



MIKE CAUSEY-Insurance Commissioner, Brian Taylor-State Fire Marshal

1429 Rock Quarry Rd, Raleigh, NC 27610 (Street Address)

1202 Mail Service Center, Raleigh, NC 27699-1202 (Mailing Address)

(919) 647-0000

<https://www.ncosfm.gov/>

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Introduction

Welcome to the June 2024 A2L Edition of the OSFM Engineering Newsletter. Due to the length of the topic, this article is published as its own newsletter, which will enable readers to search and find it easier, and also allow the Engineering Department to update it as conditions warrant.

Please note the information in this newsletter is not code language, or formal interpretations of code language, but a summary of the various federal regulations affecting the refrigerants, a summary of common questions received on this topic, and suggested guidelines for evaluating which code path to take to accommodate the newer refrigerants.

Current Topics

A2L Refrigerants-Overview

The following article was researched and written by the Chief Mechanical Code Consultant, Kate Whalen, in preparation for the industry adoption of A2L refrigerants.

Overview of Upcoming Refrigerant Changes

There is an ongoing refrigerant transition in the HVACR industry. New regulations from the EPA are restricting the production and use of hydrofluorocarbons (HFC), which includes some common refrigerants such as R-410A. As the production of this generation of refrigerants is wound down, the industry is beginning the production of systems which use the next generation of refrigerants. Codes and standards have been or are in the process of being updated to address the installation requirements for this next generation of refrigerants, as many of them are in a higher flammability category (A2L) than the current generation (A1). Many questions have come up as people have begun to plan for this transition, and new information and clarifications are being released on a regular basis from various regulatory bodies: as more information becomes available, it will be shared and guidance will be updated accordingly. A complicating factor has been that some projects which have been permitted under the 2018 code and planned on having access to appliances using A1 refrigerant are now having to pivot to use appliances using A2L refrigerant due to appliance availability. Another complicating factor is that some EPA restrictions are going into effect on January 1st, 2025, which is the same date that the 2024 NC Building Codes will be effective, which has led to some confusion over what changes are coming from the code and what changes are coming from the EPA.

Brief Overview of Refrigerant Classifications and Flammability Properties:

ASHRAE 34 designates the safety classification of refrigerant based on toxicity and flammability. Refrigerants are assigned a toxicity classification of A or B. The flammability classification is based on the flammability properties of the refrigerant and are assigned to one of four classes: 1, 2, 2L or 3. Please refer to the chart below for further information and examples of refrigerants as classified by ASHRAE 34-2022. Please refer to ASHRAE 34 for the full descriptions and technical details of refrigerant classifications.

