



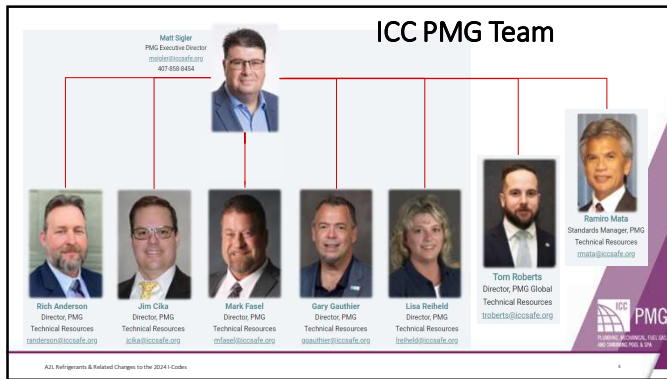
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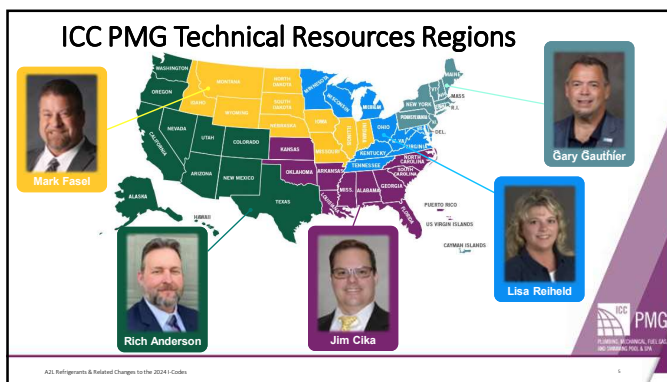
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ICC Evaluation Service (ICC-ES)

- International Code Council subsidiary
- Evaluates products using codes and standards for the built environment
- Accredited by:
 - American National Standard Institute (ANSI) to ISO/IEC 17065
 - Standards Council of Canada (SCC)
 - American Association for Laboratory Accreditation (A2LA)
 - EMA to conduct Plumbing Product listing to the Mexican NOMs
- Expert in developing and interpreting ICC-ES Acceptance Criteria (ACs) for innovative products





All References & Related Changes to the 2021 I-Codes

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Formatting changes to 2024 I-Codes

- 2024 I-Codes® have undergone substantial formatting changes as part of the digital transformation strategy of the International Code Council®(ICC®) to improve the user experience.
- Resulting product better aligns the print and PDF versions of the I-Codes with the ICC’s Digital Code content.
- Additional information can be found at iccsafe.org/design-updates.



All References & Related Changes to the 2024 I-Codes

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Formatting changes to 2024 I-Codes

Style Changes to the 2024 International Codes

Streamlined lists



Consistent grouping of associated content (e.g., tables immediately follow parent section)

Shading for table headers and notes

Single-column text

Modernized font styles

We've updated style changes to improve readability, reduce page count and book size, and support sustainability. These changes align with the Code Council's ongoing digital transformation.




All References & Related Changes to the 2024 I-Codes

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Replacement of Marginal Markings w/QR Codes

- Through 2021, print editions of the I-Codes identified technical changes from prior code cycles with marginal markings:
 - solid vertical lines for new text
 - arrows for deletion
 - asterisks for relocations
- 2024 I-Code print editions replace the marginal markings with QR codes to identify code changes more precisely.
- A QR code is placed at the beginning of any section that has undergone technical revision. If there is no QR code, there are no technical changes to that section.

Scan for Changes



52e3321

ICC, Refrigerants & Related Changes to the 2021 I-Codes10

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Replacement of Marginal Markings w QR Codes

- In the following example from the 2024 International Plumbing Code®(IPC®), a QR code indicates there are changes to Section 605 from the 2021 IPC.
- Note that the change may occur in the main section or in one or more subsections of the main section.


SECTION 605—MATERIALS, JOINTS AND CONNECTIONS

605.1 Soil and ground water. The installation of a water service or water distribution pipe shall be prohibited in soil and ground water contaminated with solvents, fuels, organic compounds or other detrimental materials causing permeation, corrosion, degradation or structural failure of the piping material. Where detrimental conditions are suspected, a chemical analysis of the soil and ground water conditions shall be required to ascertain the acceptability of the water service or water distribution piping material for the specific installation. Where detrimental conditions exist, approved alternative materials or routing shall be required.

605.2 Lead content of water supply pipe and fittings. Pipe and pipe fittings, including valves and faucets, utilized in the water supply system shall have not more than 8-percent lead content.

605.2.1 Lead content of drinking water pipe and fittings. Pipe, pipe fittings, joints, valves, faucets and fixture fittings utilized to supply water for drinking or cooking purposes shall comply with NSF 372 and shall have a weighted average lead content of 0.25 percent or less.

Scan for Changes




52e3321

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Replacement of Marginal Markings w QR Codes

- To see the code changes, scan the QR code with a smart device.
 - If scanning a QR code is not an option, changes can be accessed by entering the 7-digit code beneath the QR code at the end of the following URL: qr.iccsafe.org/ (in the above example, "qr.iccsafe.org/52e3321").
- All methods take the user to the appropriate section on ICC's Digital Codes website, where technical changes from the prior cycle can be viewed.
- Digital Codes Premium subscribers who are logged in will be automatically directed to the Premium view.
- All other users will be directed to the Digital Codes Basic free view.
- Both views show new code language in blue text along with deletion arrows for deleted text and relocation markers for relocated text.
- Digital Codes Premium offers additional ways to enhance code compliance research, including revision histories, commentary by code experts and an advanced search function. A full list of features can be found at codes.iccsafe.org/premium-features.



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Provide an overview of the HVAC industry transition from HFC refrigerants to A2L refrigerants within the built environment

Identify approved changes made to the 2021 IMC, IBC, and IFC related to A2L refrigerants


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BOSTON, MA 02118

A2L Refrigerants & Related Changes to the 2021 Codes 14

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Objectives

- Identify what is driving the industry transition to A2L refrigerants
- Discuss the timeline for the phasedown of HFCs and impacts on the transition to A2Ls
- Identify changes made to codes and standards related to A2Ls
- Identify ways to prepare for the transition to A2Ls



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Refrigerants – A Brief History

1835 – the early years of refrigeration began

- Utilized ammonia, methyl chloride, and sulfur dioxide refrigerants

1930s - 1990s – CFCs (i.e. R-12) and HCFCs (i.e., R-22)


- Colorless, odorless, nonflammable, noncorrosive and highly stable
- CFCs phased out; HCFCs being phased out!

