A2L Refrigerants & Related Changes to the 2024 I-Codes

Based the 2024 International Mechanical Code®, 2024 International Building Code® and 2024 International Fire Code®

INSTRUCTOR

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- Design Engineer, Athens Gas Light Company, technical expert for regulatory, building code, and product standards involving natural gas distribution systems.

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ICC PMG Team

ICC PMG Technical Resources Regions

ICC Family of Solutions
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

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.
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.

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.

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.
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

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

KEY:
- ODP = Ozone Depletion Potential
- GWP = Global Warming Potential

4 Generations of Refrigerants

1st Generation
1830s – 1930s
- Ammonia, methyl chloride, sulfur dioxide
  - Toxic gas
  - Flammable

2nd Generation
1930s - 2000s
- CFCs and HCFCs (R-12, R-22)
  - High ODP
  - High GWP

3rd Generation
1990s - 2030s
- HFCs (R-32, R-410A)
  - 0 ODP
  - High GWP

4th Generation
2020s - ??
- HFOs, HCs, and HFO/HFC blends (R-454A, R-454B)
  - 0 ODP
  - Low GWP

1988 – Montreal Protocol
Eliminate ozone Depleting Substances

1998 – Kyoto Protocol
Reduce Greenhouse Gas Emissions

2027 – Kigali Amendment
Reduce HFC Production and Use
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%

HFC Phasedown – AIM Act of 2020

Alternatives to HFC Refrigerants

U.S. EPA - SNAP Rule 23

<table>
<thead>
<tr>
<th>End-use</th>
<th>Alternatives</th>
<th>Terms of Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential and light commercial A/C and heat pumps</td>
<td>R-452B, R-454B, R-454C, and R-431A</td>
<td>Acceptable Subject to Use Conditions</td>
</tr>
<tr>
<td>Residential and light commercial A/C and heat pumps, excluding self-contained room A/C units</td>
<td>R-32</td>
<td>Acceptable Subject to Use Conditions</td>
</tr>
<tr>
<td>Residential and light commercial A/C and heat pumps - self-contained room A/C units</td>
<td>R-32, R-290, R-441A</td>
<td>Acceptable Subject to Use Conditions</td>
</tr>
</tbody>
</table>

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

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 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
Timeline for the Phasedown of HFCs

A2L Refrigerants & Related Changes to the 2024 I-Codes

Status of the Standards
- ASHRAE Standards
  - 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
Status of the Building Codes

- 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 IFC 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

Legislative Action by States

Sample Legislation – State of Alaska

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 8.  AS 18.95.010 is amended by adding a new subsection to read:

4 Sec. 18.95.010. Use of designated refrigerants. Notwithstanding a provision

5 of the state building code, a refrigerant designated as acceptable for use under 42

6 U.C.C. 476(d), 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 designation. In this section, "state building code" has the meaning given in

9 AS 18.95.090(c).
**Changes to Codes and Standards**

**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

**ASHRAE Standard 34 – 2022 Updates**

<table>
<thead>
<tr>
<th>Refrigerant Safety Group Classification</th>
<th>Class Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A3</td>
<td>1. Combustible and explosive, 3.6 mL/100 kcal (6.5 Btu)</td>
</tr>
<tr>
<td>B3</td>
<td>1. Combustible and explosive, 1.1 mL/100 kcal (1 Btu)</td>
</tr>
<tr>
<td>A2</td>
<td>1. Combustible and explosive, 0.6 mL/100 kcal (0.5 Btu)</td>
</tr>
<tr>
<td>B2</td>
<td>1. Non-flammable, 200 L/min (60 gpm)</td>
</tr>
<tr>
<td>A2L</td>
<td>1. Combustible and explosive, 0.2 mL/100 kcal (0.1 Btu)</td>
</tr>
<tr>
<td>B2L</td>
<td>1. Non-flammable, 100 L/min (25 gpm)</td>
</tr>
<tr>
<td>A1</td>
<td>1. Non-flammable, 50 L/min (13 gpm)</td>
</tr>
<tr>
<td>B1</td>
<td>1. Non-flammable, 30 L/min (8 gpm)</td>
</tr>
</tbody>
</table>

- Class 1: 0.5 mL/100 kcal (0.1 Btu)
**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

**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.

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**Break**
2024 IMC – New A2L Refrigerant Code Language

Chapters with new code language to address A2L refrigerants

- Chapter 2: Definitions
- Chapter 11: Refrigeration
- Chapter 15: Referenced Standards
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.