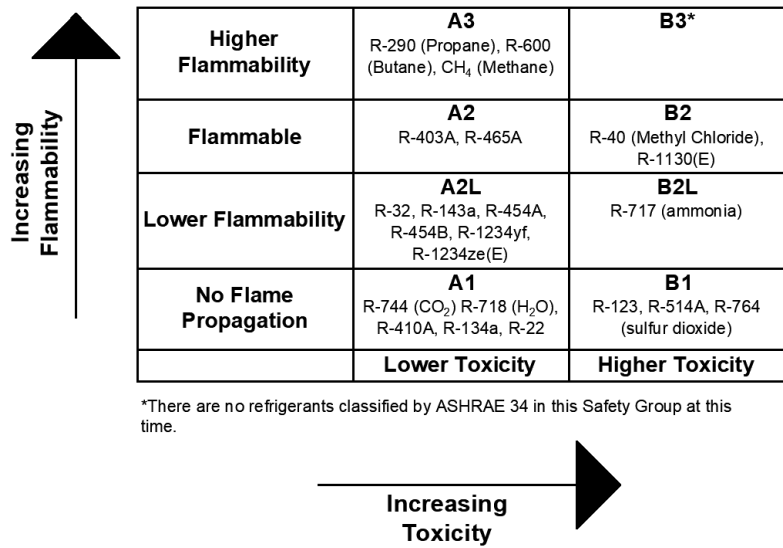


Figure 1: ASHRAE 34 Refrigerant Classifications and Examples

What does “increasing flammability” mean? Without getting too much into the details, it means that as we go up the scale, the lower flammability limit (LFL) of the refrigerant is lower and the heat of combustion is higher. The LFL, per ASHRAE 34 – 2022, is “the minimum concentration that is capable of propagating a flame through a homogeneous mixture of the substance and air under specified test conditions.” A smaller lower flammability limit value means it takes less of the substance, in this case refrigerant, mixed with air, to ignite. The heat of combustion is the heat released when the substance is combusted: a substance with a higher heat of combustion will release more heat when it is combusted. Note that Category 2L and Category 2 share the same flammability properties except that Category 2L has a slower burning velocity than Category 2. The burning velocity, as defined by ASHRAE 34 -2022, is “the maximum velocity at which a laminar flame propagates in a normal direction relative to the unburned gas ahead of it.” A substance with a smaller lower burning velocity value means that the flames will not propagate as quickly. Note that the “No Flame Propagation” classification is not necessarily “non-flammable”: per ASHRAE 34, it means that the refrigerant does not exhibit flame propagation at the test conditions of 140°F and 14.7 psia. Refrigerants classified as A1 may be flammable outside of the test conditions.

Please see the end of this paper for further discussion about the research that has been done to prepare for this transition, flammability property comparisons between A1 and A2L refrigerants, and safety considerations.

What are the EPA regulations driving this refrigerant transition and where can I find more information about them?

The EPA, per a directive in the AIM Act, is acting to phase down production and consumption of hydrofluorocarbons (HFCs), in part through the “Phasedown of Hydrofluorocarbons: Establishing the Allowance Allocation and Trading Program Under the American Innovation and Manufacturing Act” and Federal Regulation 40 CFR Part 84, the “Phasedown of Hydrofluorocarbons: Restrictions on the Use of Certain Hydrofluorocarbons Under the American Innovation and Manufacturing Act of 2020.” Many commonly-used refrigerants, such as R-134a and R410a, are hydrofluorocarbons, and as such appliances that utilize them are affected by this regulation.

The “...Allowance Allocation and Trading Program...” Act is indirectly influencing the transition of refrigerants in the HVACR sector. As part of those regulations, the EPA is restricting the manufacture of hydrofluorocarbons: production of hydrofluorocarbons is not being fully discontinued, but it will be reduced significantly over the next 12 years. As shown in

the chart below, in 2022 production of HFCs was reduced to 90% compared to the baseline production levels in 2011-2013: as of 2024, the production was decreased to 60% of those baseline values. In 2029, there will be another reduction, and by 2036, barring any additional legislation, the production of HFCs will be at 15% of the 2011-2013 baseline levels.ⁱ Please note that the HVACR industry is not the only industry which uses HFC compounds, so there will be competition both within the HVACR market and without for this reduced amount. While HFCs will still be able to be produced, and there are additional factors which effect the amount of HFCs available, such as utilizing reclaimed refrigerant, the takeaway is that overall there will be less HFC refrigerants available for both new installations and repairs of HVACR appliances.

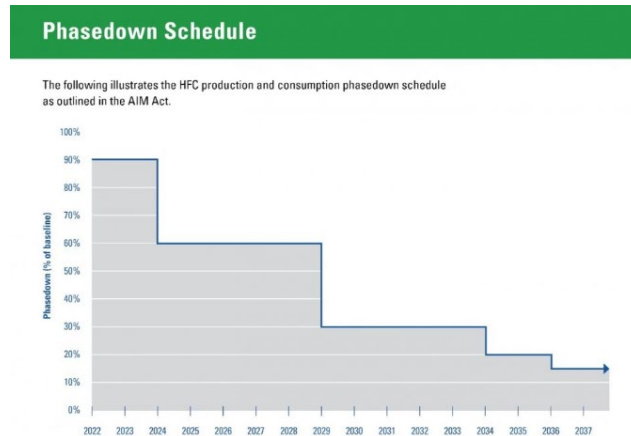


Figure 2: Illustration of the HFC Production and Consumption Phasedown Schedule as Outlined in the AIM Act

Source: <https://www.epa.gov/climate-hfcs-reduction/final-rule-phasedown-hydrofluorocarbons-establishing-allowance-allocation>

The “... Restrictions on the Use of Certain Hydrofluorocarbons...” Act (40 CFR Part 84, Subpart B), signed October 2023 and amended December 2023, is directly affecting the HVACR sector, as it prohibits the manufacture and installation of certain HVACR appliances by specified dates based on various factors, including the type of system, the application it is serving, and the Global Warming Potential (GWP) of the refrigerant. Please refer to the EPA’s “Technology Transitions Program” webpage at the link below for further information on these restrictions, including effective dates, searchable tables, frequently asked questions, and useful factsheets.

EPA “Technology Transitions Program”:

<https://www.epa.gov/climate-hfcs-reduction/technology-transitions-program>

What are NC CEO responsibilities with regards to these federal regulations?