1990s - 2030s – HFCs (i.e., R-32)

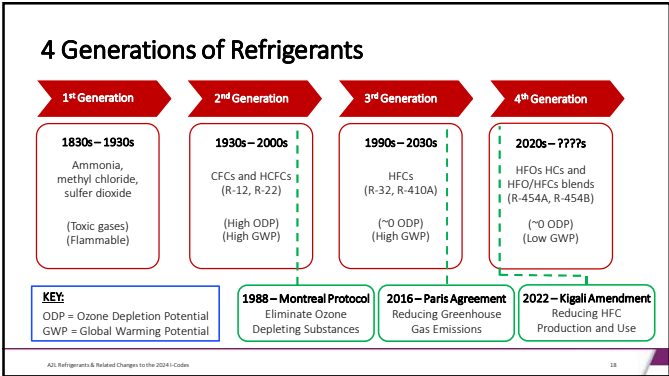
- Chlorine free refrigerants
- HFCs being phased down!

2020s - ?? – HFOs, HFO/HFC blends (i.e. R-454A), and HCs (i.e. R-290 - Propane)

- Stable and inert, nontoxic, non-flammable and flammable refrigerants
- Use of HFO/HFC blends is common and ramping up in the A/C industry




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HFC Phasedown – AIM Act of 2020



- The phasedown has already started!
- Reductions in the production and consumption of HFCs are based on 2011-2013 levels
 - 2022: 10%
 - 2024: 40%
 - 2029: 70%
 - 2034: 80%
 - 2036: 85%



A2L Refrigerants & Related Changes to the 2021 Codes19

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Alternatives to HFC Refrigerants

U.S. EPA - SNAP Rule 23

End-use	Alternatives	Terms of Use
Residential and light commercial A/C and heat pumps.	R-452B, R-454A, R-454B, R-454C and R-457A.	Acceptable Subject to Use Conditions. ^{a, b, c}
Residential and light commercial A/C and heat pumps, excluding self-contained room A/C units.	R-32	Acceptable Subject to Use Conditions. ^{a, b, c}
Residential and light commercial A/C and heat pumps - self-contained room A/C units.	R-32, R-290, R441A	Acceptable Subject to Use Conditions. ^{a, c, d}

Use Conditions:

- a. New equipment only, specifically designed and labeled for refrigerant.
- b. Equipment that meets all requirements in the 3rd edition of UL 60335-2-40.
- c. "Risk of Fire" warning labels, etc..
- d. Equipment that meets all requirements in the 8th edition of UL 484.



A2L Refrigerants & Related Changes to the 2021 Codes20

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Key Points – Transition to A2L Refrigerants

What is similar?


- Physical and chemical properties of A2L refrigerants are similar to A1s (CFC, HCFC, and HFC)
- Oxygen Deprivation is possible in tight and enclosed spaces
- Frostbite is possible due to quickly releasing any liquid refrigerant
- Personal protective equipment should be used by firefighters and technicians

What is different?

- HFCs & HFC Blends that are in A1 class DO NOT COMPLY with Lower GWP regulations
- HFCs & HFC Blends that are in A2L class COMPLY with Lower GWP regulations
- A1 refrigerants have no flame propagation
- A2L refrigerants have a low flame speed and low heat of combustion

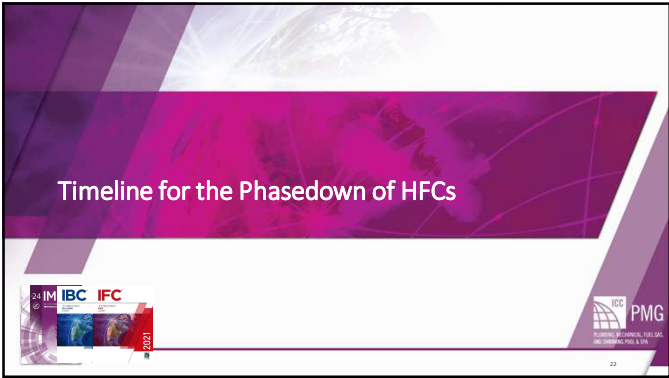
What do I need to know?

- A2L refrigerants are difficult to ignite, have slow flame speed, and low heat of combustion
- Many sections of the "currently adopted" building codes will remain the same.
- There will be some changes
 - New provisions in the IMC, IBC, and IFC
 - New standards - UL 60335 series
 - New installation guidance - ASHRAE 15

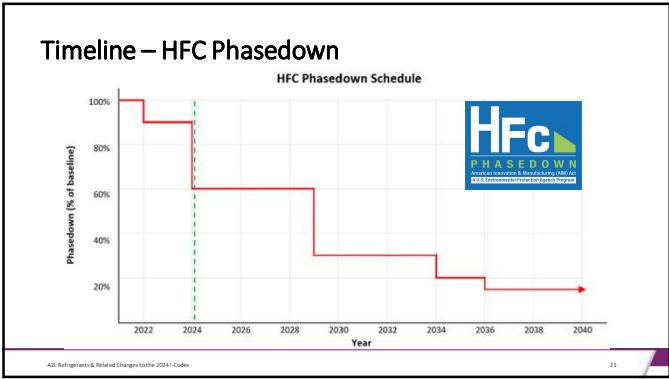


A2L Refrigerants & Related Changes to the 2021 Codes21

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Status of the Standards

- ASHRAE Standards
 - Standard 15-2022 released, Safety Standard for Refrigeration Systems
 - Standard 34-2022 released, Designation and Safety Classification of Refrigerants
- UL Standards
 - Standard 484-2014 with May 2019 revisions (latest), Room Air Conditioners
 - Standard 60335-2-40-2022, Household Heat Pumps and Air-Conditioners
 - Standard 60335-2-89-2022, Commercial Refrigerating Appliances
- All related standards have been updated to facilitate a smooth transition to A2Ls

UL 60335-2-40
Safety Standard for
Household Heat Pumps and
Air-Conditioners

PMG
PLUMBING & MECHANICAL, FALL 2016,
NEW ORLEANS, TEXAS & ILLINOIS

24

24

- 2021 Edition of I-Codes, and earlier editions
 - Prohibit use of A2L refrigerants for human comfort uses
 - A2L refrigerants treated as class A2 (flammable) refrigerants
 - Reference older standards that do not fully address A2L refrigerant concerns
- 2024 Editions of IMC, IBC, and IFB have been updated
 - Allow A2Ls for human comfort uses
 - A2L coverage is aligned with ASHRAE 15 and 34
 - Equipment needs to comply with UL 484, 60335-2-40, or 60335-2-89
 - Reference the latest standards eliminating potential conflicts
- Codes will need to change to facilitate a smooth transition to A2Ls



A21 Refrigerants & Related Charges to the 2024 I-Code

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A2L Refrigerants & Related Changes to the 2024 I-Codes

2

A BILL
FOR AN ACT ENTITLED

1 "An Act relating to refrigerants designated as acceptable for use under federal law."
2 BE IT ENACTED BY THE LEGISLATURE OF THE STATE OF ALASKA:
3 * Section 1. AS 18.95 is amended by adding a new section to read:
4 Sec. 18.95.02. Use of designated refrigerants. Notwithstanding a provision
5 of the state building code, a refrigerant designated as acceptable for use under 42
6 U.S.C. 7671k may be used in the state if the equipment containing the refrigerant is
7 listed and installed in accordance with the safety standards and use conditions imposed
8 under the regulation. In this section, "state building code" has the meaning given in
9 AS 18.56.300(c).




