

What To Know About the Low-GWP Refrigerant Transition

Since the invention of the electric thermostat in 1885 and its radical improvement on building energy efficiency, Johnson Controls has always been at the forefront of environmental protection. Today, our commitment to sustainability is stronger than ever, and it's reflected in the choices we make every day. In fact, you may have recently heard about one of these choices: Johnson Controls has chosen R-454B refrigerant to replace R-410A in all ducted residential and light/applied commercial unitary products. **Here are a few, key points about the changeover.**

1. At an institutional level, Johnson Controls is committed to environmental sustainability. We're proud to have been included in more than 40 distinguished sustainability indexes in recent years and are eager to extend this commitment to our customers by helping them reduce emissions by 16% before 2030.
2. The American Innovation and Manufacturing (AIM) Act¹, recently passed as part of the December 2020 COVID stimulus bill, directs the Environmental Protection Agency (EPA) to phase down U.S. hydrofluorocarbon (HFC) production and use by approximately 85% over the next 15 years. This requires a transition from HFC refrigerants like R-410A to a new generation of low global warming potential (GWP) refrigerants.
3. After extensive research, testing and evaluation of capacity, efficiency, safety, availability, longevity, GWP, ozone depletion potential (ODP) and other metrics, Johnson Controls has selected R-454B to replace R-410A in all ducted residential and light/applied commercial unitary products.
4. At one-fifth the GWP of R-410A, and with the lowest, EPA SNAP²-approved GWP of all ASHRAE³ 34 classified A2L (low-toxicity, mild-flammability) refrigerants on the market, R-454B has the best-in-class⁴ GWP of 466 (AR4 – 100 yr.) and offers the best outlook for long-term viability as phase-down regulations continue.
5. R-454B is more compatible with existing R-410A equipment, requires less charge and can reduce HVAC systems' energy use by up to 5%. These similar operating characteristics will make for a smoother transition for distributors, wholesalers, contractors and owners, resulting from the commonality of critical system components and their very similar operating pressures and temperatures.
6. Timing for the low-GWP refrigerant transition and whether it will be a single federal transition or the current "state by state" approach is still taking shape. However, AHRIF⁵ recently submitted a formal petition to the EPA requesting a national, sector-based phase-out of stationary AC/unitary products that would align with California's pending requirements of a 750 GWP limit starting 1/1/2025.
7. The mild flammability (A2L) aspect of the new refrigerants requires that safety standards and individual state building codes must first be updated prior to the introduction of these refrigerants into the market. The process to update codes and standards is well underway. As with installation of any HVAC equipment, those responsible for the installation should ensure the equipment specified meets the latest building codes and safety standards.
8. It is expected that R-410A will continue to be available for service of existing equipment beyond any mandated phase-out (similar to the transition from R-22). However, that time period is currently undefined. Unlike R-22, there are no viable, low-GWP drop-in replacements for R-410A. This makes long-term availability of R-410A as a service refrigerant even more important.

¹ <https://www.epa.gov/climate-hfcs-reduction>

² <https://www.epa.gov/snap/snap-regulations>

³ American Society of Heating, Refrigerating and Air-Conditioning Engineers

⁴ High-pressure, direct systems for stationary AC/unitary

⁵ Air-Conditioning, Heating and Refrigeration Institute

Below you will find a list of frequently asked questions concerning the low-GWP refrigerant transition. Details provided below may be subject to change. Please contact your distributor or regional sales rep for more information.

Q: Does this transition apply to sales of existing systems?

A: No. It's important to note that these pending mandates only apply to the sale of new equipment once HFC manufacturing is mandated to end. Equipment purchased prior to a mandated phase-out that uses R-410A as its refrigerant will still be able to be serviced. However, as the phase-down progresses, availability of virgin R-410A will decrease. The exact timeframe of this service period has yet to be confirmed. But as a point of reference, the last refrigerant transition from R-22 to R-410A ended for new equipment in 2010 and for service in 2020 (i.e., a 10-year service period). At that point, only new R-22 manufactured prior to 2020 or reclaimed R-22 could be used to service existing equipment.

Q: What is driving the current transition?

A: In the past, ozone depletion potential (ODP) was of primary concern. Today, global warming potential (GWP) is the force driving new regulations. Although R-410A has no ODP, it is considered a potent greenhouse gas due to its high GWP value of 2,088. States like California are targeting GWP levels of no more than 750 for unitary⁶ products.

Q: What low-GWP refrigerants were considered?