Predominantly, the adherence to the federal regulations lies with the license holder. As such, NC CEOs will not have the primary responsibility of enforcing these EPA restrictions. Section 101.5 of the 2018 NCMC, provided below for reference, addresses that NC Building Codes do not include all requirements for buildings and structures that may be imposed by other agencies, and identifies the responsible parties for identifying any additional requirements. An excerpt from the “... Restrictions on the Use of Certain Hydrofluorocarbons...” Act (40 CFR Part 84, Subpart B), which address the parties responsible for compliance with these regulations, is also provided below for reference.

Excerpt of 40 CFR Part 84, Subpart B § 84.54 (c) is reprinted below:

(c) No person may install any system, nor have any such system be installed through their position as a designer, owner, or operator of that system, in the following sectors or subsectors that uses a regulated substance as listed in this paragraph (c):

End of 40 CFR Part 84, Subpart B § 84.54 (c) Reprint

Source: <https://www.ecfr.gov/current/title-40/chapter-I/subchapter-C/part-84/subpart-B>

2018 NCMC Section 101.5 is reprinted below:

101.5 Requirements of other State agencies, occupational licensing boards or commissions. The *North Carolina State Building Codes* do not include all additional requirements for buildings and structures that may be imposed by other State agencies, occupational licensing boards and commissions. It shall be the responsibility of a permit holder, registered design professional, contractor or occupational license holder to determine whether any additional requirements exist.

End of 2018 NCMC Section 101.5 Reprint

Source: 2018 North Carolina Mechanical Code, <https://codes.iccsafe.org/content/NCMC2018>

What are the manufacturing and installation effective dates for affected HVACR appliances and equipment?

Please refer to the EPA's "Technology Transitions Program" webpage at the link below for further information on these restrictions, including searchable reference tables for the effective dates, links to the rules, frequently asked questions, and useful factsheets. As the effective dates are part of this federal regulation, the effective dates are not based on the edition of the North Carolina Building Code, the project permit date or the inspection date: they are effective on the date that is listed in the associated rule. Note that the terminology defined in the regulations are specific and applicable to the regulation, and do not necessarily match with definitions in the North Carolina Mechanical Code. It is important to understand how the terms are defined in the regulation in order to understand what the effective dates are applicable to. Effective dates vary for different types of products and systems, and in some cases are dependent on what type of application the product or system is serving.

EPA "Technology Transitions Program":

<https://www.epa.gov/climate-hfcs-reduction/technology-transitions-program>

FACT SHEET Final Rule - Phasedown of Hydrofluorocarbons: Restrictions on the Use of Certain Hydrofluorocarbons under Subsection (i) of the American Innovation and Manufacturing Act of 2020:

<https://www.epa.gov/system/files/documents/2023-10/technology-transitions-final-rule-fact-sheet-2023.pdf>

- The link above will go to a pdf document titled "FACT SHEET Final Rule - Phasedown of Hydrofluorocarbons: Restrictions on the Use of Certain Hydrofluorocarbons under Subsection (i) of the American Innovation and Manufacturing Act of 2020", which includes reference tables for the effective dates. The fact sheet also contains a summary and explanation of different parts of the regulation, including addressing maintenance of legacy systems and discussing the intent behind certain sections of these rules. This factsheet can be found at the Technology Transitions Program's main page and a link is provided here for reference only. Note that this document states that the tables are for informational purposes only and should not be relied on for compliance purposes: 40 CFR Part 84, Subpart B should be referenced for full details.

How do these regulations affect existing appliances? Can they still be used and repaired?

Repairs to existing systems will still be allowed, and components for repairing existing systems, which includes condenser units, may still be manufactured and installed.ⁱⁱ Per the EPA, it is not the intent of this rule to shorten the useful life of existing products or systems installed before the compliance dates.ⁱⁱⁱ Subsection (e) of 40 CFR Part 84, Subpart B § 84.54 defines when work is considered to be a new “installation” and as such subject to the relevant HFC use restrictions. As the production of high GWP HFCs will be restricted, there is also the potential that replacement components will be difficult to acquire. The EPA is requiring components intended for repairing systems to be labeled “For servicing existing equipment only,” as seen in the below excerpt. The EPA also provides additional guidance about repairs versus new installations on their “Frequent Questions” page for the phasedown of hydrofluorocarbons: a link to that page is provided below.

40 CFR Part 84, Subpart B § 84.58 (b) is reprinted below:

(b) Effective upon the date listed for each subsector in [§ 84.54\(c\)](#), or the earliest date should the specified component be used in multiple subsectors, any specified component manufactured or imported and intended for use in those subsectors that uses or is intended to use any regulated substance, or blend containing any regulated substance, regardless of global warming potential, must have a permanent label compliant with [paragraph \(c\)](#) of this section containing the information in [paragraph \(a\)\(1\)](#) of this section. For specified components that are intended for use with a regulated substance or blends containing a regulated substance that exceed the applicable GWP limit or HFC restriction, the label must state “For servicing existing equipment only” in addition to the other required labeling elements.

