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Industry Changes You Need to Know

ANSWERS ON A2L REFRIGERANTS

Do You Know About the SEER2 Regulations?

New SEER2 requirements for air conditioning and heat pump systems, including minimum efficiency and additional requirements, depend on U.S. region.

New efficiency requirements, and the testing procedures used to verify them, will go into effect January 1, 2023.

New M1 testing procedures better reflect conditions of installed equipment in the field. Manufacturers are already redesigning equipment, but all air conditioning and heat pump systems must be renovated by January 1, 2023, even if they meet current SEER ratings.

As you plan, it's important to understand the cost of equipment necessary to meet the new regulations.

New Refrigerants, New Equipment, New Processes

With ever-changing regulations and standards, it is our responsibility to look ahead to the real impacts these changes will have on facility operations, including efficient asset planning and safe refrigerant handling.

The transitioning and phasedown of HCFC and HFC refrigerants has been on the horizon for some time, but now it's here. In the start of 2022, production of HFCs must reduce, by mandate, by 10%. That reduction increases to 60% in 2024. Over the next fifteen years, the American Innovation and Manufacturing (AIM) Act targets an 85% phase down of production and consumption of HFCs.[1]

The switch to alternative refrigerants is already underway. Businesses in the United States may see clearer impacts by 2023, as major manufacturers such as Carrier[2], JCI[3],and Daikin[4] have already committed to manufacturing new equipment that use A2L refrigerants with lower GWP, such as R454B and R32.

A2L:

A class of refrigerants with lower toxicity and flammability (than A2 or A3).[5]

GWP:

Global Warming Potential, a measure of how much a gas contributes to warming the Earth.[6]

Many replacements for R-22 or alternative refrigerants have high GWP. For instance, 410A has a GWP of 2,088,[7] which means the warming potential of one pound of 410A released into the atmosphere is more than 2,000 pounds of Carbon Dioxide (CO_2).

Lower GWP thresholds can be expected going forward. For instance, California sought to prohibit the use of refrigerants with GWP of 750 or greater in new air-conditioning equipment, beginning in 2023,[8] but a lack of agreement with building codes and the possible flammability of A2L refrigerants caused a delay in implementation. California isn't the only state considering these changes: the U.S. Climate Alliance, a group of states committed to achieving the Paris Agreement's goal of reducing global warming, includes states seeking to reduce the high-warming HFCs.[9]

Finally, the AIM Act now directs the EPA to phase down production and consumption of HFCs by 85% over the next 15 years.[10] Unfortunately, as high-GWP refrigerants are phased out, many new low-GWP refrigerants available are likely to be flammable.[11] A2Ls have been used safely in air conditions globally for years.[12]

Do We Need to Talk About These Changes Now?

Major manufacturers are already changing equipment, and the marketplace will continue to respond to regulations and mandated targets. Planning and training now, so that everyone from technicians to facility owners and operations understand what's changing, will be vital to our best practices.

HFO[13] and HC[14] refrigerants will be manufactured and promoted as low-GWP refrigerants

Specialty tools, tanks, and processes will be required for both field technicians and relevant support team members

Building codes and client requirements will also evolve to match regulations and safety requirements for refrigerant handling

OEMs will have specific A2L refrigerant training as well as specific equipment training, but to be fully prepared to make the best choices for our facilities, it's important to develop our understanding of everything involved, not just how equipment will be serviced in the field.

A2L refrigerants are already in use in the U.S. more; in fact, more than 80% of new vehicles sold in the U.S. are using A2L refrigerant.[15]

What Are A2L Refrigerants?

A2L is a classification of refrigerant established by ASHRAE (formerly American Society of Heating, Refrigeration, and Air Conditioning Engineers) in ANSI/ASHRAE Standard 34 (2019). The classification system is based on safety groups determined by toxicity and flammability.[16]

A:

The letter refers to the toxicity. Class A refrigerants have lower toxicity than Class B refrigerants.

2L:

The number refers to the flammability. Flammability for Standard 34 is done by the ASTM Standard Test Method for Concentration Limits of Flammability of Chemicals (Vapors and Gases):

1 Refers to no flame propagation.

2 Refers to low flame propagation; with 2L lower than 2 (2L refrigerants have a maximum burning velocity of 10 cm/s).

3 Refers to high flame propagation, and includes highly flammable hydrocarbons.

Why Not Use A1 Refrigerants if They Are Non-Flammable?

A1 refrigerants have no flame propagation per the listed test but may be flammable at temperatures higher than the test requires. For instance, R-22 is a common A1 refrigerant, but can burn under certain conditions.[17]

There are non-flammable refrigerants, but that doesn't guarantee equipment can use those non-flammable refrigerants as replacements. For instance, Carbon Dioxide (CO_2) is not flammable[18]. However, CO_2 as a refrigerant requires much higher pressure, requiring compressors and pipelines designed to use it.[19]

R-410A (a 50-50 blend of R-32 and R-125[20]) is listed as A1, but usually cannot be used in equipment designed for R-22 due to higher operation pressures.[21] R-410A can become combustible in certain conditions.[22] These include mixing with air and exposure to sources of ignition, or very high temperatures and pressures.[23]

How Safe Are A2L Refrigerants Compared to Others?