A: Among the EPA SNAP-approved alternatives, two refrigerants were closely considered: R-32 and R-454B. Others, like R-407C, have a high GWP (1,774) or have other undesirable characteristics (R-290 is very flammable, for example). Both R-32 and R-454B offer performance similar to R-410A. However, unlike R-410A, which is classified as a nonflammable (A1) refrigerant, both R-32 and R-454B are classified by ASHRAE as nontoxic and mildly flammable (A2L). This is a first for the unitary market, and it also means there is not a true "drop-in" solution for R-410A due to this mild flammability.

⁶ Unitary Products are often referred to as stationary air-conditioning (AC) by regulators and include traditional, residential split systems as well as packaged rooftops for commercial applications.

⁷ A system in which the basic design, or location of the components, is such that leakage of refrigerant from a failed connection, seal or component could enter the occupied space.

Q: What advantages does R-454B have over R-32?

A: R-454B has a much lower GWP (466 vs 675) and has significantly lower discharge pressures vs. R-32. In fact, R-454B has very similar pressures and temperatures to R-410A, which decreases the learning curve for equipment designers and service technicians. R-454B also requires less charge than R-410A and can reduce an HVAC system's energy use by up to 5%. These similar operating characteristics will make for a smoother transition resulting from the commonality of systems components and their very similar operating pressures and temperatures. Proponents of R-32 point to the potential for improvements in energy efficiency and capacity relative to R-410A. However, the higher GWP of 675 makes R-32 more susceptible to a second, near-term transition than R-454B (which has a GWP of 466). In addition, the higher discharge temperatures of R-32 must be specifically accounted for in equipment design and application.

Q: What are the odds of another regulation forcing a transition from R-454B?

A: At one-fifth the GWP of R-410A, and the lowest SNAP-approved GWP of all ASHRAE-classified A2L (low-toxicity, mild-flammability) refrigerants on the market, there is no refrigerant that provides a lower GWP without a higher ASHRAE flammability classification (e.g., propane's A3 ASHRAE classification) at the same level of performance for high-pressure, direct systems. Other viable alternatives (most notably, R-32) do not possess the same, low-GWP ratings and therefore have a higher risk of being phased-out compared to R-454B or other alternatives with GWPs less than 750.

Q: Are A2L refrigerants approved for use in residential systems?

A: The introduction of mildly flammable refrigerants into high-probability⁷, unitary systems (e.g., residential) of this size and charge volume will be a first for the U.S. industry. A2L refrigerants are currently allowed by various codes but are limited to small charge systems (e.g., window units), whereas larger charge systems, like unitary split systems and packaged rooftops, must have their governing codes updated. Use of this A2L equipment requires reference to the updated safety standards (UL 60335-2-40, 3rd edition, ASHRAE 15 – 2019 and ASHRAE 15.2), where allowable charge volumes and leak mitigation responses are specified. It's also important to note that *mildly* flammable A2L fluids are NOT the same as *lower*-flammability A2 fluids. As we approach 2025, safety standards and building codes must first be updated; proper training will be critical to ensure the safe use of A2L refrigerants in these direct, high-probability systems. Code adoption at the state, city and municipal level may result in a patchwork of A2L allowances. Since the EPA does not have authority to override safety codes, support for adoption of A2L codes at the local and state level is critical to ensure a single, nationwide transition no later than 1/1/2025 for stationary AC equipment.

Q: How will this transition affect homeowners and facility managers?

A: Homeowners and facility managers should be well educated on the systems they purchase or manage. As the pending 1/1/2025 transition date approaches, equipment owners will need to choose between purchasing an existing R-410A system or a new, low-GWP system like those using R-454B. Multiple decision criteria should be considered, including the age of the current equipment, cost of historical and future repairs, operating cost, environmental impact, potential service life of R-410A, etc. As with any purchase, your local Johnson Controls sales representative should be consulted on this decision. If a homeowner or facility manager does purchase a new system using R-454B, the installing contractor must consider the impact of relevant safety and application standards (UL 60335-2-40, at least the 3rd edition or later, ASHRAE 15 and/or ASHRAE 15.2, which specifically address residential applications) in order to ensure proper selection and application.

Q: Will R-454B work in existing R-410A systems?

A: Most unitary systems are designed for use with a specific refrigerant. R-454B should only be used in systems for which it was specifically designed. Although many of R-454B's performance characteristics are similar to R-410A, the use of R-454B is restricted by code and regulation to systems for which it was specifically designed, largely due to the refrigerant's ASHRAE flammability and toxicity classification. For example, a system designed for an ASHRAE A1 refrigerant, like R-410A, cannot be converted to R-454B, which is designed as an ASHRAE A2L.