End of 40 CFR Part 84, Subpart B § 84.58 (b) Reprint

Source: <https://www.ecfr.gov/current/title-40/chapter-I/subchapter-C/part-84/subpart-B>

EPA “Frequent Questions on the Phasedown of Hydrofluorocarbons”:

<https://www.epa.gov/climate-hfcs-reduction/frequent-questions-phasedown-hydrofluorocarbons>

Can A2L refrigerant be utilized in existing A1 refrigeration systems?

No, per the EPA’s Significant New Alternatives Policy (SNAP) Program^{iv} and per the listing requirements for systems which utilize flammable refrigerants. Flammable refrigerants are prohibited in systems which were not designed to use them.

How does the 2024 NC Mechanical Code address A2L refrigerants?

The 2024 NCMC updated many Chapter 11 provisions which deal with A2L refrigerants. It used the 2021 IMC as the model code, but has been amended to include several 2024 IMC provisions, including updating the reference standard ASHRAE 15 to the 2022 edition. While there were many changes to Chapter 11 from the 2018 NCMC to the 2024 NCMC, the one that has been the subject of the most discussion has been the requirements regarding ventilated shafts: these requirements will be the focus of this section.

In short: per the 2024 NCMC, A2L refrigerant piping that penetrates two or more floor/ceiling assemblies shall be enclosed in a ventilated fire-resistance-rated shaft enclosure.

2024 NCMC Section 1109.2.5 is reprinted below:

1109.2.5 Refrigerant pipe shafts. Refrigerant piping that penetrates two or more floor/ceiling assemblies shall be enclosed in a fire-resistance-rated shaft enclosure. The fire-resistance-rated shaft enclosure shall comply with Section 713 of the *International Building Code*.

Exceptions:

1. Systems using R-718 refrigerant (water).
2. Piping in a direct system using Group A1 refrigerant where the refrigerant quantity does not exceed the limits of Table 1103.1 for the smallest occupied space through which the piping passes.

End of 2024 NCMC Section 1109.2.5 Reprint

Source: 2024 North Carolina Mechanical Code

2024 NCMC Section 1109.3.2 is reprinted below:

1109.3.2 Shaft ventilation. Refrigerant pipe shafts with systems using Group A2L or B2L refrigerant shall be naturally or mechanically ventilated. The shaft ventilation exhaust outlet shall comply with Section 501.3.1. Naturally ventilated shafts shall have a pipe, duct or conduit not less than 4 inches (102 mm) in diameter that connects to the lowest point of the shaft and extends to the outdoors. The pipe, duct or conduit shall be level or pitched downward to the outdoors. Mechanically ventilated shafts shall have a minimum airflow velocity in accordance with Table 1109.3.2. The mechanical ventilation shall be continuously operated or activated by a refrigerant detector. Systems utilizing a refrigerant detector shall activate the mechanical ventilation at a maximum refrigerant concentration of 25 percent of the lower flammable limit of the refrigerant. The detector, or a sampling tube that draws air to the detector, shall be located in an area where refrigerant from a leak will concentrate. The shaft shall not be required to be ventilated for double-wall refrigerant pipe where the

End of 2024 NCMC Section 1109.2.5 Reprint

Source: 2024 North Carolina Mechanical Code

Question: Does the 2024 NCMC require fire-resistance-rated-shaft enclosures in all circumstances?

Answer: No. Note that piping located on the exterior of the building where vented to the outdoors is not required to be enclosed in a fire-resistance-rated shaft enclosure, although it is still required to be protected from physical hazards as well as environmental conditions. Exception 1 provides an exception for systems which utilize water as the refrigerant and Exception 2 provides an exception for A1 refrigeration systems. There is also the option to utilize other types of systems, such as water source heat pumps, which would not involve refrigerant pipe penetrating multiple floor/ceiling assemblies.

Please note that not all A1 refrigerants have been restricted, though manufacturers of residential and light commercial systems have shifted towards utilizing A2L refrigerants. This is due in part to the fact that the pressure and temperature properties of the alternative A2L refrigerants are closer to the high GWP refrigerants which are being restricted when compared to alternative low GWP A1 refrigerants.

