential health effects	Value
Difluoromethane	Workers	Inhalation	Long-term systemic effects	7035 mg/m3
	Consumers	Inhalation	Long-term systemic effects	750 mg/m3
2,3,3,3-Tetrafluoropropene	Workers	Inhalation	Long-term systemic effects	950 mg/m3

employed in the cleanup of releases. You will need to determine which regulations are applicable.
Sections 13 and 15 of this SDS provide information regarding certain local or national requirements.

6.4 Reference to other sections

See sections: 7, 8, 11, 12 and 13.

SECTION 7: Handling and storage

7.1 Precautions for safe handling

Technical measures	:	Use equipment rated for cylinder pressure. Use a backflow preventative device in piping. Close valve after each use and when empty.
Local/Total ventilation	:	Use with local exhaust ventilation. Use only in an area equipped with explosion-proof exhaust ventilation if advised by assessment of the local exposure potential
Advice on safe handling	:	Handle in accordance with good industrial hygiene and safety practice, based on the results of the workplace exposure assessment Keep container tightly closed. Wear cold insulating gloves/ face shield/ eye protection. Prevent backflow into the gas tank. Open the valves slowly to prevent pressure surges. Close valve after each use and when empty. Do NOT change or force fit connections. Prevent the intrusion of water into the gas tank. Keep away from heat and sources of ignition. Take precautionary measures against static discharges. Take care to prevent spills, waste and minimize release to the environment. Avoid breathing gas. Valve protection caps and valve outlet threaded plugs must remain in place unless container is secured with valve outlet piped to use point. Use a check valve or trap in the discharge line to prevent hazardous back flow into the cylinder. Use a pressure reducing regulator when connecting cylinder to lower pressure (<3000 psig) piping or systems. Never attempt to lift cylinder by its cap. Do not drag, slide or roll cylinders. Use a suitable hand truck for cylinder movement.
Hygiene measures	:	Ensure that eye flushing systems and safety showers are located close to the working place. When using do not eat, drink or smoke. Wash contaminated clothing before re-use.

media

5.2 Special hazards arising from the substance or mixture

Specific hazards during fire-fighting	:	Vapours may form flammable mixture with air Exposure to combustion products may be a hazard to health. If the temperature rises there is danger of the vessels bursting due to the high vapor pressure.
Hazardous combustion products	:	Hydrogen fluoride carbonyl fluoride Carbon oxides Fluorine compounds

5.3 Advice for firefighters

Special protective equipment for firefighters	:	Wear self-contained breathing apparatus for firefighting if necessary. Use personal protective equipment.
Specific extinguishing methods	:	Use extinguishing measures that are appropriate to local circumstances and the surrounding environment. Fight fire remotely due to the risk of explosion. Use water spray to cool unopened containers. Leaking gas fire: Do not extinguish, unless leak can be stopped safely. Remove undamaged containers from fire area if it is safe to do so. Evacuate area.

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures

Personal precautions	:	Evacuate personnel to safe areas. Only trained personnel should re-enter the area. Remove all sources of ignition. Avoid skin contact with leaking liquid (danger of frostbite). Ventilate the area. Follow safe handling advice and personal protective equipment recommendations.

6.2 Environmental precautions

Environmental precautions	:	Prevent further leakage or spillage if safe to do so. Retain and dispose of contaminated wash water.

6.3 Methods and material for containment and cleaning up

Methods for cleaning up	:	Ventilate the area. Non-sparking tools should be used. Suppress (knock down) gases/vapours/mists with a water spray jet. Local or national regulations may apply to releases and disposal of this material, as well as those materials and items

SECTION 4: First aid measures

4.1 Description of first aid measures

General advice	:	In the case of accident or if you feel unwell, seek medical advice immediately. When symptoms persist or in all cases of doubt seek medical advice.
Protection of first-aiders	:	No special precautions are necessary for first aid responders.
If inhaled	:	If inhaled, remove to fresh air. Get medical attention if symptoms occur.
In case of skin contact	:	Thaw frosted parts with lukewarm water. Do not rub affected area. Get medical attention immediately.
In case of eye contact	:	Get medical attention immediately.
If swallowed	:	Ingestion is not considered a potential route of exposure.

4.2 Most important symptoms and effects, both acute and delayed

Symptoms	:	May cause cardiac arrhythmia. Other symptoms potentially related to misuse or inhalation abuse are Cardiac sensitisation Anaesthetic effects Light-headedness Dizziness confusion Lack of coordination Drowsiness Unconsciousness
Risks	:	Contact with liquid or refrigerated gas can cause cold burns and frostbite.

4.3 Indication of any immediate medical attention and special treatment needed

Treatment	:	Treat symptomatically and supportively.