A21 Refrigerants & Related Changes to the 2024 I-Codes

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ASHRAE Standard 15 – 2022 Updates



- Refrigerant safety classifications align with ASHRAE Standard 34
 - A2L is now a separate class
- Adds references to standards UL 484, UL 60335-2-40, etc.
- Refrigerant detector/detection and mitigation actions added
- New piping requirements
- Overpressure requirement updated

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ASHRAE Standard 34 – 2022 Updates

ASHRAE 34-2022 Refrigerant Safety Group Classification

	Safety Group Classification		Class Description
Higher Flammability	A3	B3	Class 3 1. Exhibit flame propagation 2. LFL < 0.0062 lb/lb or HOC > 8,169 Btu/lb
Flammable	A2	B2	Class 2 1. Exhibit flame propagation 3. HOC < 8,169 Btu/lb 2. LFL > 0.0062 lb/lb
Lower Flammability	A2L	B2L	Class 2L 1. Exhibit flame propagation 3. HOC < 8,169 Btu/lb 2. LFL > 0.0062 lb/lb 4. BV < 3.9 m/s
No Flame Propagation	A1	B1	Class 1 1. Exhibit flame propagation

Lower Toxicity Higher Toxicity



Increasing Toxicity

Key:
BV = Burning velocity
LFL = Lower flammability limit
HOC = Heat of combustion

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Equipment Standard – 2022 Updates

- UL 60335-2-40**, Household A/C and Heat Pumps
 - Updated 2022 version released
 - Requirements for the use of A2L refrigerants added
 - Added criteria for the design and testing of equipment with A2L refrigerants
- UL 60335-2-89**, Commercial Refrigerating Appliances
 - Updated in 2021 – has all current A2L coverage
- UL 484**, Room air conditioners
 - Updated in 2019 – has all current A2L coverage



A2L Refrigerants & Related Changes to the 2014-1 Codes


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UL 60335-2-40 Labeling and Marking Requirements

Warning labels for A2L refrigerants

- A/C systems charged with an A2L refrigerant, require a warning symbol
 - Must be placed on the nameplate of the unit, near the location of the refrigerant type and charge information
 - The triangular shaped ISO 7010-W021 symbol required on equipment
- Packaging and storage containers, require a warning symbol
 - The diamond shaped symbol Globally Harmonized System of Classification and Labeling of Chemicals
- Addition warning labels are also required on the outside of equipment
 - Warning– Risk of Fire or Explosion.
 - Flammable Refrigerant Used.
 - To Be Repaired Only by Trained Service Personnel.
 - Do Not Puncture Refrigerant Tubing.



ISO 7010-W021 (2011-05)



A2L Refrigerants & Related Changes to the 2014-1 Codes

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Break



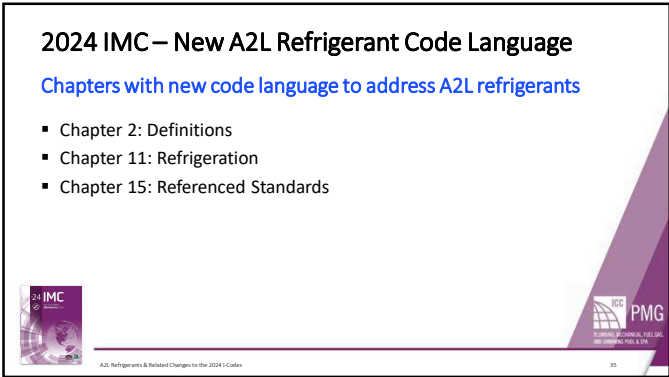
2021 IMC Significant Changes

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202 Definitions - Lower Flammability Limit (LFL)

Lower Flammability Limit (Refrigerant) (LFL). The minimum concentration of refrigerant ~~that is at which a flame is~~ capable of propagating a flame through a homogeneous mixture of refrigerant and air under specific test conditions in accordance with ASHRAE 34.



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202 Definitions – Refrigerant Safety Group Classification

Refrigerant Safety Group Classification. The ~~alphabetical/numerical~~ **alphanumeric** designation that indicates both the toxicity and flammability classifications of refrigerants in accordance with ASHRAE 34.

ASHRAE 34-2022 Refrigerant Safety Group Classification

	Safety Group Classification		Class Description
Increasing Flammability ↑	Higher Flammability	A3 B3	Class 3 1. Labeled flame propagation 2. LFL < 0.0001 (0.01%) 3. LFL < 0.100 (10%)
	Flammable	A2 B2	Class 2 1. Labeled flame propagation 2. LFL < 0.0001 (0.01%) 3. LFL < 0.100 (10%)
Lower Flammability ↓	A2L B2L	Class 2L 1. Labeled flame propagation 2. LFL < 0.0001 (0.01%) 3. LFL < 0.100 (10%)	
	No Flame Propagation	A1 B1	Class 1 1. Labeled flame propagation
	Lower Toxicity ←	Higher Toxicity →	

Key:
BV = Burning velocity
LFL = Lower Flammability limit
MOC = Limit of combustion



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202 Definitions – Refrigerant Safety Group Classification

Class 1. Indicates a refrigerant with no flame propagation.

Class 2. Indicates a refrigerant with low flammability.

Class 2L. Indicates a refrigerant with low flammability and low burning velocity.

Class 3. Indicates a refrigerant with high flammability.





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202 Definitions – Refrigerant Safety Group Classification

Flammability Classification (Refrigerant). The alphabetical/ numerical designation used to identify the flammability of refrigerants.



Toxicity Classification (Refrigerant). An alphabetical designation used to identify the toxicity of refrigerants. Class A indicates a refrigerant with low toxicity. Class B indicates a refrigerant with high toxicity.



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2024 IMC® Chapter 11


Refrigeration




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1101.2.1 Group A2L, A2, A3 and B1 high-probability equipment.

1101.2.1 Group A2L, A2, A3 and B1 high probability equipment. High probability equipment using Group A2L, A2, A3, or B1 refrigerant shall comply with UL 484, UL/CSA 60335-2-40, or UL/CSA 60335-2-89.