Question: ASHRAE 15-2022 does not restrict Section 1109.2.5 Exception 2 to only A1 refrigerants, but extends the exception to any refrigerant classification so long as the refrigerant quantity does not exceed the allowable limits: since ASHRAE 15-2022 is referenced in Chapter 11, can A2L piping be exempted from the shaft requirement?

Answer: No, per the prescriptive code provisions, only refrigerant piping containing A1 refrigerants utilize the exception. It should be noted that ASHRAE 15 has its own calculation methodology for determining the allowable charge, which the NCMC does not utilize in its entirety. That calculation method includes mitigation strategies in some cases, and the presence or absence of those strategies affects the allowable charge. The code and the reference standard both address

protection for installation of these flammable refrigerants in spaces where they were previously prohibited, but those protective provisions differ. It should also be noted that it is not uncommon for the code and referenced standards to not align on every point, and both the 2018 and 2024 NCMC Sections 102.8.1 and 102.8.2 address precedence when a conflict occurs.

2024 NCMC Section 102.8.1 is reprinted below:

[A] 102.8.1 Conflicts. Where conflicts occur between provisions of this code and the referenced standards, the provisions of this code shall apply.

End of 2024 NCMC Section 102.8.1 Reprint

Source: 2024 North Carolina Mechanical Code

2024 NCMC Section 102.8.2 is reprinted below:

[A] 102.8.2 Provisions in referenced codes and standards. Where the extent of the reference to a referenced code or standard includes subject matter that is within the scope of this code, the provisions of this code, as applicable, shall take precedence over the provisions in the referenced code or standard.

End of 2024 NCMC Section 102.8.2 Reprint

Source: 2024 North Carolina Mechanical Code

Question: Can ASHRAE 15-2022 be utilized as an alternative method per the 2024 NCMC?

Answer: Not by itself. Per Section 103.2 of the 2024 NCMC, the proposed design shall satisfactorily comply with the intent of the provisions of the code and for the purposes intended, the proposed design shall be not less than the equivalent of that prescribed in the code in quality, strength, effectiveness, fire resistance, durability and safety. The prescriptive code provision calls for A2L refrigerant piping to be in a ventilated fire-resistance-rated shaft under the specified conditions: any alternative method would need to address the protection of the pipe in terms of both the fire resistance and the ventilation.

2024 NCMC Section 103.2 is reprinted below:

[A] 103.2 Alternative materials, design and methods of construction and equipment. The provisions of this code are not intended to prevent the installation of any material or to prohibit any design or method of construction not specifically prescribed by this code, provided that any such alternative has been *approved*. An alternative material, design or method of construction shall be *approved* where the code official finds that the proposed design satisfactorily complies with the intent of the provisions of this code, and that the material, method or work offered is, for the purpose intended, not less than the equivalent of that prescribed in this code in quality, strength, effectiveness, fire resistance, durability and safety. Where the alternative material, design or method of construction is not *approved*, the *code official* shall respond in writing, stating the reasons why the alternative was not *approved*.

End of 2024 NCMC Section 103.2 Reprint

Source: 2024 North Carolina Mechanical Code

Question: Does rigid piping installed inside a wall or other enclosure meet the shaft requirement?

Answer: No, as the provisions of 1109.2.5 specify a fire-resistance-rated shaft, and it is required for any piping material.

Question: What are the ventilation outlet clearance requirements in Section 1109.3.2 of the 2024 NCMC?

Answer: Mechanically ventilated shaft exhaust outlet clearances shall be in accordance with NCMC Section 501.3.1 (1). Naturally ventilated outlets shall meet the clearance requirements from air intake openings as specified by Section 401.4 for hazardous or noxious contaminant sources. Section 401.4 was written with the expectation that the contaminant sources would be disperse upwards and outwards, but note that most refrigerants are heavier than air, and as such will disperse downwards. Section 401.4 (3) therefore would not be applicable to exhaust potentially carrying refrigerant.

Question: What are the requirements for installing A2L refrigerant systems in existing buildings under the 2024 NCMC?

Answer: As a newly-installed system, it must be installed in accordance with the code that is currently in effect.

Where can I find the 2024 NCMC?

The Rules Review Commission approved the 2024 NCMC and Chapter 11 amendments in April 2024. There were small changes to the 2024 NCMC language per RRC request but the language in Chapter 11 was not altered.

Chapter 11 of the 2024 NCMC without the amendments can be viewed at the link below as Item B-1:

<https://www.ncosfm.gov/news/events/building-code-council-meeting-june-13-2023>

Approved Amendments to Chapter 11 of the 2024 NCMC can be viewed at the link below as Item B-5:

<https://www.ncosfm.gov/news/events/building-code-council-meeting-december-12-2023>

What are the installation requirements for HVACR appliances utilizing A2L refrigerants while the 2018 NCMC is still in effect?