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.

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.
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.

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.
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.

1102.2.1 Mixing Refrigerants

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.

Table 1103.1 Refrigerant Classification, Amount & OEL

<table>
<thead>
<tr>
<th>CHEMICAL FORMULA</th>
<th>CHEMICAL NAME OF BLEND</th>
<th>BLEND DESIGNATION</th>
<th>AMOUNT OF BLEND PER OCCUPIED SPACE</th>
<th>OEL</th>
<th>OELe</th>
<th>LFL</th>
<th>RCL</th>
</tr>
</thead>
<tbody>
<tr>
<td>CCl3F</td>
<td>trichlorofluoromethane</td>
<td>A1</td>
<td>0.39</td>
<td>6.1</td>
<td>6.2</td>
<td>1,100</td>
<td>0.39</td>
</tr>
<tr>
<td>CCl2F2</td>
<td>dichlorodifluoromethane</td>
<td>A1</td>
<td>5.6</td>
<td>90</td>
<td>90</td>
<td>18,000</td>
<td>5.6</td>
</tr>
<tr>
<td>CClF3</td>
<td>chlorotrifluoromethane</td>
<td>A1</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

[Due to space constraints, only portions of Table 1103.1 are shown.]
1104.3.1 Air Conditioning for Human Comfort

Air conditioning for human comfort.

In nonindustrial 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 A2 refrigerants.

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

Table 1104.3.2 deleted in its entirety.

1104.3.2 Group A2, A3, B2 and B3 Refrigerants

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

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.
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 Section 1106.4.3.

Table 1106.4.2 Group A2L and B2L Detector Activation

<table>
<thead>
<tr>
<th>Alarm Type</th>
<th>Alarm Reset</th>
<th>Time to Alarm (seconds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than or equal to the OEL in Table 1103.1</td>
<td>Automatic</td>
<td>300</td>
</tr>
<tr>
<td>Less than or equal to the refrigerant concentration level in Table 1103.1</td>
<td>Manual</td>
<td>15</td>
</tr>
</tbody>
</table>

Table 1107.4 Refrigerant Pipe

<table>
<thead>
<tr>
<th>Piping Material</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aluminum tube</td>
<td>ASTM B210/ASTM B501, ASTM B491/ASTM B541</td>
</tr>
<tr>
<td>Brass (copper alloy) pipe</td>
<td>ASTM B43</td>
</tr>
<tr>
<td>Copper linesets</td>
<td>ASTM B280, ASTM B1003</td>
</tr>
<tr>
<td>Copper tube</td>
<td>ASTM B42, ASTM B302</td>
</tr>
<tr>
<td>Steel pipe</td>
<td>ASTM B68, ASTM B75, ASTM B88, ASTM B280, ASTM B819</td>
</tr>
<tr>
<td>Steel tube</td>
<td>ASTM A53, ASTM A106, ASTM A333</td>
</tr>
</tbody>
</table>

* Soft annealed copper tubing larger than 1/32-inch (3.5 mm) O.D. shall not be used for field-assembled refrigerant piping due to its potential for mechanical damage.