		Safety Group	
Increasing Flammability ↑	Higher Flammability	A3	B3
	Lower Flammability	A2, A2L	B2, B2L
	No Flame Propagation	A1	B1
		Lower Toxicity	Higher Toxicity
		Increasing Toxicity →	





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1101.7 Changing Refrigerant

1101.7 Changing refrigerant. Changes of refrigerant in an existing system to a refrigerant with a different refrigerant designation shall be allowed only where in accordance with the following:

1. The owner or the owner's authorized agent shall be notified prior to making a change of refrigerant, and the change of refrigerant shall not be made where the owner objects to the change.
2. The change in refrigerant shall be in accordance with one of the following.
 - 2.1 Written instructions of the original equipment manufacturer.
 - 2.2 An evaluation of the system by a registered design professional or by an approved agency that validates safety and suitability of the replacement refrigerant.
 - 2.3 Approved by the code official.
3. Where the replacement refrigerant is classified into the same safety group, requirements that were applicable to the existing system shall continue to apply.
4. Where the replacement refrigerant is classified into a different safety group, the system shall comply with the requirements of this standard for a new installation, and the change of refrigerant shall require code official approval.

[Deleted text not shown for brevity.]



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1102.2.1 Mixing Refrigerants

1102.2.1 Mixing. Refrigerants with different refrigerant designations shall only be mixed in a system in accordance with both of the following:

1. The addition of a second refrigerant is allowed by the equipment manufacturer and is in accordance with the manufacturer's written instructions.
2. The resulting mixture does not change the refrigerant safety group.

Refrigerants, including refrigerant blends, with different designations in ASHRAE 34 shall not be mixed in a system.

Exception: Addition of a second refrigerant is allowed where permitted by the equipment or appliance manufacturer to improve oil return at low temperatures. The refrigerant and amount added shall be in accordance with the manufacturer's instructions.





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Table 1103.1 Refrigerant Classification, Amount & OEL

TABLE 1103.1
REFRIGERANT CLASSIFICATION, AMOUNT AND OEL

CHEMICAL REFRIGERANT	FORMULA	CHEMICAL NAME OF BLEND	REFRIGERANT SAFETY GROUP CLASSIFICATION	AMOUNT OF REFRIGERANT PER OCCUPIED SPACE							OEL#	[F] DEGREES OF HAZARD*		
				RCL			LFL							
				Pounds per 1,000 cubic feet	ppm	g/m3	lb/MCF	ppm	g/m3	ppm				
R-11 ⁴	CCl3F	trichlorofluoromethane	A1	0.39	1,100	6-2 6.1				≤1,000		2-0-0b		
R-12 ⁴	CCl2F2	dichlorodifluoromethane	A1	5.6	18,000	90				1,000		2-0-0b		
R-13 ⁴	CCF3	chlorotrifluoromethane	A1	—	—	—				1,000		2-0-0b		

[Due to space constraints, only portions of Table 1103.1 are shown.]



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1104.3.1 Air Conditioning for Human Comfort

1104.3.1 Air conditioning for human comfort.

In other than industrial occupancies where the quantity in a single independent circuit does not exceed the amount in Table 1103.1, Group B1, B2 and B3 refrigerants shall not be used in high-probability systems for air conditioning for human comfort. High-probability systems used for human comfort shall use Group A1 or A2L refrigerant.

Exceptions:

- Equipment listed for and used in residential occupancies containing a maximum of 6.6 pounds (3 kg) of refrigerant.
- Equipment listed for and used in commercial occupancies containing a maximum of 22 pounds (10 kg) of refrigerant.
- Industrial occupancies.



A31 Refrigerants & Related Changes to the 2014 I-Codes

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1104.3.2 Group A2, A3, B2 and B3 Refrigerants

1104.3.2 Nonindustrial occupancies Group A2, A3, B2 and B3 refrigerants.

Group A2 and B2 refrigerants shall not be used in high-probability systems where the quantity of refrigerant in any independent refrigerant circuit exceeds the amount shown in Table 1104.3.2. Group A2 and B2 refrigerants shall not be used in high-probability systems. Group A3 and B3 refrigerants shall not be used except where approved.

Exceptions: This section does not apply to laboratories:

- Laboratories where the floor area per occupant is not less than 100 square feet (9.3 m2).
- Listed self-contained systems having a maximum of 0.331 pounds (150 g) of Group A3 refrigerant.
- Industrial occupancies.
- Equipment listed for and used in residential occupancies containing a maximum of 6.6 pounds (3 kg) of Group A2 or B2 refrigerant.
- Equipment listed for and used in commercial occupancies containing a maximum of 22 pounds (10 kg) of Group A2 or B2 refrigerant.





Table 1104.3.2 deleted in its entirety.

A31 Refrigerants & Related Changes to the 2014 I-Codes

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1106.3 Class 2 and 3 refrigerants.

1106.3 Flammable Class 2 and 3 refrigerants.

Where refrigerants of Groups A2, A3, B2 and B3 are used, the *machinery room* shall conform to the Class I, Division 2, *hazardous location* classification requirements of NFPA 70.

Exception: Machinery rooms for systems containing Group A2L refrigerants that are provided with ventilation in accordance with Section 1106.4.



A31 Refrigerants & Related Changes to the 2014 I-Codes

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1106.4 Group A2L and B2L Refrigerant



1106.4 Group A2L and B2L refrigerant. Machinery rooms for Group A2L and B2L refrigerant shall comply with Sections 1106.4.1 through Section 1106.4.3.

1106.4.1 Elevated temperatures. Open flame-producing devices or continuously operating hot surfaces over 1290 °F (700 °C) shall not be permanently installed in the room.

1106.4.2 Refrigerant detector. In addition to the requirements of Section 1105.3, refrigerant detectors shall signal an alarm and activate the ventilation system in accordance with the response time specified in Table 1106.4.2.

1106.4.3 Mechanical ventilation. The machinery room shall have a mechanical ventilation system complying with ASHRAE 15.

[Current Section 1106.4 deleted and replaced as shown.]



A2L Refrigerants & Related Changes to the 2014 I-Codes

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Table 1106.4.2 Group A2L and B2L Detector Activation

TABLE 1106.4.2 GROUP A2L and B2L DETECTOR ACTIVATION

Activation Level	Maximum Response Time (seconds)	ASHRAE 15 Ventilation Level	Alarm Reset	Alarm Type
Less than or equal to the OEL in Table 1103.1	300	1	Automatic	Trouble
Less than or equal to the refrigerant concentration level in Table 1103.1	15	2	Manual	Emergency

[Current TABLE 1106.4.2 deleted and replaced as shown.]



A2L Refrigerants & Related Changes to the 2014 I-Codes

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Table 1107.4 Refrigerant Pipe

TABLE 1107.4 REFRIGERANT PIPE

PIPING MATERIAL	STANDARD
Aluminum tube	ASTM B210/ASTM B210M, ASTM B491/B491M
Brass (copper alloy) pipe	ASTM B43
Copper linesets	ASTM B280, ASTM B1003
Copper pipe	ASTM B42, ASTM B302
Copper tube ^a	ASTM B62, ASTM B75, ASTM B88, ASTM B280, ASTM B819
Steel pipe ^b	ASTM A53, ASTM A106, ASTM A333
Steel tube	ASTM A254, ASTM A334

a. Soft annealed copper tubing larger than 1 1/2-inch (38 mm) O.D. shall not be used for field-assembled refrigerant piping unless it is protected from mechanical damage.

b. ASTM A53, Type F steel pipe shall not be used for refrigerant lines having an operating temperature less than -20°F (-29°C). Only be permitted for discharge lines in pressure relief systems.