The 2018 NCMC treats A2L refrigerants as a subset of A2, so the prescriptive A2 provisions can be followed for refrigerants that are classified on Table 1103.1 and appliances which meet the standards listed in Chapter 11. The manufacturer's instructions are required to be followed. For systems which utilize refrigerants that are not listed on Table 1103.1 in the 2018 NCMC, the latest edition of ASHRAE Standard 34 can be used to classify the refrigerant in accordance with Section 1103.1 and Section 105.2. A link to ASHRAE's standards and guidelines page is below: the latest edition of ASHRAE Standard 34 can be viewed at no cost.

ASHRAE Standards and Guidelines:

<https://www.ashrae.org/technical-resources/standards-and-guidelines>

However, some new systems will likely require A2L refrigerant charges in excess of the limits in the 2018 NCMC prescriptive code provisions. In that case, Section 105.2 in the 2018 NCMC can be utilized for alternative means and methods. The 2024 NCMC, 2024 IMC or the ASHRAE 15-2022 standard are potential options to use as an alternative method for direct comfort-cooling systems which contain A2L refrigerant which otherwise would be prohibited from installation under the prescriptive provisions of the 2018 NCMC. Please see the associated guidance paper, "Installation of A2L Refrigeration Systems under the 2018 North Carolina Mechanical Code," for further information.

Where can I find ASHRAE 15-2022, the 2024 IMC and the 2024 NCMC?

ASHRAE 15-2022 can be viewed at ASHRAE's standards and guidelines webpage for no cost: the link is below.

<https://www.ashrae.org/technical-resources/standards-and-guidelines>

The 2024 IMC can be viewed for no cost at the link below.

<https://codes.iccsafe.org/content/IMC2024V1.0>

The 2024 NCMC can be viewed for no cost at a link designated at the end of the newsletter.

Why can ASHRAE 15-2022 be utilized as an alternative method under the 2018 NCMC but not the 2024 NCMC?

As discussed above, new federal regulations will be affecting the availability of many A1 refrigeration systems, and there is a need to accommodate the installation of systems containing A2L refrigerant under the 2018 NCMC. The 2018 NCMC addresses the additional flammability characteristics of A2L refrigerants primarily by restricting their usage outside of machinery rooms or in nonindustrial occupancies. As there are projects permitted under the 2018 NCMC which may be required to use A2L refrigerant due to the lack of availability of certain A1 refrigerants, alternative methods must be utilized to accommodate projects during this transition period. While ASHRAE 15 is not perfectly aligned with the NCMC language, it is a respected standard that the NCMC references heavily in terms of the requirements contained in Chapter 11. The updated ASHRAE 15-2022 standards include provisions which allow much greater use of A2L refrigerants: so long as the refrigeration system is installed in accordance with the provisions of that standard, in accordance with the conditions of the listing and in accordance with the manufacturer's instructions, the intent of the 2018 NCMC has been met. The 2024 NCMC, in comparison, does include prescriptive provisions for A2L systems to be installed, and as such those provisions are required to be followed unless an alternative method is requested and approved: please see "Question: Can ASHRAE 15-2022 be utilized as an alternative method per the 2024 NCMC?" above for further discussion on this.

What are the installation requirements for HVACR appliances utilizing A2L refrigerants under the 2018 and 2024 NCRC?

The 2024 NCRC mechanical and fuel gas provisions were frozen by legislative action and no changes can currently be made to those sections: as such, the 2024 NCRC mechanical and fuel gas code provisions are identical to the 2018 NCRC provisions. As discussed above, this refrigerant transition is happening independently of the NC code, so the type of appliances and refrigerant available will change regardless of whether those code provisions are updated. The 2018 and 2024 NCRC require that appliances be installed in accordance with the manufacturer's instructions and in accordance with their listings. The listing requires that the manufacturer's instructions provide directions on where systems containing flammable refrigerants can be installed, including room volume requirements. The manufacturer may also require detection systems to be installed based on the refrigerant charge size. The listing also requires the manufacturer to include certain warning labels on the appliances. This is not an all-inclusive list of what the manufacturer or listing may require. The NCRC does not currently include specific language for flammable refrigerants, but again, to emphasize, appliances must be installed in accordance with the manufacturer's instructions and in accordance with their listings under both the 2018 and 2024 codes, and the instructions and listing both address the requirements for the installation and use of these types of systems.

It seems like there have been a lot of changes to the code requirements for systems containing refrigerant: has anything remained the same?