* ASTM A53, Type F steel pipe shall not be used for refrigerant lines having an operating temperature less than -20°F (-29°C) and shall only be permitted for discharge lines in pressure relief systems.
Table 1107.5 Refrigerant Pipe Fittings

<table>
<thead>
<tr>
<th>PIPE/WELDING MATERIAL</th>
<th>STANDARD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard Aluminum</td>
<td>ASTM B361</td>
</tr>
<tr>
<td>Copper and Copper Alloy (Copper)</td>
<td>ASTM B185, ASTM B186, ASTM B187, ASTM B193, ASTM B209, ASTM B210, ASTM B270</td>
</tr>
<tr>
<td>Steel</td>
<td>ASTM A105, ASTM A181, ASTM A193, ASTM A234, ASTM A420, ASTM A707</td>
</tr>
</tbody>
</table>

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:

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

Due to space constraints, only portions of Sections 1109.2 to 1109.4 are shown. Please refer to the “A2L Refrigerants Transition” documents for the complete text.
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.

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, 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. Systems erected on 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.

[Due to space constraints, only portions of Sections 1110.3 to 1110.7 are shown. Please refer to the “A2L Refrigerants Transition” documents for the complete text.]

Chapter 15: Referenced Standards

ASHRAE
15-2022 Safety Standard for Refrigeration Systems
34-2022 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: Room Air Conditioners—with Revisions through May 2019

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2024 IBC – New A2L Refrigerant Code Language

Chapters with new code language to address A2L refrigerants

- Chapter 2: Definitions
- Chapter 3: Occupancy Classification and Use
- Chapter 4: Special Detailed Requirements Based on Occupancy and Use

Chapter 2: Definitions

Modification to 2021 IBC:

(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). Where not otherwise specified, the term “flammable gas” includes both Category 1A and Category 1B.

1. Category 1A:
   - A gas that reacts exothermically or violently at 68°F (20°C) or less.
   - A gas that is 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.
### Chapter 3: Occupancy Classification and Use

**Modification to 2021 IBC:**

**Table 307.1(1)**

<table>
<thead>
<tr>
<th>Maximum Allowable Quantity per Control Area of Hazardous Materials Poseing a Physical Hazard</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Material</strong></td>
</tr>
<tr>
<td>----------------</td>
</tr>
<tr>
<td>Flammable Liquids</td>
</tr>
<tr>
<td>Combustible Liquids</td>
</tr>
<tr>
<td>Flammable Solids</td>
</tr>
<tr>
<td>Oxidizers</td>
</tr>
<tr>
<td>Organic Peroxides</td>
</tr>
<tr>
<td>Cryogenic Liquids, solid and gases</td>
</tr>
<tr>
<td>Water-reactive Materials</td>
</tr>
<tr>
<td>Pyrophoric Solids, liquids, solids and gases</td>
</tr>
<tr>
<td>Pyrophoric Gases</td>
</tr>
<tr>
<td>Unstable (reactive) Materials</td>
</tr>
</tbody>
</table>

**Notes:**
- Category 1A flammable gases have a burning velocity greater than 3.9 inches per second (10 cm/s).
- Category 1B flammable gases have a burning velocity of 3.9 inches per second (10 cm/s) or less.
- Category 1C flammable gases have a burning velocity less than 3.9 inches per second (10 cm/s).

**Changes:**

- **Table 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:
  - Gases, flammable or combustible liquids:
    - Category 1A flammable gases.
    - Category 1B flammable gases.
  - Organic peroxides, Class I.
  - Oxidizers, Class 2 and 3.
  - Pyrophoric solids, liquids, solids and gases, nondetonable.
  - Unstable (reactive) materials, Class 3, nondetonable.
  - Water-reactive materials, Class 3.

- **Table 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:
  - Gases, flammable or combustible liquids:
    - Category 1A flammable gases.
    - Category 1B flammable gases.
  - Oxidizers, Class 2.
  - Oxidizers, Class 3.
  - Water-reactive materials, Class 2.
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 in 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 414.2.5(3) 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).

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

<table>
<thead>
<tr>
<th>Flammable Gas Category</th>
<th>Maximum Allowable Quantity per Control Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category 1B Low BV</td>
<td>390,000 cu. ft.</td>
</tr>
<tr>
<td>Liquefied</td>
<td>42,000 lbs.</td>
</tr>
</tbody>
</table>

- Control areas shall be separated from each other by not less than a 1-hour fire barrier.
- 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.
- 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.
- “Low BV” Category 1B flammable gas has a burning velocity of 3.9 in/s (10 cm/s) or less.