A2L Refrigerants & Related Changes to the 2014 I-Codes



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Table 1107.5 Refrigerant Pipe Fittings

Modification to 2021 IMC:

PIPING MATERIAL	STANDARD
Aluminum	ASTM B361
Brass (copper alloy)	ASME B16.15, ASME B16.24
Copper and Copper Alloy (Brass)	ASME B16.15, ASME B16.18, ASME B16.22, ASME B16.24, ASME B16.26, ASME B16.50
Steel	ASTM A105, ASTM A181, ASTM A193, ASTM A234, ASTM A420, ASTM A707



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A21, Refrigerants & Related Changes to the 2021 I-Codes

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1107.7 Flexible connectors, expansion & vibration compensators

Modification to 2021 IMC:

1107.7 Flexible connectors, expansion and vibration compensators.

Flexible connectors and expansion and vibration control devices shall be listed and labeled for use in refrigerant systems and pressures for which the components are installed.



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A21, Refrigerants & Related Changes to the 2021 I-Codes

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1109.2.2 Refrigerant pipe enclosure

1109.2.2 Refrigerant pipe enclosure. Refrigerant piping shall be protected by locating it within the building elements or within protective enclosures.

Exception: Piping protection within the building elements or protective enclosure shall not be required in any of the following locations:

- Where installed without ready access or located more than 7 feet 3 inches (2210 mm) above the finished floor.
- Where located within 6 feet (1829 mm) of the refrigerant unit or *appliance*.
- Where located in a *machinery room* complying with Section 1105.
- Outside the building.
 - Protected from damage from the weather, including, but not limited to, hail, ice, and snow loads and
 - Protected from damage within the expected foot or traffic path or
 - Outside, underground, installed not less than 8 inches (200 mm) below finished grade and protected against corrosion.

Due to space constraints, only portions of Sections 1109.2 to 1109.4 are shown. Please refer to the "A21 Refrigerants Transition" documents for the complete text.



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A21, Refrigerants & Related Changes to the 2021 I-Codes



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1109.7 Condensate control

1109.7 Condensate control.

Refrigerating piping and fittings that, during normal operation, will reach a surface temperature below the dew point of the surrounding air, and are located in spaces or areas where condensation has the potential to cause a safety hazard to the building occupants, structure, electrical equipment or any other equipment or appliances, shall be insulated or protected in an approved manner to prevent damage from condensation.



ICC Building & Mechanical, Fall 2016
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1110.3 Test gases

1110.3 Test gases. The medium used for pressure testing the refrigerant system shall be one of the following inert gases: oxygen-free nitrogen, helium, or argon or premixed nonflammable oxygen-free nitrogen with a tracer gas of hydrogen or helium. For R-744 refrigerant systems, carbon dioxide shall be allowed as the test medium. For R-718 refrigerant systems, water shall be allowed as the test medium. Oxygen, air, combustible gases and mixtures containing such gases shall not be used as a test medium. Systems erected on the premises with tubing not exceeding 5/8 inch (15.9 mm) outside diameter shall be allowed to use the refrigerant identified on the nameplate label or marking as the test medium.

1110.3.1 Test gases not permitted. Oxygen, air, refrigerants other than those identified in Section 1110.3, combustible gases and mixtures containing such gases shall not be used as the pressure test medium.





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Chapter 15: Referenced Standards

ASHRAE 15-2022 34-2022	Safety Standard for Refrigeration Systems Designation and Safety Classification of Refrigerants
ASTM A333-18	Standard Specification for Seamless and Welded Steel Pipe for Low-Temperature Service and other Applications with required Notch Toughness
UL UL 484—2014; UL/CSA 60335-2-40—17 2022 UL/CSA 60335-2-89—17 2021	Room Air Conditioners—with Revisions through May 2019 Household and Similar Electrical Appliances—Safety—Part 2-40: Particular Requirements for Electrical Heat Pumps, Air-Conditioners & Dehumidifiers Household and Similar Electrical Appliances—Safety—Part 2-40: Particular Requirements for Electrical Heat Pumps, Air-Conditioners & Dehumidifiers



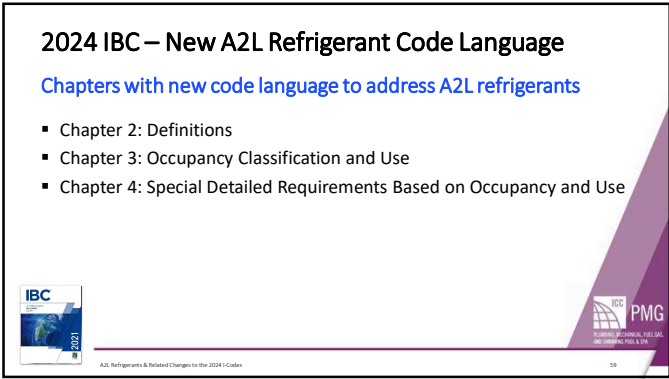
ICC Building & Mechanical, Fall 2016
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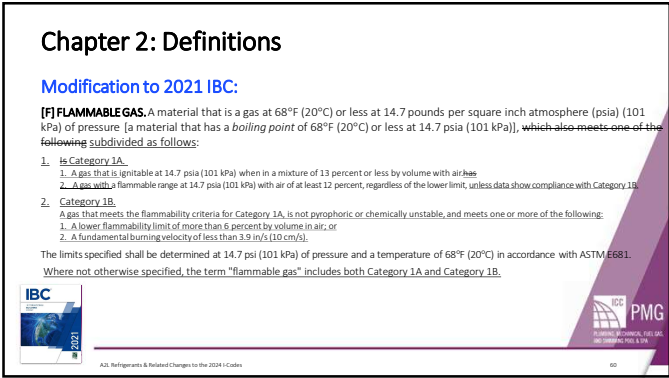
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Chapter 3: Occupancy Classification and Use

Modification to 2021 IBC:

TABLE 307.1(1)
MAXIMUM ALLOWABLE QUANTITY PER CONTROL AREA OF HAZARDOUS MATERIALS POSING A PHYSICAL HAZARD^{a, b, c, d, e}

MATERIAL	CLASS	GROUP WHEN THE MAXIMUM ALLOWABLE QUANTITY IS EXCLUDED	STORAGE ^f		USE-CLOSED SYSTEM ^g		USE-OPEN SYSTEM ^h	
			Solid (pounds (pounds-feet))	Liquid (gallons (gallons-feet at 60°F))	Gas (cubic feet at 60°F)	Solid (pounds (pounds-feet))	Liquid (gallons (gallons-feet))	Gas (cubic feet at 60°F)
Common	IA and IB (flammable)	H-2	NA	NA	1,000 ⁱ	NA	NA	NA
Flammable gas	IA and IB (flammable)	H-2	NA	(150) ^j	NA	NA	(150) ^k	NA

¹ "High-BV" Category IB flammable gas has a burning velocity greater than 3.9 in/s (10 cm/s). "Low-BV" Category IB flammable gas has a burning velocity of 3.9 in/s (10 cm/s) or less.