As a category of refrigerants, A2L are less flammable and less toxic than most other categories, but flammability and toxicity are not the only dangers of refrigerants. Since many refrigerants are heavier than air, they can displace air, especially in confined spaces, leading to asphyxiation or suffocation; it's also important to note that pressurizing a gas increases risk of injury due to improper handling or damaged equipment, and exposure to refrigerants in some conditions can cause frostbite.[24]

To quantify the risk of poisoning or suffocation posed by a refrigerant leak, ASNI/ASHRAE Standard 15 define the RCL and ODL. The Refrigerant-Concentration Limit (RCL) is the concentration of refrigerant bound to cause acute toxicity in an enclosed space. The Oxygen-Deprivation Limit is the concentration of refrigerant that would deprive those in the space of sufficient oxygen for normal breathing.[25]

Care must be taken for both flammable and non-flammable refrigerants regarding the RCL and ODL. For instance, Standard 15 seeks to limit the amount of refrigerant available to leak into a space.[26] The RCL and ODL informs the calculation of maximum allowable refrigerant charge for a space.

How Easily do A2L Refrigerants Ignite?

In order for an A2L refrigerant to ignite, two failure conditions must be satisfied[27]:

1. A refrigerant leak must be significant enough for the amount of A2L present to reach the lower flammability limit;
2. An ignition source must also be present with enough energy to ignite the refrigerant.

Lower Flammability Limit (LFL): The lowest concentration of a vapor or gas that will burn when introduced to an ignition source.

Autoignition Temperature (AIT): The lowest temperature at which a vapor or gas spontaneously ignites (without another ignition source).

Tests on ignition sources have also confirmed that potential ignition sources such as toasters, hot plates, and sparks from receptacles (while having peak temperatures above the AIT) did not ignite the leaked refrigerant[28].

A2L Ignition Facts:[29]

- **A2L have a Lower Flammability Limit** (above 3.5% by volume)
- **A2L have lower Heat of Combustion (HOC)** (less than 19000 kJ/kg)
- In practice, igniting A2L refrigerants requires much more energy – 1,000 times more than most easily flammable (A3) refrigerants.[30]

Are Chemical By-Products of A2L Burning Worse than A1 Refrigerants?

While hydrofluoric acid is produced by combustion of all fluorocarbon refrigerants, A2L refrigerants without chlorine do not produce hydrochloric acid when they burn.[31]

Can We Prepare Technicians to Sork Safely on Equipment Using A2Ls?

Training is already available from professional organizations in A2L handling (such as from ACCA, Air Conditioning Contractors of America[32]), and equipment manufacturers report they have developed training, including certifications specific to A2L.[33]

Skilled tradesmen already work with highly flammable substances, such as propane and natural gas, used in multiple types of equipment from boilers to water heaters, and in home appliances like gas stoves.

A2Ls already see widespread use in Australia. A report on the R-22 phaseout noted that R-134a and R-410a (an A1 refrigerant) comprised 81%[34] of refrigerant use in Australia, but a 2021 report notes that transition to HFC-32 (an A2L refrigerant) was well underway in small split systems (more than 30% of new equipment), and in larger equipment and chillers.[35]

Will Working With A2Ls Require New Equipment?

Equipment and tools should be certified for use with A2L refrigerants.

Spark-proof tools? Non-sparking may not be required, as testing with A2L refrigerants found no ignition from friction sparks or cordless drill tests.[36]

Refrigerant cylinders and refrigerant tanks? Since A2Ls are flammable, cylinders should have a red band on top. Disposable cylinders for A2Ls will have pressure relief valves instead of rupture discs.[37]

Evacuation and refrigerant recovery? While the process is similar, additional safety precautions should be taken, and vacuum pumps and recovery machines should also be compatible with A2Ls.[38]

Refrigerant oils? In general, synthetic oils are recommended for use with A2L refrigerants, such as the polyolesteroil[39] used with R-410A systems.[40]

New labeling? While similar to systems that use A1, labels will need to indicate a flammable refrigerant.[41]

Can A2L Refrigerants Be Used to Retrofit R-410A or R-22 Units?

No. In fact, it should be clear that A2L refrigerants should only be used in systems specifically designed to use refrigerants of their type and characteristics[42], and that all appropriate equipment manufacturer guidelines for refrigerant use in equipment, as well as applicable standards and regulations, should be followed.

Are Code Changes and Standards for Testing and Listing A2L Already in Place?

Fourteen code change proposals to the International Building Code, International Fire Code, and International Mechanical Code changes regarding A2Ls were approved,[43] and UL/CSA 60335-2-40 (3rd edition) includes requirements for the safe use of A2Ls[44] and was published and ANSI approved in 2019.[45] The standard is based on IEC 60335-2-40; however, the UL version has adopted more conservative safety requirements.

Will R-410A Still Be Available in California or Will Systems Have to Switch?

While new installations will not be able to use R-410A, the proposed limits are different for existing facilities.[46]

Will New Equipment Have New Features Specific to A2Ls?

In keeping with ASHRAE 15, the Safety Standard for Refrigeration Systems, and UL 60335-2-40, new units will have mitigation methods for preventing leaks and ignition of any leaked material, which may include leak detection systems.[47] As professional groups develop new best practices, and original equipment manufacturers continue to implement safety features on equipment, it's important to seek out training on equipment to ensure proper installation, service, and operation.

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