Actually, the basics of determining allowable system charge and installation requirements has not changed at all: the system type, occupancy, and refrigerant classification will all be determined using the NCMC as before. There will be some additional requirements for certain types of systems, including those discussed above, but that basic process for determining the applicable requirements has remained the same.

Does the 2024 NCMC or EPA’s “Technology Transitions Program” prohibit A1 refrigerant installation? Does the 2024 NCMC or EPA’s “Technology Transitions Program” require A2L refrigerant to be used? Will all A1 refrigerants will be prohibited going forward or will any A2L refrigerant be permissible? Why can’t we just use different A1 refrigerants that have lower GWP? Why are A2L refrigerants being utilized at all?

Not all A1 refrigerants have been prohibited from use in new installation, and A2L refrigerants are not required to be used.

Note that the restrictions of the EPA’s Technology Transition Program are not set by refrigerant safety classifications. Please also note that EPA’s Significant New Alternatives Policy (SNAP) program additionally restricts what types of refrigerant can be used. The NCMC restricts refrigeration system installation in part by the refrigerant safety classification but it does not prohibit A1 or A2L refrigeration system installation so long as the applicable code requirements are followed. Part of the EPA’s “Technology Transitions Program” restricts refrigerants based on their GWP values, and there are A1 refrigerants which meet the EPA GWP requirements. There are also A2L refrigerants which would not meet those requirements and would be prohibited per those regulations. However, the transition to A2L refrigerants is the HVACR industry adapting to these new restrictions. Due to physical and chemical properties, such as pressure and/or temperature characteristics, available A1 refrigerants may not be best suited for all applications or best suited to meet system efficiency requirements. For instance, in residential and light commercial systems, A2L refrigerants were a more direct replacement for the high GWP A1 refrigerants than other A1 refrigerants in terms of those factors.

Are A2L refrigerants safe?

This question has been the topic of more than ten years of research and planning. Due to the flammability properties of A2L refrigerants, previous codes and standards greatly restricted their use. In order to utilize these refrigerants more widely, the risks of these refrigerants had to be identified and strategies to mitigate those risks had to be developed. During this period of time, flammability properties were determined, ignition sources were studied, and risk mitigation measures were established. This research involved stakeholders across the HVACR industry, including the EPA, AHRI, ASHRAE, ICC, UL, and appliance manufacturers: codes and standards were updated were based on that work and they will continue to be updated as more ongoing research is completed.

HVACR appliances utilizing A2L have been installed across the world, including Europe, Japan, and Australia, and research was done to study the safety provisions other countries have put in place for A2L installations and build upon them based off of their experience. Additionally, over 80% of new vehicles sold in the US utilize A2L refrigerants, and their use in that application was studied as well.^v

In order for A2L to ignite in an HVACR application, three things would need to happen: there would need to be a leak in the system, the leak would need to be large enough and contained enough that the LFL concentration was reached, and there would have to be a high enough energy ignition source to ignite the A2L. A static spark or toaster, for instance, would not ignite an A2L refrigerant: an open flame could.^{vi} The updated standards restrict the allowable charge size and add requirements for mitigation measures, such as ventilation or automatic shut-off valves, as necessary in order to prevent the LFL from being reached in the event of a leak. In the event of an externally fueled fire, a 15-pound A2L system charge would add approximately 66,000 BTU to the fire, as compared to 42,000 BTU which would be added from a 15-pound R-410A system. This is an additional fuel load of about 24,000 BTU added to the fire in comparison to that A1 refrigerant system, which is approximately an additional 3.4 lbs of dry wood.^{vii}

It is important to remember is that while A2L refrigerants are classified as low flammability, they are still a higher flammability classification than A1 and can propagate flame under certain conditions that A1 refrigerants would not: however, A2L refrigerants can be safely used when installed in accordance with the manufacturer's instructions, in accordance with their listing, and in accordance with the code.

Additional information:

AHRI and UL released a report showing A1 and A2L refrigerant reactions under building fire conditions, which may be of interest, although it is a technical research report: the link to that report is below. The report includes useful comparative examples to help understand the values of heat release rates and heat flux shown in the results. A link to an AHRI webinar which discusses the testing set-up, background, and the results is also included below. The report tested R-410A, an A1 refrigerant, against two A2L refrigerants, R-454B and R-32, in different ignition scenarios. As a note, the A2L refrigerant charges tested in this research are slightly lower than the A1 charge tested: the paper explains this is due to the A2L refrigerants requiring a lower charge than a comparable A1 system. For the most part, the A1 and A2L refrigerants had comparable results in terms of temperature increase, heat release rate, heat flux, and hydrogen fluoride gas generation. The most notable difference was in the testing scenario which represented the refrigerant charge from a 5-ton unit leaking into a below-ground space with minimal air movement. Please note that this scenario did not take into account any code required mitigation and the charge amount was 4 to 5 times greater than the standards would have allowed, as there was difficulty getting the A2L refrigerant to ignite. Under this test scenario, the A2L refrigerant propagated flame and the A1 refrigerant did not. The flame propagated slowly, and no deflagration was observed.