[Portions of table not shown remain unchanged.]

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A3.1. Refrigerants & Related Changes to the 2018 I-Codes

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Chapter 3: Occupancy Classification and Use

Modification to 2021 IBC:

[F] 307.4 High-hazard Group H-2. Buildings and structures containing materials that pose a deflagration hazard or a hazard from accelerated burning shall be classified as Group H-2. Such materials shall include, but not be limited to, the following:

- Class I, II or IIIA flammable or combustible liquids [remaining text unchanged]
- Combustible dusts [remaining text unchanged]
- Cryogenic fluids, flammable.
- Category 1A Flammable gases.
- Category 1B Flammable gases having a burning velocity greater than 3.9 inches per second (10 cm/s).
- Organic peroxides, Class I.
- Oxidizers, [remaining text unchanged]
- Pyrophoric liquids, solids and gases, nondetonable.
- Unstable (reactive) materials, Class 3, nondetonable.
- Water-reactive materials, Class 3.

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A3.1. Refrigerants & Related Changes to the 2018 I-Codes

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Chapter 3: Occupancy Classification and Use

Modification to 2021 IBC:

[F] 307.5 High-hazard Group H-3. Buildings and structures containing materials that readily support combustion or that pose a physical hazard shall be classified as Group H-3. Such materials shall include, but not be limited to, the following:

- Class I, II or IIIA flammable or combustible liquids [remaining text unchanged]
- Combustible fibers, other than densely packed baled cotton, [remaining text unchanged]
- Consumer fireworks, 1.4G (Class C, Common)
- Cryogenic fluids, oxidizing
- Category 1B Flammable gases having a burning velocity of 3.9 inches per second (10 cm/s) or less
- Flammable solids
- Organic peroxides, Class II and III
- Oxidizers, Class 2
- Oxidizers, Class 3, [remaining text unchanged]
- Oxidizing gases
- Unstable (reactive) materials, Class 2
- Water-reactive materials, Class 2

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Chapter 4: Special Detailed Requirements Based on Occupancy and Use


Modification to 2021 IBC:

[F] 414.2.5 Hazardous materials in Group M display and storage areas and in Group S storage areas, Hazardous materials located in Group M and Group S occupancies shall be in accordance with Sections 414.2.5.1 through 414.2.5.4.

414.2.5.4 Flammable gas. The aggregate quantity of Category 1B flammable gas having a burning velocity of 3.9 in/s (10 cm/s) or less stored and displayed within a single control area of a Group M occupancy or stored in a single control area of a Group S occupancy is allowed to exceed the maximum allowable quantities per control area specified in Table 307.1(1) without classifying the building or use as a Group H occupancy, provided the materials are stored and displayed in accordance with the International Fire Code and quantities do not exceed the amounts specified in Table 414.2.5(3).



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A3.1 Refrigerants & Related Changes to the 2021 IBC Codes

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Chapter 4: Special Detailed Requirements Based on Occupancy and Use

Addition to 2021 IBC:

TABLE 414.2.5(3) MAXIMUM ALLOWABLE QUANTITY OF LOW BURNING VELOCITY CATEGORY 1B FLAMMABLE GAS IN GROUP M AND S OCCUPANCIES PER CONTROL AREA^a

FLAMMABLE GAS CATEGORY	MAXIMUM ALLOWABLE QUANTITY PER CONTROL AREA	
	Sprinklered in Accordance with Note b	Nonsprinklered
Category 1B (Low BV) ^c		
Gaseous	390,000 cu. ft.	195,000 cu. ft.
Liquefied	40,000 lbs. ^d	20,000 lbs.


For SI: 1 pound = 0.454 kg, 1 cubic foot = 0.02832 m³, 1 square foot = 0.093 m², 1 inch/second = 2.54 cm/s.

a. Control areas shall be separated from each other by not less than a 1-hour fire barrier.


b. The building shall be equipped throughout with an approved automatic sprinkler system with minimum sprinkler design density of Ordinary Hazard Group 2 (to the area where flammable gases are stored or displayed).

c. Where storage areas exceed 50,000 square feet in area, the maximum allowable quantities area allowed to be increased by 2 percent for each 1,000 square feet of area in excess of 50,000 square feet, up to not more than 100 percent of the table amounts. Separation of control areas is not required. The aggregate amount shall not exceed 80,000 pounds.

d. "Low BV" Category 1B flammable gas has a burning velocity of 3.9 in/s (10 cm/s) or less.



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A3.1 Refrigerants & Related Changes to the 2021 IBC Codes

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Chapter 4: Special Detailed Requirements Based on Occupancy and Use


Modification to 2021 IBC:

[F] TABLE 414.5.1 EXPLOSION CONTROL REQUIREMENTS^{a, b}


HAZARD CATEGORY	MATERIAL CLASS	EXPLOSION CONTROL METHODS	
		Barricade construction	Explosion (deflagration) venting or explosion (deflagration) prevention systems ^c
Flammable gas	Gaseous	Not Required	Required ^d
	Liquefied	Not Required	Required ^d

j. Not required for Category 1B Flammable Gases having a burning velocity not exceeding 3.9 in/s (10 cm/s).

[Portions of table not shown remain unchanged.]



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A3.1 Refrigerants & Related Changes to the 2021 IBC Codes


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2024 IFC – New A2L Refrigerant Code Language

Chapters with new code language to address A2L refrigerants

- Chapter 2: Definitions
- Chapter 6: Building Services and Systems
- Chapter 9: Fire Protection and Life Safety Systems
- Chapter 33: Fire Safety During Construction and Demolition
- Chapter 50: Hazardous Materials – General Provisions



A2L Refrigerants & Related Changes to the 2024 IFC Codes

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Chapter 2: Definitions

Modification to 2021 IFC:

[F] FLAMMABLE GAS. A material that is a gas at 68°F (20°C) or less at 14.7 pounds per square inch atmosphere (psia) (101 kPa) of pressure [a material that has a boiling point of 68°F (20°C) or less at 14.7 psia (101 kPa)], ~~which is subdivided as follows:~~



1. Is Category 1A.
 1. A gas that is ignitable at 14.7 psia (101 kPa) when in a mixture of 13 percent or less by volume with air; ~~has~~ has with a flammable range at 14.7 psia (101 kPa) with air of at least 12 percent, regardless of the lower limit, unless data show compliance with Category 1B;
2. Category 1B.