SECTION 5: Firefighting measures

5.1 Extinguishing media

Suitable extinguishing media	:	Water spray Alcohol-resistant foam Carbon dioxide (CO2) Dry chemical
Unsuitable extinguishing	:	None known.

Hazard statements : H220 Extremely flammable gas.
H280 Contains gas under pressure; may explode if heated.

Precautionary statements :

Prevention:

P210 Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.

Response:

P377 Leaking gas fire: Do not extinguish, unless leak can be stopped safely.
P381 In case of leakage, eliminate all ignition sources.

Storage:

P410 + P403 Protect from sunlight. Store in a well-ventilated place.

Additional Labelling

Contains fluorinated greenhouse gases. (HFC-32)

2.3 Other hazards

This mixture contains no substance considered to be persistent, bioaccumulating and toxic (PBT).
This mixture contains no substance considered to be very persistent and very bioaccumulating (vPvB).
May displace oxygen and cause rapid suffocation.
Vapours are heavier than air and can cause suffocation by reducing oxygen available for breathing.
Misuse or intentional inhalation abuse may cause death without warning symptoms, due to cardiac effects.
Rapid evaporation of the product may cause frostbite.

SECTION 3: Composition/information on ingredients

3.2 Mixtures

Hazardous components

Chemical name	CAS-No. EC-No. Index-No. Registration number	Classification	Concentration (% w/w)
Difluoromethane*	75-10-5 200-839-4 01-2119471312-47	Flam. Gas 1; H220 Press. Gas Liquefied gas; H280	68.9
2,3,3,3-Tetrafluoropropene*	754-12-1 468-710-7 01-0000019665-61	Flam. Gas 1; H220 Press. Gas Liquefied gas; H280	31.1

* Voluntarily-disclosed non-hazardous substance
For explanation of abbreviations see section 16.

SAFETY DATA SHEET
according to Regulation (EC) No. 1907/2006

Opteon™ XL41 (R-454B) Refrigerant

Version	Revision Date:	SDS Number:	Date of last issue: 01.12.2017
3.4	03.04.2018	1354822-00035	Date of first issue: 27.02.2017

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1 Product identifier

Trade name : Opteon™ XL41 (R-454B) Refrigerant

SDS-Identcode : 130000143545

1.2 Relevant identified uses of the substance or mixture and uses advised against

Use of the Substance/Mixture : Refrigerant

Recommended restrictions on use : For professional and industrial installation and use only.

1.3 Details of the supplier of the safety data sheet

Company : Chemours Netherlands B.V.
Baanhoekweg 22
3313 LA Dordrecht Netherlands

Telephone : +31-(0)-78-630-1011

Telefax : +31-78-6163737

E-mail address of person responsible for the SDS : sds-support@chemours.com

1.4 Emergency telephone number

+(44)-870-8200418 (CHEMTREC - Recommended)

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

Classification (REGULATION (EC) No 1272/2008)

Flammable gases, Category 1	H220: Extremely flammable gas.
Gases under pressure, Liquefied gas	H280: Contains gas under pressure; may explode if heated.

2.2 Label elements

Labelling (REGULATION (EC) No 1272/2008)

Hazard pictograms :

Signal word : Danger

ment; OPPTS - Office of Chemical Safety and Pollution Prevention; PBT - Persistent, Bioaccumulative and Toxic substance; PICCS - Philippines Inventory of Chemicals and Chemical Substances; (Q)SAR - (Quantitative) Structure Activity Relationship; REACH - Regulation (EC) No 1907/2006 of the European Parliament and of the Council concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals; RID - Regulations concerning the International Carriage of Dangerous Goods by Rail; SADT - Self-Accelerating Decomposition Temperature; SDS - Safety Data Sheet; SVHC - Substance of Very High Concern; TCSI - Taiwan Chemical Substance Inventory; TRGS - Technical Rule for Hazardous Substances; TSCA - Toxic Substances Control Act (United States); UN - United Nations; vPvB - Very Persistent and Very Bioaccumulative

Further information

Sources of key data used to compile the Safety Data Sheet	:	Internal technical data, data from raw material SDSs, OECD eChem Portal search results and European Chemicals Agency, http://echa.europa.eu/

Classification of the mixture:		**Classification procedure:**
Flam. Gas 1	H220	Based on product data or assessment
Press. Gas Liquefied gas	H280	Based on product data or assessment

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and shall not be considered a warranty or quality specification of any type. The information provided relates only to the specific material identified at the top of this SDS and may not be valid when the SDS material is used in combination with any other materials or in any process, unless specified in the text. Material users should review the information and recommendations in the specific context of their intended manner of handling, use, processing and storage, including an assessment of the appropriateness of the SDS material in the user's end product, if applicable.

GB / EN