AHRI report No. 8028 A2L REFRIGERANTS AND FIREFIGHTER TACTICAL CONSIDERATIONS:

https://www.ahrinet.org/system/files/2023-08/AHRI-8028_Final_Report.pdf

AHRI Refrigerant Webinar Series | 9: A2L Refrigerants and Tactical Considerations for Firefighters:

<https://www.youtube.com/watch?v=En67XcAJRn0>

Links for further information:

EPA Main Page for HFC Reduction: <https://www.epa.gov/climate-hfcs-reduction>

- The EPA main website for HFC Reduction which contains links to the below sources as well as additional information.

FACT SHEET Final Rule - Phasedown of Hydrofluorocarbons: Restrictions on the Use of Certain Hydrofluorocarbons under Subsection (i) of the American Innovation and Manufacturing Act of 2020:

<https://www.epa.gov/system/files/documents/2023-10/technology-transitions-final-rule-fact-sheet-2023.pdf>

- The link above will go to a pdf document titled “FACT SHEET Final Rule - Phasedown of Hydrofluorocarbons: Restrictions on the Use of Certain Hydrofluorocarbons under Subsection (i) of the American Innovation and Manufacturing Act of 2020”, which includes the referenced tables. The fact sheet also contains a summary and explanation of different parts of the regulation, including addressing maintenance of legacy systems and discussing the intent behind certain sections of these rules.

EPA Frequently Asked Questions: <https://www.epa.gov/climate-hfcs-reduction/frequent-questions-phasedown-hydrofluorocarbons>

- The EPA FAQ site provides answers to many common questions which have come up around this topic, including questions about the differences between components, products, and systems and questions about what

constitutes a repair versus a new installation with regards to this new rule. They have also been updating it to address new questions as they occur.

Federal Register 40 CFR 80 Phasedown of Hydrofluorocarbons: Restrictions on the Use of Certain Hydrofluorocarbons Under the American Innovation and Manufacturing Act of 2020:
<https://www.federalregister.gov/documents/2023/10/24/2023-22529/phasedown-of-hydrofluorocarbons-restrictions-on-the-use-of-certain-hydrofluorocarbons-under-the>

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Federal Register Interim Rule 40 CFR 80 Phasedown of Hydrofluorocarbons: Technology Transitions Program Residential and Light Commercial Air Conditioning and Heat Pump Subsector :
<https://www.federalregister.gov/documents/2023/12/26/2023-28500/phasedown-of-hydrofluorocarbons-technology-transitions-program-residential-and-light-commercial-air>

- The links above are to the full rule and the interim rule. Please note that these documents, as well as any additional updates made to these documents, are the official regulatory documents and as such, supersede any additional supporting documents that the EPA has provided, such as the FAQ site and the charts from the final rule fact sheets, as discussed above.

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

ⁱⁱ <https://www.epa.gov/system/files/documents/2023-10/technology-transitions-final-rule-fact-sheet-2023.pdf>

ⁱⁱⁱ <https://www.federalregister.gov/documents/2023/10/24/2023-22529/phasedown-of-hydrofluorocarbons-restrictions-on-the-use-of-certain-hydrofluorocarbons-under-the>

^{iv} EPA Frequent Questions on the Phasedown of Hydrofluorocarbons: Technician Questions: <https://www.epa.gov/climate-hfcs-reduction/frequent-questions-phasedown-hydrofluorocarbons#technician>

^v AHRI Safe Refrigerant Transition: FAQs: https://www.ahrinet.org/system/files/2023-06/AHRI_SRTTF_Low_GWP_Refrigerants_FAQs_0.pdf

^{vi} AHRI Safe Refrigerant Transition: FAQs: https://www.ahrinet.org/system/files/2023-06/AHRI_SRTTF_Low_GWP_Refrigerants_FAQs_0.pdf

^{vii} AHRI Safe Refrigerant Transition: Chemical Physical and Environmental Properties of A2L Refrigerant: https://www.ahrinet.org/system/files/2023-06/Ch2-Chemical_Physical_and_Environmental_Properties_of_A2L_Refrigerants_0.pdf