A gas that meets the flammability criteria for Category 1A, is not pyrophoric or chemically unstable, and meets one or more of the following:

 1. A lower flammability limit of more than 6 percent by volume in air; or
 2. A fundamental burning velocity of less than 3.9 in/s (10 cm/s).

The limits specified shall be determined at 14.7 psi (101 kPa) of pressure and a temperature of 68°F (20°C) in accordance with ASTM E681.

Where not otherwise specified, the term "flammable gas" includes both Category 1A and Category 1B.



A2L Refrigerants & Related Changes to the 2024 IFC Codes

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Chapter 6: Building Services and Systems

Modification to 2021 IFC:

[M] 608.17 Electrical equipment. Where refrigerant of Groups A2, A3, B2 and B3, as defined in the *International Mechanical Code*, are used, refrigeration machinery rooms shall conform to the Class I, Division 2, hazardous location classification requirements of NFPA 70.

Exceptions Exception: Ammonia machinery rooms that are provided with ventilation in accordance with Section 1101.1.2, Exception 1, of the *International Mechanical Code*.

Machinery rooms for systems containing Group A2L refrigerants that are provided with ventilation in accordance with Section 608.18.



A2L Refrigerants & Related Changes to the 2024 IFC Codes

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Chapter 9: Fire Protection and Life Safety Systems

Modification to 2021 IFC:

TABLE 911.1
EXPLOSION CONTROL REQUIREMENTS¹

MATERIAL	CLASS	EXPLOSION CONTROL METHODS	
		Barricade construction	Explosion (deflagration) venting or explosion (deflagration) prevention systems
Hazard Category			
Flammable gas	Gaseous	Not required	<u>Required¹</u>
	Liquefied	Not required	<u>Required¹</u>

h. Not required for Category 1B Flammable Gases having a burning velocity not exceeding 3.9 in/s (10 cm/s).

[Portions of table not shown remain unchanged.]



A21. Refrigerants & Related Changes to the 2024 I-Codes

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Chapter 33: Fire Safety During Construction and Demolition

Modification to 2021 IFC:

3307.2.1 Pipe cleaning and purging. The cleaning and purging of flammable gas piping systems, including cleaning new or existing piping systems, purging piping systems into service and purging piping systems out of service, shall comply with NFPA 56.

Exceptions:

1. Compressed gas piping systems other than fuel gas piping systems where in accordance with Chapter 53
2. Piping systems regulated by the *International Fuel Gas Code*.
3. Liquefied petroleum gas systems in accordance with Chapter 61.
4. Cleaning and purging of refrigerant piping systems shall comply with the *International Mechanical Code*.



A21. Refrigerants & Related Changes to the 2024 I-Codes

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Chapter 50: Hazardous Materials – General Provisions

Modification to 2021 IFC:

TABLE 5003.1.1(1)

TABLE 5005.1-1(1)
MAXIMUM ALLOWABLE QUANTITY PER CONTROL AREA OF HAZARDOUS MATERIALS POSING A PHYSICAL HAZARD^{a, b, m, n, p}

MATERIAL	CLASS	GROUP WHEN THE MAXIMUM ALLOWABLE CLINICITY IS EXCEEDED	STORAGE		USE CLOSED SYSTEMS*		USE OPEN SYSTEMS	
			Solid powder (cubic feet)	Liquid gaseous (cubic feet)	Solid powder (cubic feet)	Liquid gaseous (cubic feet)	Solid powder (cubic feet)	Liquid gaseous (cubic feet)
Flammable gas	Gaseous							
	1A and 1B (24h, 30d)	H-2	NA	NA	1,000**	NA	1,000**	NA
	1B (30d, 180d)				360,500**		360,500**	
	Liquid							
	1A and 1B (24h, 30d)	H-2	NA	NA	1,000**	NA	1,000**	NA
	1B (30d, 180d)				10,000**		10,000**	

r. "High BV" Category 1B flammable gas has a burning velocity greater than 3.9 in/s (10 cm/s). "Low BV" Category 1B flammable gas has a burning velocity of 3.9 in/s (10 cm/s) or less.

[Portions of table not shown remain unchanged.]



A21. Refrigerants & Related Changes to the 2024 I-Codes

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Chapter 50: Hazardous Materials – General Provisions

Modification to 2021 IFC: **TABLE 5003.1.1(3)**
MAXIMUM ALLOWABLE QUANTITY PER CONTROL AREA OF HAZARDOUS MATERIALS POSING A PHYSICAL HAZARD IN AN OUTDOOR CONTROL AREA a, b, c, d

MATERIAL	CLASS	STORAGE ¹		USE-CLOSED SYSTEMS ²		USE-OPEN SYSTEMS ³		
		Solid pounds (pounds) ⁴	Liquid gallons (gallons) ⁴	Gas (cubic feet at NTP)	Solid pounds (pounds) ⁴	Gas (cubic feet at NTP)	Solid pounds (pounds) ⁴	Liquid gallons (gallons) ⁴
Flammable gas	Gasoline							
	1A and 1B (High-BV) ⁵	Not Applicable	Not Applicable	3,000	Not Applicable	Not Applicable	1,500	Not Applicable
	1B (Low-BV) ⁶	Not Applicable	Not Applicable	195,000	Not Applicable	Not Applicable	97,500	Not Applicable
	Liquefied							
	1A and 1B (High-BV) ⁵	Not Applicable	(300)	Not Applicable	Not Applicable	(150)	Not Applicable	Not Applicable
	1B (Low-BV) ⁶	Not Applicable	(20,000)	Not Applicable	Not Applicable	(10,000)	Not Applicable	Not Applicable

c. "High-BV" Category 1B flammable gas has a burning velocity greater than 3.9 in/s (10 cm/s). "Low-BV" Category 1B flammable gas has a burning velocity of 3.9 in/s (10 cm/s) or less.

[Portions of table not shown remain unchanged.]



IBC, Refrigerants & Related Changes to the 2018 IFC Codes



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Chapter 50: Hazardous Materials – General Provisions

Modification to 2021 IFC:

5003.8.3.5 Hazardous materials in Group M display and storage areas and in Group S storage areas. Hazardous materials located in Group M and Group S occupancies shall be in accordance with Sections 5003.8.3.5.1 through 5003.8.3.5.4.

5003.8.3.5.4 Flammable gas. The aggregate quantity of Category 1B flammable gas having a burning velocity of 3.9 in/s (10 cm/s) or less stored and displayed within a single control area of a Group M occupancy, or in an outdoor control area, or stored in a single control area of a Group S occupancy, is allowed to exceed the maximum allowable quantities per control area specified in Table 5003.1.1(1) without classifying the building or use as a Group H occupancy, provided the materials are stored and displayed in accordance with Section 5003.11.2.