Modification to 2021 IBC:

[F] TABLE 414.5.1 EXPLOSION CONTROL REQUIREMENTS

- 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]
Chapter 2: Definitions
Modification to 2021 IFC:

**[F]** 2021 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

**[M]** 608.17 Electrical equipment. Where refrigerants 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.

**Exception:** Ammonia machinery rooms that are provided with ventilation in accordance with Section 1101.1.3, 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.**
Chapter 9: Fire Protection and Life Safety Systems

Modification to 2021 IFC:

TABLE 911.1

EXPLOSION CONTROL REQUIREMENTS

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>CLASS</th>
<th>EXPLOSION CONTROL REQUIREMENTS</th>
</tr>
</thead>
<tbody>
<tr>
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</table>

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

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.
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.


Modification to 2021 IFC:

TABLE 5003.1.1(1)

MAXIMUM ALLOWABLE QUANTITY PER CONTROL AREA OF HAZARDOUS MATERIALS POSING A PHYSICAL HAZARD

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>CLASS</th>
<th>MAX QTY</th>
<th>COUNT</th>
<th>TOT WEIGHT</th>
<th>FRACTION</th>
<th>TOTAL COUNT</th>
<th>TOTAL WEIGHT</th>
<th>TOTAL QTY</th>
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|          |       |         |       |            |          |             |              |           |

Note: Categories 1A, 1B, and 1C have a lower BQ than Category 1D. Categories 2A, 2B, and 2C have a lower BQ than Category 2D. Categories 3A, 3B, and 3C have a lower BQ than Category 3D.

Modification to 2021 IFC:

Table 5003.1.1(2)

MAXIMUM ALLOWABLE QUANTITY PER CONTROL AREA OF HAZARDOUS MATERIALS POSING A PHYSICAL HAZARD IN AN OUTDOOR CONTROL AREA

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>CAUTION</th>
<th>HIGH BV</th>
<th>LOW BV</th>
<th>HIGH BV</th>
<th>LOW BV</th>
<th>CAUTION</th>
<th>HIGH BV</th>
<th>LOW BV</th>
<th>CAUTION</th>
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</tbody>
</table>

Note: All Quantities shall be in pounds unless otherwise specified.


Modification to 2021 IFC:

5003.1.1 Maximum allowable quantities for Group M storage and display and Group S storage. 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 quantities specified in Table 5003.1.1.

5003.1.1.1 Nonflammable solid and nonflammable or noncombustible liquid hazardous materials. 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 5003.1.1.

5003.1.1.2 Nonflammable solid and nonflammable or noncombustible liquid hazardous materials. 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 5003.1.1.

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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 storage area of a Group M occupancy, or an outdoor storage 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. The 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 density 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 distance 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.

**Table 5003.11.2**

<table>
<thead>
<tr>
<th>Flammable Gas Category</th>
<th>Maximum Allowable Quantity per Control Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category 1B flammable gas with low burning velocity</td>
<td>200,000 cu. ft.</td>
</tr>
</tbody>
</table>

For SI: 1 pound = 0.454 kg, 1 cubic foot = 0.02832 m³, 1 square foot = 0.093 m², 1 inch/second = 2.5641 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 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.
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.

Architects and Design Professionals
Role: Providing safe building and system designs
- Utilize new codes and standards in system designs utilizing A2Ls
  - Equipment rooms
  - 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:
  - Limitations for Human Comfort (2022 ASHRAE Standard 15, Section 7.6)
  - Limitations for other than Human Comfort (2022 ASHRAE Standard 15, Section 7.7)

Contractors and Technicians
Role: Installing safe systems within the built environment
- Comfort conditioning is a key area affected by these changes.
  - 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.
  - Pipe lengths are critical and system designs must be adhered to.
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)

Discussion Activity

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