Q: Is there any known drop-in for R-410A?

A: As of the creation of this document, there are no known, low-GWP (< 750 GWP) drop-ins for R-410A in high-probability systems (e.g., unitary). While it is possible future refrigerants could be developed to fill this need, Johnson Controls application engineering must approve any alternatives prior to use or else equipment warranties could be voided. Under no circumstances should any type of flammable refrigerant be used in an R-410A system.

Q: How will this transition compare to the phase-out of R-22? Will R-410A eventually be banned, similar to what occurred with R-22?

A: While the production of new R-22 equipment ended in 2010, some production of new R-22 refrigerant was still permitted for another 10 years to support existing equipment. Production of new R-22 for service applications ended on 1/1/2020, but even today significant quantities of R-22 are still available in the market from numerous refrigerant reclaimers. Based on the lessons learned from the R-22 phase-out, as well as reluctance to strand viable legacy equipment, it is reasonable to believe R-410A will similarly be available for service beyond any mandated new equipment phase-out. However, the phase-down schedule outlined in the AIM Act could force the EPA into shortening the traditionally long (~10 year) service tail. Because the AIM Act phase-down schedule applies broadly to HFCs and not just R-410A, a comprehensive, sector-by-sector phase-out schedule has not been established for the stationary AC (unitary) sector. It's currently unclear what might happen in the later years of the AIM Act phase-down. Johnson Controls recommends that contractors and equipment owners quickly establish proper refrigerant management practices, invest in available flammable refrigerant training and establish sources of both virgin and reclaimed R-410A before the AIM Act phase-down on virgin refrigerant occurs.

⁸ <https://www.ahrinet.org/saferefrigerant>

⁹ <https://www.acca.org/education/a2l-refrigerants>

Q: How else can I prepare for the transition from R-410A to R-454B?

A: First, support the adoption of A2L codes at a local and state level. Second, become familiar with UL 60335-2-40, 3rd and 4th editions, ASHRAE 15 and ASHRAE 15.2. UL 60335-2-40, 3rd edition requires contractors to calculate conditioned space volumes and total charge sizes, for example. Third, review the AHRI Safe Refrigerant Transition Task Force (SRTTF)⁸ best practices. Fourth, complete ACCA A2L refrigerant training⁹ before equipment enters the market (updated ASHRAE 15.2 training is expected by the end of 2022). And finally, strengthen your current refrigerant management practices: ensure your technicians are EPA section 608-certified for the equipment they will be servicing, train technicians not to mix different recovered refrigerants in the same cylinder, implement robust refrigerant tracking and documentation practices and establish a reliable supply chain for R-410A reclamation before 2025.

Q: Did Johnson Controls evaluate R-466A? Why was it not selected?

A: Johnson Controls evaluated multiple, low-GWP alternatives before finally settling on R-454B for its unitary offering. Multiple factors were considered in the evaluation process, including GWP, cost, efficiency, availability, material compatibility, safety, etc. While R-466A was included in our evaluation process, when all the factors above were considered, it was not chosen. Johnson Controls will continue to evaluate all viable alternatives as new formulations are developed. These evaluations will be conducted under the umbrella of governing HFC regulations (e.g., AIM Act, EPA SNAP, UL, ASHRAE, etc.) and future compliance dates.

Q: Will there be a sell-through period for existing R-410A equipment?

A: Yes. While regulations with the EPA and the California Air Resources Board (CARB) are still pending as of this writing, all indications are that the rules will be designated as "date of manufacturing," which means all R410A products built prior to the mandated effective dates (e.g., 1/1/2025 for stationary AC) can be sold and installed indefinitely. This information will be updated once the regulations are finalized.

Q: Will Johnson Controls require technicians to be certified to service its A2L unitary equipment?

A: While details of these requirements have yet to be finalized, it is highly likely that Johnson Controls will require some amount of training or certification for service technicians and installers beyond what is presently required by EPA section 608 regulations. With our priority on safety, we believe it is paramount that anyone working with even mildly flammable refrigerants be thoroughly trained in the safe use and handling of such refrigerants. Additional information will be provided well ahead of the proposed, 1/1/2025 transition.

Q: Why haven't all HVAC manufacturers agreed on a single, low-GWP refrigerant for this transition?

A: Since there are no regulations that mandate a specific refrigerant be used, manufacturers are free to choose the refrigerant that best meets their market and business requirements.

Q: Is R-32 easier to reclaim compared to R-454B since R-32 is not a blend?