IBC, Refrigerants & Related Changes to the 2018 IFC Codes

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Chapter 50: Hazardous Materials – General Provisions



Modification to 2021 IFC:

5003.11 Maximum allowable quantity for Group M storage and display and Group S storage. The aggregate quantity of nonflammable solid and nonflammable or noncombustible liquid hazardous materials stored and displayed within a single control area of a Group M occupancy, or an outdoor control area, or stored in a single control area of a Group S occupancy, is allowed to exceed the maximum allowable quantity per control area indicated in Section 5003.1 where in accordance with Sections 5003.11.1 and 5003.11.2 through 5003.11.3.

5003.11.1 Nonflammable solid and nonflammable or noncombustible liquid hazardous materials Maximum allowable quantity per outdoor control area in Group M or S occupancies. The aggregate amount of nonflammable solid and nonflammable or noncombustible liquid hazardous materials stored and displayed within a single control area of a Group M occupancy, or an outdoor control area, or stored in a single control area of a Group S occupancy, shall not exceed the amounts set forth in Table 5003.11.1.

5003.11.2 Maximum allowable quantity per outdoor control area in Group M or S occupancies. The aggregate amount of nonflammable solid and nonflammable or noncombustible liquid hazardous materials stored and displayed within a single outdoor control area of a Group M occupancy shall not exceed the amounts set forth in Table 5003.11.1.

[Current Section 5003.11.3 becomes Section 5003.11.1.1 with subsections renumbered accordingly.]



IBC, Refrigerants & Related Changes to the 2018 IFC Codes

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Chapter 50: Hazardous Materials – General Provisions

Modification to 2021 IFC:

5003.11.2 Category 1B flammable gas with low burning velocity. The aggregate quantity of Category 1B flammable gas having a burning velocity of 3.9 in/s (10 cm/s) or less stored and displayed within a single control area of a Group M occupancy, or an outdoor control area, or stored in a single control area of a Group S occupancy shall not exceed the amounts set forth in Table 5003.11.2.

5003.11.2.1 Fire protection and storage arrangements. Fire protection and container storage arrangements for quantities of Category 1B flammable gases permitted by Table 5003.11.2 shall be in accordance with the all of the following:

1. Storage of the Category 1B flammable gases on shelves shall not exceed 6 feet (1829 mm) in height, and shelving shall be metal.
2. Rack storage, pallet storage or piles of the Category 1B flammable gas greater than 6 feet 6 inches (1981 mm) in height shall be provided with an automatic sprinkler system with a minimum design of Extra Hazard Group 1.
3. Combustible commodities shall not be stored above the Category 1B flammable gases.
4. Flammable liquids shall be separated from the Category 1B flammable gases by a distance 20 feet (6096 mm). The separation is permitted to be reduced to 10 feet (3048 mm) where secondary containment or diking is provided to retain a flammable liquid spill at a distance of 10 feet (3048 mm) from the Category 1B flammable gas storage.



A2L Refrigerants & Related Changes to the 2021 I-Codes

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Chapter 50: Hazardous Materials – General Provisions

Modification to 2021 IFC:

TABLE 5003.11.2
MAXIMUM ALLOWABLE QUANTITY OF LOW-BURNING VELOCITY CATEGORY 1B FLAMMABLE GAS IN GROUP M AND S OCCUPANCIES PER CONTROL AREA^a

FLAMMABLE GAS CATEGORY	MAXIMUM ALLOWABLE QUANTITY PER CONTROL AREA	
	Sprinklered in accordance with Note b	Nonsprinklered
Category 1B (Low BV) ^d		
Gaseous	390,000 cu. ft.	195,000 cu. ft.
Liquefied	40,000 lbs. ^c	20,000 lbs.



For SI: 1 pound = 0.454 kg, 1 cubic foot = 0.02832 m³, 1 square foot = 0.093 m², 1 inch/second = 2.54 cm/s.

a. Control areas shall be separated from each other by not less than a 1-hour fire barrier.

b. The building shall be equipped throughout with an approved automatic sprinkler system with minimum sprinkler design density of Ordinary Hazard Group 2 in the area where flammable gases are stored or displayed.

c. Where storage areas exceed 50,000 square feet in area, the maximum allowable quantities are allowed to be increased by 2 percent for each 1,000 square feet of area in excess of 50,000 square feet, up to not more than 100 percent of the table amounts. Separation of control areas is not required. The aggregate amount shall not exceed 80,000 pounds.

d. "Low BV" Category 1B flammable gas has a burning velocity of 3.9 in/s (10 cm/s) or less.



A2L Refrigerants & Related Changes to the 2021 I-Codes

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Preparing for the Transition to A2Ls



A2L Refrigerants & Related Changes to the 2021 I-Codes



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Local Government

Role: Code Adoptions/Amendments and Code Enforcement

- Adopt/Amend code language to reflect the changes tied to A2L refrigerants in the 2024 I-Codes.
- Approve A2L alternative materials and methods complying with the most current industry standards.
 - This could be a stop-gap measure while developing new code language.
- Include code enforcement officials in the transition process
 - Their participation and guidance will be vital to the smooth transition to A2L refrigerants.



A2L Refrigerants & Related Changes to the 2024 I-Codes



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Architects and Design Professionals

Role: Providing safe building and system designs

- Utilize new codes and standards in system designs utilizing A2Ls
 - o Equipment rooms
 - o Shafts and areas where refrigerant lines are run.
- Ensure adequate ventilation and safety measures where A2L equipment is installed.
- Ensure adequate space where A2L refrigerants will be stored.
- Ensure limitations to the amount of A2Ls in HVAC systems are followed:
 - o Limitations for Human Comfort (2022 ASHRAE Standard 15, Section 7.6)
 - o Limitations for other than Human Comfort (2022 ASHRAE Standard 15, Section 7.7)



A2L Refrigerants & Related Changes to the 2024 I-Codes



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Contractors and Technicians

Role: Installing safe systems within the built environment

- Comfort conditioning is a key area affected by these changes.
 - o 2021 and earlier versions of the codes did not allow use of A2Ls.
- Ensure equipment and tools are suitable for use with A2Ls.
- Ensure refrigerant piping complies with updated IMC Table 1107.4.
- Ensure pipes conveying A2Ls are suitably marked with "Risk of Fire" labels.
- Ensure that refrigerant charge does not exceed ASHRAE 15 limitations.
 - o Pipe lengths are critical and system designs must be adhered to.




A2L Refrigerants & Related Changes to the 2024 I-Codes

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Conclusions

- Waiting on 2024 code adoptions presents complications
- Preparing early will save cost and heartache for the industry
- Visit the ICC A2L Refrigerants Transition website.
 - Go to iccsafe.org, and search for "A2L Refrigerants Transition".
- For A2L safety training and certifications
 - Visit: Air-Conditioning, Heating, and Refrigeration Institute (AHRI - ahrinet.org)



PLUMBING, MECHANICAL, FUEL GAS,
AND SWIMMING POOL & SPA

A2L Refrigerants & Related Changes to the 2024 Codes

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Discussion Activity





PLUMBING, MECHANICAL, FUEL GAS,
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Thank you for participating

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