A: While R-32 is a single component refrigerant versus R-454B, which is a blend of R-32 (68.9%) and R-1234yf (31.1%), the properties of R-454B are very similar to R-410A, which is also a blend: R-32 (50%) and R-125 (50%). Therefore, reclamation of R-454B will not be significantly different than R-410A, which is the long-established industry standard. The primary factor in the reclamation cost will be the quality of the recovered (used) refrigerant. Regardless of the type of refrigerant being reclaimed, the more contaminated a recovered refrigerant is, the greater the reclamation processing cost. It is a well-established best practice to avoid recovering different, used refrigerants into a single recovery cylinder.

Refrigerant Attributes

Fluid	ASHRAE 34	GWP	Component Mix - Ratio %	Exposure Limit	Operating Pressure	LFL	UFL	Burning Velocity	MIE	Auto Ignition	Hot Surface Temperature	Efficiency	Capacity
		CO ₂ e		ppm	psia	% v/v	% v/v	cm/sec	mJ	C	C	vs R-410A	vs R-410A
R-410A	A1	2,088	R-32/R-125 - 50/50	140,000	434	-	-	-	-	> 750	-	-	-
R-454B	A2L	466	R-32/R-1234yf - 69/31	30,000	405	11.8	21.5	5.2	100-300	498	700	=	<
R-32	A2L	675	R-32 - 100%	36,000	444	14.4	29.3	6.7	21-40	648	700	+	+

LFL - lower flammability limit

UFL - upper flammability limit

MIE - minimum ignition energy

Q: How does R-454B compare to R-32? What are the advantages and disadvantages?

A: While R-454B and R-32 have some similarities in terms of refrigerant attributes, there are some distinct differences, one of the most notable being their GWP levels. The above table compares some of these attributes, including those for R-410A.

Q: Will R-454B ever fractionate (separate) during a leak?

A: R-454B has properties very similar to R-410A, which is also a blend. Because of R-454B's low temperature glide, leaks can be topped off similar to what was done with R-410A (note that R-410A systems cannot be charged with R-454B; this is strictly prohibited by codes and safety standards).

Q: What are the current EPA rules regarding servicing of unitary equipment?

A: Section 608 Technician Certification¹⁰ of the EPA regulations requires that technicians must pass an EPA-approved test given by an EPA-approved certifying organization in order to become certified. The tests are specific to the type of equipment upon which the technician seeks to work. Tests must be administered by an EPA-approved certifying organization. Section 608 Technician Certification credentials do not expire.

¹⁰ <https://www.epa.gov/section608/section-608-technician-certification-0>

¹¹ <https://www.ahrinet.org/analytics/research/ahri-flammable-refrigerants-research-initiative>

Q: Will R-454B require a special oil?

A: No. Unlike R-32, where special design considerations must be taken into account due to its higher operating pressures and temperatures, R-454B is compatible with traditional POE oils.

Q: What are the potential ignition sources for A2Ls like R-454B? What ignition sources are not typically sufficient to result in ignition?

A: A2Ls have a high minimum ignition energy (MIE) compared to more flammable A3 refrigerants (e.g., propane) and typically require an open flame or other high-energy source to ignite. Several common ignition sources were tested under different "real world" scenarios in order to ensure proper design, and mitigation requirements were included in the latest equipment safety standards (e.g., UL 60335-2-40, 3rd edition or higher, ASHRAE 15 or ASHRAE 15.2). Detailed research reports can be accessed via the Air-Conditioning Heating and Refrigeration Institute's Flammable Refrigerants Research Initiative.¹¹

Q: Will R-454B systems require refrigerant detection or alarms of any kind?

A: Yes. In most cases, Safety Standard UL 60335-2-40, 3rd edition or later specifies that the factory install sensors that would detect any leakage of an A2L refrigerant. It also specifies the mitigation response the equipment must be able to meet. Other field requirements that address piping and service requirements are listed in ASHRAE Standards 15 and 15.2, which specifically address residential systems.

Q: Will factory-charged R-454B equipment require Hazardous Material Regulation (i.e., HAZMAT)?

A: Per the Department of Transportation (DOT), HVAC equipment containing less than 26.6 lbs. of an A2L refrigerant like R-454B will not be subject to HAZMAT when shipped via ground, rail or ocean transport. Additional changes governing transportation and service of A2L refrigerants are currently under revision. Those responsible for the safe storage and transportation of A2L refrigerants must confirm their facilities and transportation vendors adhere to the regulation in effect at the time.